

Cost Benefit Analysis

for Feasibility Studies

Date:

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# Revision history

| Version | Date revised | Author | Revision summary |
| --- | --- | --- | --- |
| 0.1 | 3/13/24 | PLS | Draft |
| 0.2 | 3/20/24 | PLS | Edits provided by WaTech communications team. |
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# Document approvals

| Name of approver | Project role | Date approved |
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# Purpose

Project teams frequently must consider alternatives when deciding on a solution (e.g., commercial off-the-shelf software vs. custom build). A frequently asked question when considering those alternatives is: How will costs and benefits change under the proposed set of circumstances? The outcome of a cost-benefit analysis (CBA) is intended to answer that question.

# Approach

A CBA is comprised of these core steps:

* Review project goals and objectives.
* Identify the analysis goals and objectives.
* Identify assumptions and constraints.
* Identify improvement alternatives.
* Determine costs and benefits for current environment.
* Conduct alternatives analysis.
* Prepare tradeoff analysis.
* Identify and recommend the most cost-effective alternative.

## Review project goals and objectives

Develop an understanding of the business problem or opportunity that is driving the financial analysis (e.g., near term cost reduction; not meeting mission objectives).

* This includes a review of the project’s mission, goals and objectives, performance measures.
* The purpose of this review is to obtain an understanding of the project drivers in order that subsequent CBA tasks support the strategic elements of the project.
* A CBA is not meant to determine goals and priorities. It is meant to determine the most cost-effective means to achieve them.

## Identify the analysis goals and objectives

The goals of the analysis must be driven by the mission, goals and objectives, and performance measures of the project. Goals and objectives may include:

* Understand the economic impact of the proposed process and/or system change by evaluating the life-cycle cost associated with each alternative.
* Estimate the present value of investments.
* Provide the agency with an analysis of costs, improvements, and benefits that can be expected to accrue from recommended process changes or system enhancements.
* Provide decision makers with a cost-focused framework that will enable them to make a decision whether to proceed with detailed analysis and development of a new system (feasibility study inputs).
* Categorize costs in terms of accepted analysis practices, providing a clear understanding of recurring process costs, one-time process costs, recurring system costs, one-time system costs (system development, procurement, training), cost avoidance, etc.

## Identify assumptions and constraints

Identify key assumptions and constraints that affect the results of the cost benefit analysis.

* Assumptions are believed to be true.
* While constraints are true.
* Assumptions tend to be good for the alternative while constraints are not.

#### Assumptions

Assumptions are explicit statements used to describe the present and future environment upon which the economic analysis is based. The following guidelines shall be used in making assumptions.

* An assumption is what’s believed true.
* For example, this can be an event or circumstance that is likely to occur over the course of investment.
* They are stated without proof or evidence; but assumptions are also realistic.

Assumptions categories may include:

* Assumptions related to functional requirements.
* Assumptions related to project activities.
* Assumptions related to workload and resource estimates.
* Assumptions related to cost analysis.

#### Constraints

* Constraints are factors outside, but have a direct impact on, the process or system design.
* They include laws and regulations, technology, political, financial, operational (e.g., staff skills)
* Constraints are limitations.
* Assumptions vs. constraints.

## Identify alternatives

* Identify feasible alternatives, including, if applicable, the status quo.
* From the list of potential alternatives, narrow down the alternatives to a manageable number of alternatives.
* To develop a short list of alternatives, evaluate each candidate alternative using non-financial, qualitative factors.
* If a candidate alternative is eliminated, specific reasons for dropping that alternative should be documented in the analysis.

## Determine costs and benefits for current environment

This will establish a baseline for all target business alternatives to be measured.

* Document work breakdown structure – These are the processes, functions, and activities required to sustain the status quo operations (including any planned enhancements).
* Identify cost components (i.e., resources) required to support the status quo - Personnel, hardware, software, management support, and systems integration services
* Select cost estimating methods (e.g., bottom-up, analogous systems)
* Develop data collection model to collect and project the costs and benefits.
* Collect and normalize status quo cost data – This includes costs of the cost components, volume information (e.g., number of system users), and normalization data such as inflation rates and growth factors.
* Estimate life cycle costs for status quo alternative (discounted to accurately calculate the net present value of the investment)
* Consider the technology lifecycle.
* Segment costs and benefits by fiscal year.
* Include at least 5 years of maintenance and operations costs for each alternative.
* Conduct sensitivity analysis (e.g., to identify those variables whose changes create the greatest changes in cost).
* Define the current risks and opportunities related to maintaining the status quo.
* Prepare status quo cost/benefit analysis that documents the expected costs, benefits, and assumptions (calculation methods, time periods) for the status quo.

