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CONTENT

Cost Benefit Analysis for Regulatory Impact Analysis (RIA)

1.0 Overview of Cost Benefit Analysis in RIA

Regulatory Impact Analysis (RIA), a tool adopted by OECD countries to review existing and new legislation and regulation, is also increasingly applied by APEC countries.

Quality and efficient regulation can potentially save hundreds of millions of public and private funding. It also helps in eradicating corruption in legislation and regulation through greater transparency while ensuring that policymakers make well-informed decisions in passing the regulation. For private stakeholders, such analysis promotes business environments that are conducive to invest, grow and create jobs, and improve business productivity.

Regulation has positive impacts (benefits) and negative impacts (costs). A benefit to one stakeholder may be a cost to another. In most regulations, a specific business group incurs the regulatory costs so that society can benefit in terms of safety, environment, consumer protection and others. Hence, it is important to evaluate the costs to all parties and ensure the total benefits are in excess of the total costs that are imposed. This is primarily the rationale for using CBA as the preferred method for regulatory analysis – the weighing of all total costs and total benefits embedded in its structure.

Bearing in mind the difficulties involved in preparing RIA documents, proper understanding of the problem and finding solutions that commensurate to the issue is of utmost importance. Government regulations that are excessive or poorly designed can impose a cost on society that will outweigh the benefits of the regulation. This will, in the end, have an opposite effect of the actual intended objective.

There are seven parts in RIA:

- Identification of problem
- Objectives
- Identification of options

- Assessment of options
- Preferred options
- Consultation
- Proposed regulations

One of the analytical tools in the 'identification of options' is the cost benefit analysis (CBA). In most RIA countries, CBA is integrated as the key feature of the RIA process in facilitating the selection of the best option.

As Malaysia is in its inception in applying the fundamentals of the RIA process, using CBA requires analytical skills and a willingness to find and develop analyses with no data or limited data. Therefore, this can be overwhelming to government departments with no prior training in CBA.

In countries like United States[1], United Kingdom[2], Australia[3], and Canada[4], CBA is a compulsory requirement for any governmental project bidding. The government departments need to be able to learn and apply the CBA in practice if Malaysia is to adopt the 'best practice' RIA guidelines from some of these OECD countries. For this reason, the guideline report and CBA template are both designed as comprehensive instructions to practitioners in conducting CBA analysis so that informed decision making is made based on the best available data.

1 See www.statedevelopment.qld.gov.au/resources/.../cost benefit-analysis-template.xls
2 See www.dilgp.qld.gov.au/.../template/r4r-round-4-cost benefit-analysis-template.xls
3 See https://www.pmc.gov.au/regulation/guidance-policymakers/cost benefit-analysis
4 See https://www.tbs-sct.gc.ca/rtrap-parfa/analys/analys-eng.pdf

2.0 The Concept of Cost Benefit Analysis

CBA is a comparative analysis of the costs and the benefits of undertaking a particular action or project to determine if taking the action or project is worthwhile. It is used to decide whether to implement one specific intervention or regulation if the net benefits are significant. It can also be used when choosing between competing options. In this case, the option chosen is the one with the highest return on investment or the highest net benefits given a limited amount of budget.

CBA involves an economic valuation technique that measures all the positive consequences (or benefits) and compares these with negative consequences (or costs) of an action or project in monetary values. The valuation in monetary units allows decision-makers to compare the outcomes of various alternatives.

At present, CBA is the only analytical framework that evaluates the costs and benefits to all parties. This qualifies it as the most desirable tool in assessing regulation and its viable options.
Other empirical methods such as Costs Effectiveness Analysis and Multi-Criteria Analysis support the findings from CBA.

CBA facilitates informed decision-making by weighing all the possible costs and benefits. However, quantifying the benefits and costs is a challenging task, therefore, a qualitative assessment is still an important component of the CBA. An example of a qualitative assessment in CBA is to provide for the components of costs and benefits that can be monetised while still listing the non-monetised costs and benefits.

Upon consideration of both monetised and non-monetised items, policymakers are still required to evaluate the probability of achieving the policy objective and whether the benefits stated are significant to society.

2.1. Application of Cost Benefit Analysis

The application of CBA is essential in the regulatory analysis as the introduction of regulations brings about costs and benefits to different stakeholders. One group of stakeholders may have to give up something to achieve the regulatory objective and the associated benefits for another group of stakeholders. In most cases, a CBA provides evidence that the benefits of government intervention outweigh the costs and identifies the option that provides the greatest net benefit to society. On the other hand, CBA can also show that none of the options provide benefits to society and government intervention is not warranted.

Consider two different regulatory analyses that involve $50 compliance cost per annum and $10 per unit compliance cost that increases by 8% per annum. In deciding a more feasible option, policy-makers are more likely to be concerned with the effect of cost imposition on consumer prices and business operating costs, particularly if the benefits to society appear small relative to other comparable measures.

2.2. Methodologies in Cost Benefit Analysis

There are 9 essential steps in the CBA process:

1. Define the objectives, project scopes and the stakeholders
2. Identify all the project options
3. Identify all quantified and unquantified costs and benefits
4. Estimate monetary value of each quantifiable costs and benefits in the future
5. Calculate present value of costs and benefits
6. Calculate net present value
7. Undertake sensitivity tests
8. Identify preferred action (taking into account unquantified costs and benefits)
9. Prepare a report

2.3. Principles of Cost Benefit Analysis

The following eight principles are viewed as a guide in conducting CBA to prevent misunderstanding on the methods of measurement:

1. There must be a common unit of measurement and time. The common unit of measurement refers to the currency used and the time range, which can be in the range of 10 years and beyond.

2. CBA valuations should represent consumers' or producers' valuations as revealed by their actual behaviour. This valuation can be obtained through focus group discussions (FGD), survey questions, or big data from search engines like Google or social media platforms like Facebook.

3. Benefits are usually measured by market choices. Priority is usually given to those that benefit the social welfare of the society.

4. Some measurement of benefits require the valuation of human life. The estimated value needs to be included if benefits include saving human life.

5. The analysis of a project should involve a "with versus without" comparison. The CBA should include options that showcase scenarios with and without the intervention.

6. CBA involves a study of a particular area. The geographical location of the CBA needs to be specified to ensure only those that are affected are included in the study.

7. Double counting of benefits or costs must be avoided. For example, funds transferred from the Federal Government to the State Government should not be recorded as a transfer when both have their standing in the projects. This is because the transfer is a cost to the Federal Government but is a benefit to the State Government, which on the net will be offset.

8. Decision criteria for a project. In CBA, the decision criteria are based on the Net Present Value (NPV). However, to accommodate components that are intangible and unquantifiable, supporting methodologies such as Multi-Criteria Analysis and Cost-Effectiveness Analysis can be used.

2.4. Challenges in Cost Benefit Analysis

The primary challenges in CBA are:

1. Accuracy
    - Not all costs and benefits are expressed in monetary value
    - Rely heavily on similar projects of the past
    - Rely heavily on other project members
    - The unconscious bias of team members may exist.

2. Determination of which costs to include
    - Unlike in accounting, CBA includes private, social, direct, indirect, tangible, and intangible costs and benefits
    - Benefits and costs are primarily affected by the welfare economics
    - Benefits are often associated with the consumers' willingness to pay
    - Costs are often associated with the quantum compensation losers are willing to receive for giving up the resources.

3. Identification of the stakeholders
    - Confusion often arises as to whose costs and benefits need to be included. As a result, at times the benefits may be inflated when the benefits of non-stakeholders are included.

2.5. Type of Costs and Benefits

Type of costs and benefits to be included in CBA:

Direct (Hard) Costs	Direct (Hard) Benefits
Indirect (Soft) Costs	Indirect (Soft)Benefits
Tangible Costs	Tangible Benefits
Intangible Costs	Intangible Benefits

Direct costs are costs that are directly incurred as a result of the proposed regulation. This includes compliance costs, maintenance costs, labour costs, and the administrative costs incurred to the groups that need to comply with the proposed regulation.

Direct benefits are benefits that are directly gained as a result of the proposed regulation. These include revenue enhancements and costs reduction to the government.

Indirect costs are costs that are incurred as the by-product (indirectly) of the proposed regulations. This includes environmental costs, social costs, unemployment costs, and other economic-wide impact costs.

Indirect benefits are the benefits gained as the by-products (indirectly) of the proposed regulation. This include increase in productivity, the number of potential lives saved and the number of potential jobs created.

Both the direct costs and benefits are attached to the main players while the indirect costs and benefits are attached to the secondary players.

Intangible costs and benefits are items that are not quantifiable i.e. those that do not have a market price to approximate their values. For example, improvement in psychological health, time savings and positive and negative impacts on the environment.

3.0 The Concept of Discounting

The key calculation component in CBA is discounting. Discounting a cash flow means to bring the future value to the present, taking into account the time value of money.

To illustrate, RM1 today would not have the same value as RM1 six years in the future. At present, RM1 can be used to purchase a bottle of mineral water. However, six years from now, the same bottle of mineral water will cost RM1.50.

As the time value of money is affected by inflation, the future stream of cash flows needs to be discounted to find the equivalent amount.

Another example is to look at the returns of a project. If the return in 2020 is RM1000 at a 3% interest rate, what is the equivalent value today (or better known as the Present Value of RM1000)? What would the present value of RM1000 be in 2021, 2025 or 2030?

Table 1: Calculating Present Value

Present Value	2020	2021	2025	2030
$\frac{RM1000}{(1+3\%)^1} = RM970.87$	RM1000 (1 Year from 2020 to 2019)			
$\frac{RM1000}{(1+3\%)^2} = RM942.60$	RM1000 (2 Years from 2021 to 2019)			
$\frac{RM1000}{(1+3\%)^6} = RM837.48$	RM1000 (6 Years from 2025 to 2019)			
$\frac{RM1000}{(1+3\%)^{11}} = RM722.42$	RM1000 (11 Years from 2025 to 2019)			

3.1. Net Present Value (NPV)

Once the future cash flow discounts have been established, the summation will yield the present value. The following timeline illustrates the cash flow of benefits and costs in Year 1 to Year 7.

Present Value (PV) of Benefits = $12 + \frac{10}{(1+r)^1} + \frac{80}{(1+r)^2} + \frac{39}{(1+r)^6}$

Present Value (PV) of Costs = $\frac{75}{(1+r)^3} + \frac{26}{(1+r)^7}$

Where r is the discount rate

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

NPV is defined as the difference between the present value of the benefits and the present value of the costs. If the NPV of a single prospective option is positive, then the option should be accepted (i.e. NPV > 0). However, if the NPV of a single prospective option is negative, then that option should be rejected as there are more costs associated with the option than the benefits (i.e. NPV < 0). If the NPV of a prospective option is zero, then it should also probably be rejected as it generates the same return that is expected (i.e. NPV=0). If there is an array of options for consideration, then the one with the highest NPV shall be chosen.

3.2. Benefit-Costs Ratio (BCR)

BCR is commonly used as an alternative to NPV. The BCR is a ratio of the present value of benefits over the present value of costs: $\frac{PV\ of\ Benefits}{PV\ of\ Costs}$

If this ratio is greater than 1, then the proposed option is accepted, however, if it is less than 1, the proposed option should be rejected. If the BCR is equal to 1, then it should also probably be rejected as the benefits equal the costs. If there is an array of options to be considered, the one with the highest BCR should be chosen.

3.3. Choosing the Discount Rate

Another key element to consider is the discount rate or interest rate in the calculation. Typically, long-term borrowing rates from banks are used as the initial point and subsequently, sensitivity analysis is conducted. In a sensitivity analysis, the initial interest rate is increased and decreased by +/- 25 basis points to cater for unpredictable interest rates in the future. The end objective is to gauge the feasibility of the option in the event of interest rate changes in the future.

3.4. Internal Rate of Return

Internal rate of return (IRR) is the interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equals zero. In other words, it is the discount rate at which NPV is zero. It is a threshold when the NPV will change from positive to negative.

For instance, if the current interest rate used in a project with a positive NPV is 3.25% and calculations reveal an IRR of 5%, an interest rate increase to 5% will turn the positive NPV into a negative NPV.

Hence, IRR is used to evaluate the attractiveness of a project or an investment. Knowing the IRR can shed some idea as to how much the cost of funding will be in the future. If the discount rate used in the calculation is lower than the IRR, the project will most likely not have issues on interest payment as it is a feasible one. However, if

the discount rate is higher than the IRR, it can be inferred that the project costs are beyond the breakeven interest payment.

Hence, if the IRR of a new project exceeds a company's required rate of return, that project is desirable. Should IRR fall below the expected rate of return, then the project shall be rejected.

4.0 Economic Concepts in Cost Benefit Analysis

4.1. Marginal Utility

In economics language, utility means satisfaction or happiness. Marginal utility means the additional utility one obtains and the unit of measurement is called util. For instance, the utility of eating 3 apples is 10 util. If one eats 4 apples, the utility increases to 12util. The additional 2 util from 3 apples to 4 apples is the marginal utility. This concept is as significant in many regulations, as its imposition affects society's happiness and satisfaction.

4.2. Opportunity Costs

It is defined as the loss of one alternative when another alternative has been chosen. To illustrate, if a person has to decide between going to work (utility = 10) or sleep at home (utility = 8) and he or she chooses to go to work, then the opportunity cost is sleep. The opportunity cost is the next best alternative that one forgoes. In this example, the person chose to forego a happiness level of 8 and acquires the happiness level of 10. The person would be worst off should he or she chose the opposite.