## Conduct alternative analysis

This examines and relates the costs, benefits, and uncertainties of each alternative to determine the most cost-effective means of meeting the project objective.

* Redefine feasible alternatives (e.g., three alternatives in addition to the status quo).
* Conduct market research.
* Collect and normalize cost data for each alternative using the same approach for determining the costs for the current environment (prior step), including:
* Work breakdown structure
* Cost components
* Estimate life cycle costs for each alternative.
* Consider the technology lifecycle.
* Segment costs and benefits by fiscal year.
* Include at least 5 years of maintenance and operations costs for each alternative.
* Estimate the benefits—qualitative and non-quantitative—for each alternative.
* Conduct sensitivity analysis.
* Define the current risks and opportunities for each alternative.

• Prepare analysis that documents the expected costs, benefits, and assumptions (e.g., calculation methods, time periods) for each alternative.

## Prepare tradeoff analysis

* Develop structure to compare tradeoffs (e.g., cost, schedule, performance, benefits, risk) among the alternatives.
* Identify the most advantageous and reasonable solution and document rationale.
* Prepare analysis report (e.g., feasibility study, business case analysis report).
* Documentation occurs throughout the analysis.
* The final product should provide sufficient information on how the estimates were developed so that independent analysts could reproduce the estimate.

## Identify and recommend the most cost-effective alternative

* Develop recommendations based on the results of the analysis.
* Alternatives should be compared to one another, as well as to the status quo, so that a recommendation can be formulated.

# Cost estimation

## Cost categories

Sample cost categories include:

* Hardware and software costs - These include the hardware and software needed to implement a system. These costs are sometimes non-recurring with system lives of greater than one year.
* Other non-recurring costs - These include the capital equipment and supporting equipment.
* Personnel costs - These include the costs for labor needed for the process.
* Other recurring costs - These include internal charges for systems use, the costs for the hardware and software maintenance, and contractor support.
* Facility/space use impacts.

## Net Present Value

To compare projects based on economic factors, there are typically three options: internal rate of return, the payback method, and net present value.

Net present value (NPV) is the preferred choice.

* The notion behind NPV is that a dollar today is worth more than a dollar tomorrow.
* NPV translates future cash flows into today’s dollars.

#### How to calculate NPV

The NPV calculation:



* It is the sum of the present value of cash flows (positive and negative) for each year associated with the investment, discounted so that it’s stated in today’s dollars.
* To calculate it, estimate the present value of each year’s costs and benefits by taking the projected cash flow for each year and dividing it by (1 + discount rate)n.
* For a cash flow five years out, the calculation is this:



The larger the number, the better:

* In the private sector, the larger the positive number, the greater the benefit.
* However, in the public sector, the NPV is often negative (greater cash outflow than inflow). In those cases, the smaller the negative number, the greater the benefit.

#### Discount rate

* The discount rate is organization specific as it’s related to how the agency gets its funds.
* In the public sector, it’s often the cost of borrowing money. For example, if the state pays 4% interest on its debt, then it may use that figure as the discount rate.
* The agency’s finance office typically sets the discount rate. Otherwise, use the [discount rate](https://www.frbdiscountwindow.org/Pages/Discount-Rates/Current-Discount-Rates) published by the Federal Reserve.

#### Inflation rate vs. discount rate

The inflation rate and the discount are not the same things. Sometimes they are the same value; but they do not measure the same thing. Inflation measures purchasing power in different time periods (e.g., things cost more in the future). Discounting reflects the time value of money (e.g., what could be earned if invested).

#### What about IRR or payback method?

As mentioned above, there are two other common methods for calculating the economic value of a project: internal rate of return and the payback method.

### Internal rate of return

* The internal rate of return (IRR) is a complex mathematical formula.
* It takes inputs, solves a complex equation, and gives out an answer.
* However, these answers are not correct all the time.
* There are some cases in which the cash flow pattern is such that the calculation of IRR ends up giving multiple rates. So instead of having one IRR, we would then have multiple IRRs.

### Payback method

* Under the payback method, an investment project is accepted or rejected based on the payback period.
* The payback period means the time that a project requires to recover the money invested in it.
* According to the method, the project that promises the quickest recovery of initial investment (shortest payback period) is the one preferred.
* However, in the public sector, where cash outflows often exceed the cash inflows, the payback period is not going to be attained.