In CBA, one needs to factor in the opportunity costs. The qualified option requires a comparison with the next best alternative that was not chosen. In other words, the next best alternative is the option that would have been chosen if the qualified option was not selected. By comparing the qualified option to the next best alternative, the opportunity costs can be quantified. Thus, this evaluation provides information demonstrating if the proposed qualified option is worth pursuing.

Some examples of opportunity costs are as follows:

- opportunity to fund one project over another project
- opportunity to spend funds versus saving the funds
- opportunity to fund a healthcare facility versus a new computer system
- opportunity to fund a courthouse versus a prison

4.3. Willingness to Pay (WTP)

Willingness to pay is one of the critical elements in CBA as certain government projects require fees from the consumers. For example, the imposition of new tolls at a highway or fees to provide a park in the neighbourhood. One challenge is to identify the amount consumers are willing to pay. The projects may not be able to garner sufficient support from the public if the fee imposed is expensive. If the fee imposed is too cheap, then there is a possibility that the government will eventually have to cover the financial shortages. Subsequently, if the government is operating on a tight budget, the projects are most likely abandoned.

How is WTP estimated?

- The best way is directly from estimating the demand curve. However, this is not possible when the market does not exist
- Indirectly by asking respondents in survey questions
- Big data obtained from search engines, social media platforms, etc.
- Inferring WTP from the population's indirect market behaviour.

Consider the following example, the provision of water by planning agencies. It is widely regarded that the benefits are obvious that WTP is not worth measuring. Therefore, water was provided at a low cost as much as possible to as many people as possible. This poses a problem as over time, many water systems were unused or fell into disrepair and were abandoned.

The critical point, in this case, is caused by ignoring the community's preferences and demands. The World Bank consequently set up a water demand research team to estimate the WTP for water in a number of areas using survey methods. From the survey, one can estimate the community's willingness to pay for their water system.

4.4. Consumer and Producer Surplus

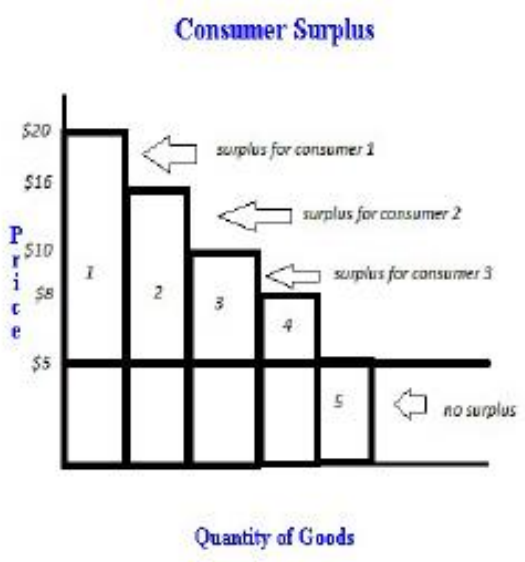
Consumer surplus is the difference between the value to buyers of a level of consumption of a good and the amount the buyers must pay to get that good. In other words, consumer surplus is the welfare consumers get from the good.

Producer surplus is the difference between the revenue sellers take in from the sale of a good and the minimum amount they would accept to produce it. Producer surplus is the welfare of sellers.

It is significant to consider both surpluses when discussing the concept of government interventions in the market. Changes in conditions and market supply and demand will bring about changes in the level of consumer and producer surplus.

For example, in the consumer surplus chart below, $5 is the market price for a small-sized pizza.
Consumer 1 is willing to pay $20 and hence, Surplus for consumer 1= $20-$5=$15.
Consumer 2 is willing to pay $16, therefore, Surplus for consumer 2 = $16-$5=$11.
The consumer surplus here is directly derived by asking people through survey questions.

Figure 1: Calculating Consumer Surplus



(1) Person	(2) Maximum Price Willing to Pay	(3) Actual Price (Equilibrium Price)	(4) Consumer Surplus
Bob	$13	$8	$5 (= $13 - $8)
Barb	12	8	4 (= $12 - $8)
Bill	11	8	3 (= $11 - $8)
Bart	10	8	2 (= $10 - $8)
Brent	9	8	1 (= $9 - $8)
Betty	8	8	0 (= $8 - $8)

4.5. Demand and Supply Curves

The demand curve showcases the relationship between quantity and price for consumers. As the price increases, the quantity demanded decreases.

The supply curve shows the relationship between quantity and price for producers. As the price increases, the quantity supplied decreases.

The demand curve is projected from consumers' willingness to pay and the supply curve from producers' willingness to accept. The consumers' and producer's surplus, in turn, is derived from the supply and demand curves.

Figure 2: Supply and Demand Curves

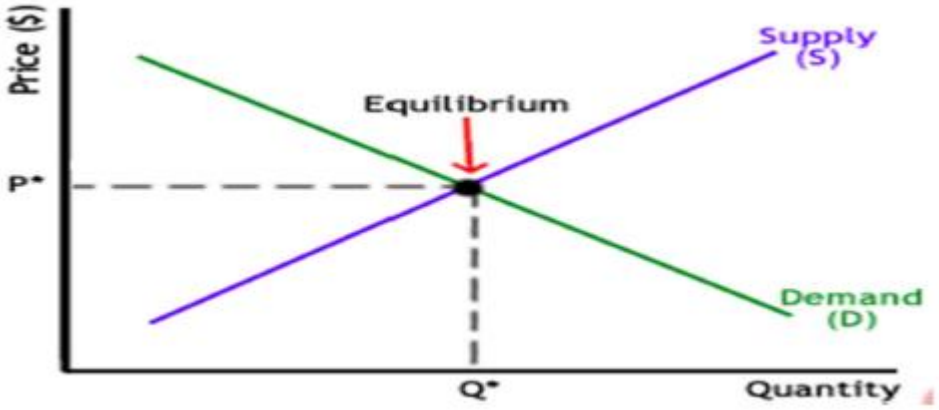
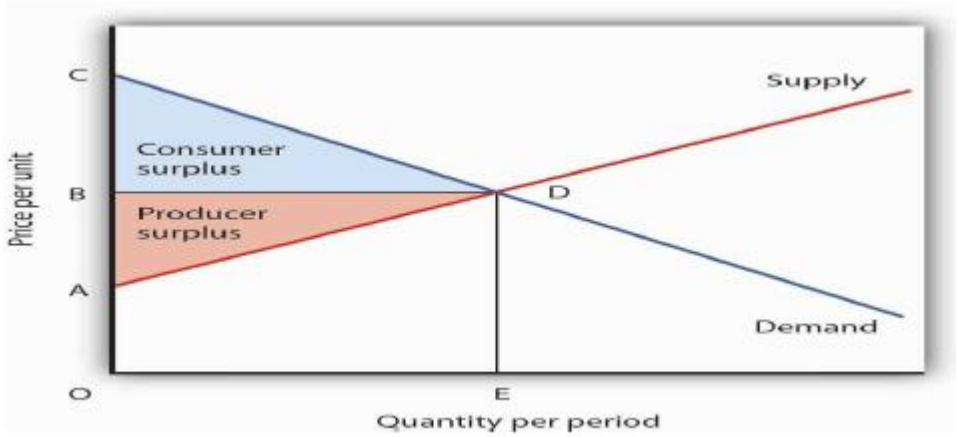


Figure 3: Graphical Consumer Surplus



4.6. Efficiency: Pareto and Kaldor Hicks Optimality

One of the ways to gauge the efficiency of a particular option is to implement the Pareto and Kaldor Hicks optimality criterion.

A Pareto improvement or Pareto efficiency is any change to the economy which leaves everyone at least as well of and someone strictly better off. In other words, at least one person is made better off as a result of the change and no person is made worse off.

This welfare criterion, called Pareto optimum, is introduced by Vilfredo Pareto (1896) and became a foundational concept in welfare theory. The allocation is Pareto optimal or Pareto efficient when no further Pareto improvement can be made. An outcome is Pareto superior to another, or Pareto dominates it if the second is a Pareto improvement over the first. Pareto improvement is seen as a win-win situation which means nobody is worse off than before. If a proposed policy change were a Pareto improvement, nobody would have any reason to oppose it. If put to a vote, it would pass unanimously. If something is a Pareto improvement, it is relatively easy to make the case.

The following scenario depicts a Pareto improvement:

A car is worth $3,000 to Person A and $4,000 to Person B. Person B buys it for $3,500. Person B is better off because s/he is paying less than $4,000 and Person A is also better off because s/he receives more than what it was worth to him/her. This solution is a Pareto improvement.

However, the world is a complex place – most new laws create some winners and some losers, therefore the Pareto criterion usually cannot accurately tell lawmakers whether one policy is “better” than another. An outcome may be seen as a Pareto improvement but it does not mean this is a satisfactory outcome or fair. There could still be inequality after a Pareto improvement.

Even the car example might not be a true Pareto-improvement. If the car is ugly and the new owner parks it on the street, Person B's neighbours are a little bit worse off after Person B buys it from Person A. Also, if Person B drives the car more than Person A did, the sale would have led to more air pollution.

Hence, another method is needed for outcomes – the Kaldor Hicks Optimality.

Nicholas Kaldor built the concept of efficiency on the foundation provided by Pareto. Pareto efficiency occurs when one party benefits from a decision, but others are not made worse off. In other words, no one loses out. Kaldor Hicks maintains that a decision can be more efficient as long as in theory, everyone can be compensated to offset any potential costs. That is, a project is desirable if those affected can be compensated by the monetary amount and whether such compensation should take place is a political question on which the economist qua economist could hardly pronounce an opinion.

For example, suppose building a new airport led to a net utility of 100 units to the wider society. However, building a new airport would make residents worse off by contributing to air pollution, noise pollution, etc. This welfare loss might be calculated at 10 units. Therefore, in theory, the new airport could be efficient according to Kaldor-Hicks by compensating residents from some of the net gains. However, those directly under the flight path may feel it is unfair they have been singled out to have to put up with an airport nearby.

4.7. Shadow Pricing

Shadow price or social value is at the heart of CBA and public policy. It is the price of an intangible item for which there is no market from which to derive a price.

An example of a shadow pricing commodity is the value of a park to the social well-being of a community when calculating the costs of its construction. The numerical value assigned to the park should be the value to a community (shadow price) regardless of its construction costs.

If the market price is lower than the shadow price, then the scale of the activities should be expanded. If the market price is higher than the shadow price, then the activity should be reduced either via disinvestment or tax. In the example above, if the market price (the costs of park construction) is less than the shadow price (the value to the community), then this activity should be increased. However, if it is the opposite, then the activity should be halted.

The knowledge of shadow prices is essential to guiding the direction of policy changes.

5.0 Standing in Cost Benefit Analysis

One of the first decisions to be made in implementing CBA is to determine who has the standing or who the stakeholders are. It also means who has the right to have his/her benefits and costs included in the analysis.

The objective of identifying those with standing is to ensure that the project owner can determine the perspectives from which the analysis is done. Standing determines which costs and benefits will be included in the analysis. It is impractical and undesirable to include the values of all affected because some people may be slightly affected while others, greatly.

Ideally, standing should be global or universal so that the interests of people in the city, in neighbouring cities, and elsewhere are included. However, this is impractical or inconsistent. For example, an analysis performed by the Federal Government often excludes effects on foreign citizens, an analysis performed by state or local governments may exclude effects arising outside their jurisdictions and purely private parties will focus only on the results beneficial for the private parties.

Consider too a project done by a department of a city government. If the CBA is done from the perspectives of the department alone, it may only cater to the interests of its members, and the department's costs and revenues matter. However, if a CBA is done from the perspectives of an entire city, the residents of that city and the city government have standing.

For instance, a town considering building a hospital will put its neighbouring town's hospital out of business. If the residents of the respective neighbouring town have standing, their benefits from having access to a new hospital should be included along with the cost of the loss of the older hospital.

Hence, the point of view from which the CBA is done (or who has standing) should be made
clear and consistently applied throughout the study.

The following is an example of a CBA from a holistic point of view:

A city department of parks and recreation is considering the construction and operation of a golf course. The costs are fairly well known but the city department will have to decide what to include as benefits. These may be from various angles:

- Universal standing – measure the value that all golfers would attach
- City's standing – city resident golfers and revenues earned from non-resident golfers
- Department of parks – revenues that the course will generate

6.0 Other Analysis

6.1 Cost-effectiveness Analysis (CEA)

The CEA is a methodology that is used when the benefits cannot be monetised, for instance when a number of lives are saved or a number of accidents are prevented are taken into account. In CEA, the ratio of costs are calculated to this single quantified measure: $\frac{Costs}{Number\ of\ Lives\ Saved}$; $\frac{Costs}{Number\ of\ Accidents\ Prevented}$

The best option is the one with the lowest ratio.

The advantage of CEA is that it allows analysis when data is not available through unit cost.

However, one needs to exercise caution as it excludes the actual benefits involved. Furthermore, an option with the highest ratio value may be the one that has the greatest impact instead, i.e. the option saves the most number of lives or prevents the most number of accidents. This can happen when the option with the lowest unit cost is assumed to address the problem when it may not be the most effective one.

For example, there are two policy options to reduce road accidents;

- Option 1 costs $40 million and prevents 20 accidents
- Option 2 costs $20 million and prevents 5 accidents.

Table 2: The cost of each accident saved is calculated by taking the ratio of cost to accidents.