# Benefit estimation

A CBA identifies the benefits—quantitative and qualitative—as part of the evaluation criteria.

* Quantifying benefits is often a difficult step in conducting a cost benefit analysis.
* Some benefits may be characterized in financial terms, while other benefits may not.
* To the fullest extent possible, benefits are identified and quantified for each alternative.
* Just like cost estimation, it is important to follow a rigorous approach in benefits estimation. Some recommended steps include:
1. Document the current environment.
2. Identify deficiencies with the current environment.
3. Document expected revised environment.
4. Classify benefits such as:
	* Beneficiaries.
	* Quantitative.
		+ Cost savings.
		+ Cost avoidance.
		+ Performance improvements.
	* Qualitative.
	* Probability of occurring.
	* Timing.

## Sample benefits

Benefits should be defined in a clear, specific, and measurable manner. Examples include:

|  |  |
| --- | --- |
| * Reduced costs.
 | * Controlled costs.
 |
| * Streamlined processes.
 | * Improved staff utilization.
 |
| * Increased productivity.
 | * Fewer manual functions.
 |
| * Increased resources.
 | * Reduced errors.
 |
| * Increased collections.
 | * Improved controls.
 |
| * Improved interfaces.
 | * Less data redundancy.
 |
| * Compliance with regulations.
 | * Faster retrieval.
 |
| * More timely reporting.
 | * Less processing time.
 |
| * Improved access.
 | * Improved security.
 |
| * Improved emergency response & backup.
 | * Improved information management.
 |
| * Improved customer service.
 |  |

## Quantifiable benefits

* Quantifiable benefits are those that can be measured or assigned a numeric value, such as dollars, counts, time, productivity improvements, and percentage changes.
* Dollar benefits include cost reductions and cost avoidance.
* Quantifiable benefits are calculated by subtracting the cost of an alternative from the cost of baseline operations over the period of the estimate. The difference is savings.

## Qualitative benefits

Qualitative benefits may include enhanced performance, reliability, utility, consistency and compatibility, improved quality, enhancement of best practices, meeting statutory and regulatory requirements, and modernization.

The table below illustrates a sample approach for scoring and comparing qualitative benefits among alternatives.

| Benefit type | Fully meets [3] | Partially meets [2] | Does not meet [1] |
| --- | --- | --- | --- |
| Data information for decision making | Single data/reporting source for the organization.Data available in real-time.Extensive tools and reporting available. | Data available real-time via multiple sources.Some data is standardized; but some unique and non-standardized data sets still exist. | Limited or no reporting tools and analysis available.Data must be shared manually across the organization. |
| Improved efficiency | Increases opportunities for improved customer service and cost savings. | Offers potential for cost savings. | Meets regulatory and statutory requirements. |

# Concluding insights

* Develop a detailed model (e.g., in Excel) where variables can be easily changed, traceability and assumptions clearly documented. Some Excel based CBA templates are available including the [Cost Benefit Analysis Template](https://stateofwa.sharepoint.com/%3Ax%3A/r/sites/WaTech-chiefinformation/oversightconsult/Shared%20Documents/Team/Drafts/Cost%20Benefit%20Analysis%20Template.xlsx?d=wf57ac71824b24beca470ca99bb7037f4&csf=1&web=1&e=w9FtUH).
* Construct model and other artifacts so they can be updated without contractor support.
* Calculate costs through daily business operation expenditures (e.g., personnel costs, contracts, licenses, equipment).
* Check for outlier costs (e.g. licensing).
* Identify lifecycle costs (ageing technology, volume growth rates, inflation), and leverage work breakdown structures to estimate cost.
* Present and obtain approval of the financial analysis approach.
* Discount costs and benefits to calculate the net present value of the investment.
* Look for potentially hidden costs such as maintenance, upgrades, services, and internal IT.
* Separate cost savings from cost avoidance.
* Ignore sunk costs - Any cost incurred before a decision is made to undertake an alternative is considered irrelevant to the decision; therefore, sunk costs are likewise not included.
* Show costs when they are incurred (i.e., cash flow). Amortized or depreciated costs should not be considered.
* Work closely with design engineers to understand the system complexities and uncertainties.
* Use a work breakdown structure for estimation.
* Consider more than the NPV. The most alternative with the best NPV might not be the best alternative.

# Contact

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