Option	Option 1	Option 2
Costs	$40 million	$20 million
# of Accidents Prevented	20	5
Cost for each Accident Saved	$40 million/20= $2 million	$20 million/5=$4million

The analysis shows Option 1 to have the highest cost, $40 million but the lowest unit cost in preventing accidents, i.e. $2 million as compared to $4 million in Option 2. Hence, according to CEA, Option 1 is the preferred option.

Figure 6: Cost-effectiveness Analysis Template

Option 1	Year 0	Year 1	Year 2	Year 3	Year 4
Population/households Supported by Option 1	400	500	600	700	800
Total Population	3,000				
Present Value of Total Costs (One-Off Costs + Recurrent Costs)	135				
Cost Per Unit ($/person)	0.0450				

Option 2	Year 0	Year 1	Year 2	Year 3	Year 4
Population/households Supported by Option 2	67	59	90	89	68
Total Population	373				
Present Value of Total Costs (One-Off Costs + Recurrent Costs)	370				
Cost Per Unit ($/person)	0.992				

6.2. Multi-Criteria Analysis

Multi-criteria analysis (MCA) is used when the impacts are difficult to quantify. It is a weighted scorecard approach and requires the judgments of experts in deciding the relative importance of the criteria.

$$Weighted\ Score\ Card = Score * Weighting$$

A standard criterion rating scale from -10 for negative outcomes to 10 for positive outcomes relative to the base case is often used. A score of 10 means that the option is twice more important than a score of 5.

For example, Option 1 costs $4 million while Option 2 costs $8 million. A cost scale of -5 for Option 1 and -10 for Option 2 are assigned respectively. Hence, the score is negative since this is a cost.

And hence, there are two options for preventing road accidents with different approaches;

- Option 1 is to expand the road
- Option 2 is to install traffic lights

Table 3: Two options for preventing road accidents with different approaches

		Base Case		Option 1		Option 2	
Criteria	Weighting	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Reduction in accidents	30%	0	0	+10	+3	+6	1.8
Costs of Compliance	50%	0	0	-4	-2	-5	-2.5
Traffic Flows	20%	0	0	+7	1.4	-8	-1.6
Total	100%				+2.4		-2.3

Therefore, using the MCA, Option 1 is the preferred approach because it yields positive score as compared to Option 2.

Figure 7: Multi-Criteria Analysis Template

CRITERIA	WEIGHTAGE	BASE CASE		Option 1		Option 2	
		SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE
Reduction in Accidents	30%	0	0	10	3	6	1.8
Costs of Compliance	50%	0	0	-4	-2	-5	-2.5
Traffic Flows	20%	0	0	7	1.4	-8	-1.6
Total		0	0		2.4		-2.3

7.0 Guidelines to Use CBA Template

7.1 Sample CBA Project Appraisals

This is a sample project to be used with the Cost Benefit Analysis template. Consider yourself an analyst who is required to perform a project appraisal that considers three possible options; a training centre, luxury apartments, or new industrial units for a redevelopment project of an abandoned factory site in a city centre. The site has created problems for the locals due to antisocial behaviour including graffiti, vandalism, street drinking, etc.

Your task is to consider all the associated costs and benefits for each option and order them as first, second, and third choices accordingly based on your findings. It also requires further consideration in which you have to account for in your final appraisals which are not explicitly listed below.

These are intangible items (quantified but in non-monetary value) and qualitative items. Use a discount rate of 3% throughout. Calculate costs and benefits for the full 20-year period.

Scenario 1
Enterprise Training Centre This option is popular with the municipal council as it will be used to train local youths and help them to venture into businesses with the guidance of the skilled staff at the centre. The costs and benefits associated with Option 1 are as follows: • Building costs: RM2.8 million (occurring only in year 0) • Staff for the centre: RM0.2 million per year (beginning year 1 and is expected to increase by 5% per year) • Training benefits and job creation: RM0.25 million per year (beginning year 2 and is

expected to increase by 10% per year)

- Building maintenance: RM10,000 per year (beginning year 1 and is expected to increase by 3% per year due to inflation)
- The multiplier effect on the local economy: RM5.2 million (this is a one-off estimate
- provided by local economists)
- The number of new jobs created every year for 10 years is approximately 500.

Scenario 2

Luxury Apartment

This option is to build luxury urban apartments and sell them. It is also popular with the municipal council as it can generate substantial revenues in the short term.

The costs and benefits associated with Option 2 are as follows:

- Building costs: RM4.2 million (occurring only in year 0)
- Advertising and estate agent costs: RM40,000 (occurring in year 0-3 and is expected to
  increase 3% thereafter)
- Income received from the sale of apartments: RM2.35 million per year (occurring in year 1-3)
- The multiplier effect on the local economy (from consumption of individuals living in apartments): RM1.5 million (one-off estimate provided by local economists)
- The number of new jobs created in year 0 is approximately 80

5 Taken from Dr D. Wheatley, CBA Builder, 2011.

Scenario 3
New Industrial Units This option is to build eight industrial units on the site to be rented to businesses. This idea is popular with the municipal council as it is seen as the cheapest option and will create jobs in the local area. However, it is likely to result in substantial congestion noise and air pollution. The costs and benefits associated with Option 3 are as follows: • Demolition costs: RM200,000 (occurring in year 0 only) • Building costs: RM2 million (occurring in year 0 only) • Job creation: RM0.3 million per year (occurring in year 1-5 and is expected to increase by 5% per year) • Income from business rental rates: RM270,000 per year (beginning in year 1 and expected to increase by 2% per year) • Unit maintenance: RM100,000 per year (beginning in year 1 and expected to increase by 2% per year) • Multiplier effect on local economy: RM2.2million (one-off estimate provided by local economists) • The number of new jobs created is approximately 200 for year 1-3.

7.2 Solutions

For **Scenario 1**, refer to CBA template: Enterprise Training Centre.

List down all the one-off costs/benefits and recurrent costs/benefits.

Figure 8: Option 1 One-Off and Recurrent Costs and Benefits

One-Off Costs	Recurrent Costs
Building cost: RM2.8 million (year 0)	Staff for the centre: RM0.2million per year (beginning year 1 and increase by 5% per year)
	Building maintenance: RM10,000 per year (beginning year 1 and increase by 3% per year)
One-Off Benefits	**Recurrent Benefits**
Multiplier effect on local economy: RM5.2million	Training benefits and jobs creation: RM0.25 million per year (beginning year 2 and increase by 10% per year)
	Number of new jobs created every year for 10 years: approximately 500.

Figure 9: Option 1 One-Off and Recurrent Costs and Benefits in CBA Template

One-Off Costs				
Name of Costs	Monetary Value	Year	Discount Rate (%)	PV of Costs
Building Costs	2800000	0	3.00%	RM2,800,000.00

Recurrent Costs		Year					
		0	1	2	3	4	5
Staff wages	Monetary Value (RM)		200000	200000	200000	200000	200000
	Growth Rate (%)		5%	5%	5%	5%	5%
	Lag Factor		1	1	1	1	1
	Compound Value (RM)	RM0.00	RM200,000.00	RM210,000.00	RM220,500.00	RM231,525.00	RM243,101.25
	Discount Rate (%)		3%	3%	3%	3%	3%
	PV of Costs	RM0.00	RM194,174.76	RM197,945.14	RM201,788.74	RM205,706.96	RM209,701.27
Building Maintenance	Monetary Value (RM)		10000	10000	10000	10000	10000
	Growth Rate (%)		3%	3%	3%	3%	3%
	Lag Factor		1	1	1	1	1
	Compound Value (RM)	RM0.00	RM10,000.00	RM10,300.00	RM10,609.00	RM10,927.27	RM11,255.09
	Discount Rate (%)		3%	3%	3%	3%	3%
	PV of Costs	RM0.00	RM9,708.74	RM9,708.74	RM9,708.74	RM9,708.74	RM9,708.74

One-Off Benefits				
Name of Benefits	Monetary Value	Year	Discount Rate (%)	PV of Costs
		0		RM0.00
		0		RM0.00

Recurrent Benefits		Year					
		0	1	2	3	4	5
Training Benefits	Monetary Value (RM)			250000	250000	250000	250000
	Growth Rate (%)			5%	5%	5%	5%
	Lag Factor			2	2	2	2
	Compound Value (RM)	RM0.00	RM0.00	RM250,000.00	RM262,500.00	RM275,625.00	RM289,406.25
	Discount Rate (%)			3%	3%	3%	3%
	PV of Benefits	RM0.00	RM0.00	RM235,648.98	RM240,224.69	RM244,889.24	RM249,644.37
Multiplier effect	Monetary Value (RM)						
	Growth Rate (%)						
	Lag Factor						
	Compound Value (RM)	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00
	Discount Rate (%)						
	PV of Benefits	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00

Figure 10: Option 1 Cost-Effectiveness Analysis

Option 1	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Jobs Creation by Option 1	500	500	500	500	500	500	500	500	500	500	500
Total Population	5,500										
Present Value of Total Costs (One-Off Costs + Recurrent Costs)	5,017,593										
Cost Per Unit ($/person)	912										

Enter all this information in the Costs and Benefits and Costs-Effectiveness Analysis worksheet.

Refer to worksheet NPV, IRR and Sensitivity Analysis.

Figure 11: Option 1 NPV and IRR

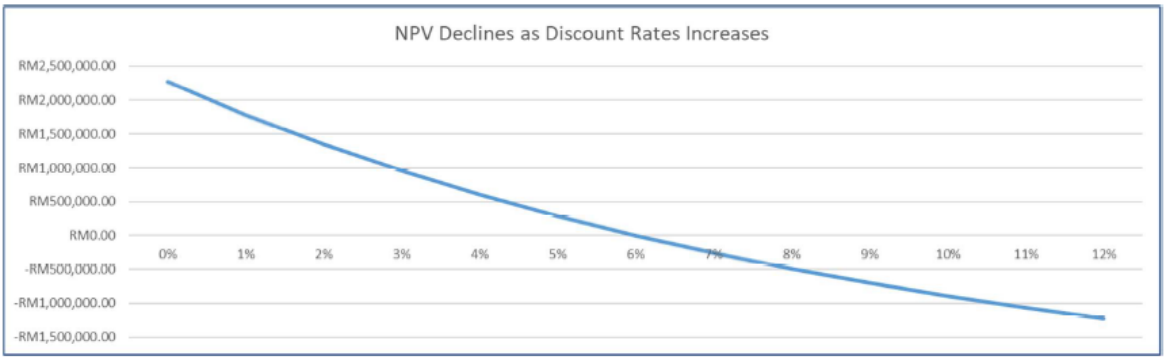
Net Present Value (NPV)	RM2,475,658.06					
To Calculate Internal Rate of Return (IRR)	6%					
One-Off Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	-2800000	0	0	0	0	0
Recurrent Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	RM0.00	-RM203,883.50	RM27,995.10	RM28,727.21	RM29,473.54	RM30,234.36
Total Benefits-Costs (RM)	-RM2,800,000.00	-RM203,883.50	RM27,995.10	RM28,727.21	RM29,473.54	RM30,234.36

The NPV is RM2.475 million, which means the project is most likely accepted. The IRR is 6%, but the discount rate used here is 3%, which means an interest rate of 6% is needed to breakeven. Therefore, Option 1 is acceptable.

Figure 12: Option 1 Sensitivity Analysis

Discount Rates Sensitivity Analysis (%)	Discount Rates	NPV
-6%	0%	RM2,270,299.82
-5%	1%	RM1,784,407.09
-4%	2%	RM1,348,234.94
-3%	3%	RM956,279.04
-2%	4%	RM603,689.87
-1%	5%	RM286,189.58
Baseline Rate is the IRR	6%	RM0.00
1%	7%	-RM258,219.71
2%	8%	-RM491,427.12
3%	9%	-RM702,243.52
4%	10%	-RM892,994.78
5%	11%	-RM1,065,746.91
6%	12%	-RM1,222,337.08

Figure 13: The Sensitivity of NPV as Discount Rate Changes



For **Scenario 2**, refer to CBA template Luxury Apartment.

List down all the one-off costs/benefits and recurrent costs/benefits.

Figure 14: Option 2 One-Off and Recurrent Costs and Benefits

One-Off Costs	Recurrent Costs
Building cost: RM4.2 million (year 0)	Advertising and estate agent costs: RM40,000 (occurring in year 0-3 and is expected to increase 3%)
One-Off Benefits	**Recurrent Benefits**
Multiplier effect on local economy: RM5.2million	Income received from sale of apartments: RM2.35 million per year (occurring in year 1-3). Sales increases by 4.5% per year since Year 0.
	Number of new jobs created in year 0: approximately 80

Figure 15: Option 2 One-Off and Recurrent Costs and Benefits in CBA Template

One-Off Costs				
Name of Costs	Monetary Value	Year	Discount Rate (%)	PV of Costs
Building Costs	4200000	0	3.00%	RM4,200,000.00

Recurrent Costs		Year					
		0	1	2	3	4	5
Advertising and Estate Agent Costs	Monetary Value (RM)	40000	40000	40000	40000		
	Growth Rate (%)	3%	3%	3%	3%		
	Lag Factor	0	0	0	0		
	Compound Value (RM)	RM40,000.00	RM41,200.00	RM42,436.00	RM43,709.08	RM0.00	RM0.00
	Discount Rate (%)	3%	3%	3%	3%		
	PV of Costs	RM40,000.00	RM40,000.00	RM40,000.00	RM40,000.00	RM0.00	RM0.00

One-Off Benefits				
Name of Benefits	Monetary Value	Year	Discount Rate (%)	PV of Costs
		0		RM0.00

Recurrent Benefits		Year					
		0	1	2	3	4	5
Sales of Apartments	Monetary Value (RM)		2350000	2350000	2350000		
	Growth Rate (%)		5%	5%	5%		
	Lag Factor		0	0	0		
	Compound Value (RM)	RM0.00	RM2,455,750.00	RM2,566,258.75	RM2,681,740.39	RM0.00	RM0.00
	Discount Rate (%)		3%	3%	3%		
	PV of Benefits	RM0.00	RM2,384,223.30	RM2,418,945.00	RM2,454,172.35	RM0.00	RM0.00
Multiplier effect	Monetary Value (RM)						
	Growth Rate (%)						
	Lag Factor						
	Compound Value (RM)	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00
	Discount Rate (%)						
	PV of Benefits	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00

Figure 16: Option 2 Cost-effectiveness Analysis

Option 2	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Population/households Supported by Option 2	80					
Total Population	80					
Present Value of Total Costs (One-Off Costs + Recurrent Costs)	4,360,000					
Cost Per Unit ($/person)	54,500					

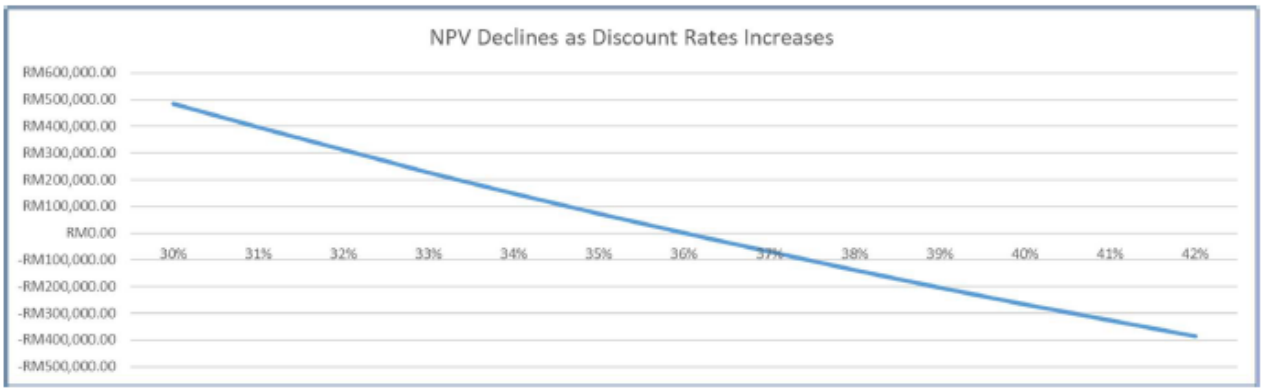
Figure 17: Option 2 NPV and IRR

Net Present Value (NPV)	RM8,097,340.65					
To Calculate Internal Rate of Return (IRR)	36%					
One-Off Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	-4200000	0	0	0	0	0
Recurrent Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	-RM40,000.00	RM2,344,223.30	RM2,378,945.00	RM2,414,172.35	RM0.00	RM0.00
Total Benefits-Costs (RM)	-RM4,240,000.00	RM2,344,223.30	RM2,378,945.00	RM2,414,172.35	RM0.00	RM0.00

Figure 18: Option 2 Sensitivity Analysis

Discount Rates Sensitivity Analysis (%)	Discount Rates	NPV
-6%	30%	RM485,501.49
-5%	31%	RM395,885.60
-4%	32%	RM310,064.92
-3%	33%	RM227,787.46
-2%	34%	RM148,822.41
-1%	35%	RM72,958.05
Baseline Rate is the IRR	36%	RM0.00
1%	37%	-RM70,230.45
2%	38%	-RM137,897.77
3%	39%	-RM203,153.52
4%	40%	-RM266,137.51
5%	41%	-RM326,978.87
6%	42%	-RM385,797.01

Figure 19: The Sensitivity of NPV as Discount Rate Changes



Enter all respective information in the costs and benefits worksheet. Refer to worksheet NPV, IRR and Sensitivity Analysis. The NPV is RM8.097 million, which

means the project will most likely be accepted. The IRR is 36%, but the discount rate used here is 3%, which means an interest rate of 36% is needed to breakeven.

For **Scenario 3**, refer to CBA template Industrial Units.
List down all the one-off costs/benefits and recurrent costs/benefits.

Figure 19: Option 3 One-Off and Recurrent Costs and Benefits

One-Off Costs	Recurrent Costs
Demolition costs: RM200,000 (occurring in year 0 only)	Unit maintenance: RM100,000 per year (beginning in year 1 and expected to increase by 2% per year)
Building costs: RM2 million (occurring in year 0 only)	
One-Off Benefits	**Recurrent Benefits**
Multiplier effect on local economy: RM2.2million	Job creation: RM0.3 million per year (occurring in year 1-5 and is expected to increase by 5% per year)
	Income from business rental rates: RM270,000 per year (beginning in year 1 and expected to increase by 2% per year)
	Number of new jobs created: approximately 200 for year 1-3.

Figure 20: Option 3 One-Off and Recurrent Costs and Benefits in CBA Template

One-Off Costs				
Name of Costs	Monetary Value	Year	Discount Rate (%)	PV of Costs
Demolition	200000	0	3.00%	RM200,000.00
Building Costs	2000000	0	3.00%	RM2,000,000.00

Recurrent Costs		Year					
		0	1	2	3	4	5
Unit Maintenance	Monetary Value (RM)		100000	100000	100000	100000	100000
	Growth Rate (%)		2%	2%	2%	2%	2%
	Lag Factor	0	1	1	1	1	1
	Compound Value (RM)	RM0.00	RM100,000.00	RM102,000.00	RM104,040.00	RM106,120.80	RM108,243.22
	Discount Rate (%)	3%	3%	3%	3%		
	PV of Costs	RM0.00	RM97,087.38	RM96,144.78	RM95,211.34	RM106,120.80	RM108,243.22

Recurrent Benefits		Year					
		0	1	2	3	4	5
Job Creation	Monetary Value (RM)		300000	300000	300000	300000	300000
	Growth Rate (%)		5%	5%	5%	5%	5%
	Lag Factor		0	0	0	0	0
	Compound Value (RM)	RM0.00	RM315,000.00	RM327,607.50	RM342,349.84	RM357,755.58	RM373,854.58
	Discount Rate (%)		3%	3%	3%		
	PV of Benefits	RM0.00	RM305,825.24	RM308,801.49	RM313,298.60	RM357,755.58	RM373,854.58
Multiplier effect	Monetary Value (RM)						
	Growth Rate (%)						
	Lag Factor						
	Compound Value (RM)	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00
	Discount Rate (%)						
	PV of Benefits	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00	RM0.00
Income	Monetary Value (RM)		270000	270000	270000	270000	270000
	Growth Rate (%)		2%	2%	2%	2%	2%
	Lag Factor		0	0	0	0	0
	Compound Value (RM)	RM0.00	RM275,400.00	RM280,908.00	RM286,526.16	RM292,256.68	RM298,101.82
	Discount Rate (%)		3%	3%	3%	3%	3%
	PV of Benefits	RM0.00	RM267,378.64	RM264,782.73	RM262,212.03	RM259,666.28	RM257,145.25

Figure 21: Option 3 Cost-effectiveness Analysis

Option 3	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Population/households Supported by Option 3	200	200	200	200		
Total Population	800					
Present Value of Total Costs (One-Off Costs + Recurrent Costs)	3,156,242					
Cost Per Unit ($/person)	3,945					

Figure 22: Option 3 NPV and IRR

Net Present Value (NPV)	RM2,014,478.20

To Calculate Internal Rate of Return (IRR)	13%					
One-Off Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	-2200000	0	0	0	0	0

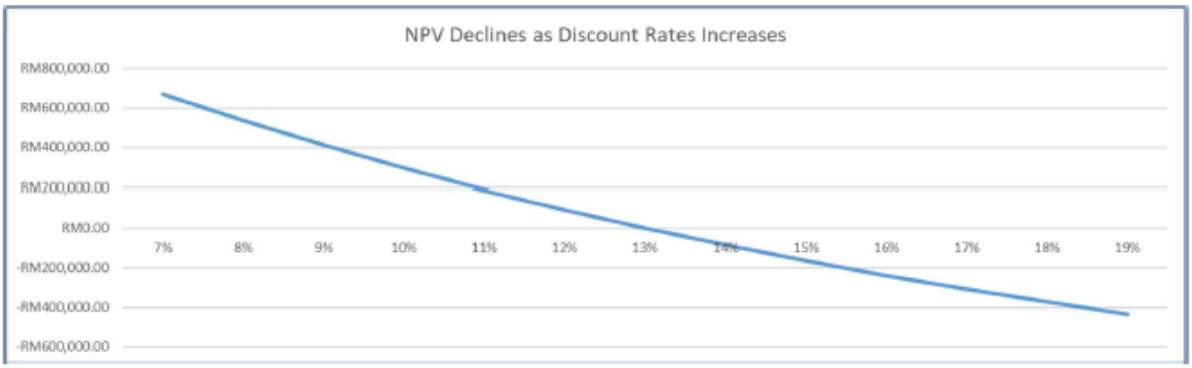
Recurrent Benefits-Costs	Year					
	0	1	2	3	4	5
Monetary Value (RM)	RM0.00	RM476,116.50	RM477,439.44	RM480,299.29	RM511,301.06	RM522,756.61

Total Benefits-Costs (RM)	-RM2,200,000.00	RM476,116.50	RM477,439.44	RM480,299.29	RM511,301.06	RM522,756.61

Figure 23: Option 3 Sensitivity Analysis

Discount Rates Sensitivity Analysis (%)	Discount Rates	NPV
-6%	7%	RM669,740.53
-5%	8%	RM535,277.35
-4%	9%	RM411,168.51
-3%	10%	RM296,423.45
-2%	11%	RM190,158.88
-1%	12%	RM91,586.12
Baseline Rate is the IRR	13%	RM0.00
1%	14%	-RM85,230.79
2%	15%	-RM164,672.20
3%	16%	-RM238,832.21
4%	17%	-RM308,167.39
5%	18%	-RM373,088.62
6%	19%	-RM433,966.13

Figure 24: The Sensitivity of NPV as Discount Rate Changes



Enter all respective information in the costs and benefits worksheet. Refer to worksheet NPV, IRR and Sensitivity Analysis. The NPV is RM2.014 million, which means the will most likely be accepted. The IRR is 13%, but the discount rate used here is 3%, which means an interest rate of 13% is needed to breakeven.

Cost-effectiveness Analysis		
Option 1	**Option 2**	**Option 3**
RM 912	RM 54,500	RM3,945
Cost Benefit Analysis (NPV)		
Option 1	**Option 2**	**Option 3**
RM2.476million	RM8.097million	RM2.014million

Finally, list down all the qualitative impacts for each option in the Qualitative-Non-quantifiable template to get overall insights.

8.0 Case Study

The Atomic Energy Legislation (RUUTA) Case Study

Malaysia has long been an advocate of stricter control over the usage, administration, and disposal of nuclear-related materials.

Although Act 304 laid the foundation in the governing of nuclear and nuclear-related device handling, there are many loopholes in the Act that needs to be addressed, along with the changing of times. The Atomic Energy Legislation (RUUTA) aims to replace Act 304 (Atomic Energy Licensing Act 1984) to aid in the above.

In a nutshell, RUUTA aims to control and monitor all activities and practices involving atomic energy to ensure adequate protection is given to workers, the public, and the environment from potential negative effects of the usage, transportation, misuse, disassembly, and the liability resulting from the usage of atomic energy.

The process of putting in new legislation calls for various stakeholders to be involved. Therefore, it is of utmost importance to conduct an impact analysis to weigh the pros and cons of options.

In this particular case, the Atomic Energy Licensing Board (AELB) is faced with two options;

Option 1, maintaining the status quo i.e. to continue with Act 304; or

Option 2 is to abolish and replace Act 304 with RUUTA.

The positive implication of Option 1 is that no changes need to be made and thereby no new laws need to be adhered to or financial implications incurred in the industry. This would also mean that there would be no expenses for the Government in terms of new legislation. However, there are negative impacts of not having RUUTA in place.

Most noteworthy is the prohibition against the development and use of nuclear weapons. The lack of reference to this in Act 304 may lead to negative perceptions as to Malaysia's stand for the development and prohibition of nuclear weapons. The lack of clear provisions is a hindrance for the country to provide the parameters and platforms for legal controls that are consistent with the most current international guidelines, obligations, and instruments. As it is, there are currently six critical international instruments that cannot be signed or ratified due to the non-existence of legal domestic provisions.

Another negative impact is the no-graded approach of Act 304 that has caused it to be not cost-effective for the Malaysian Government, users, or license applicants. A no-graded approach means that there is no differentiation in the magnitude of control from low risk to high-risk activities. This has forced operators of baggage scanning equipment to be subjected to the same stringent rules as those using radioactive items in their operations.

Option 2 is to go ahead with the legislation of RUUTA, the positive impact of which will enable the laws and regulations to be current and control and monitoring to be done smoothly by having provisions in place to address issues in Act 304.

However, there are negative implications should Option 2 be the chosen option. In Option 2, AELB will need to monitor the changes RUUTA will bring to the industry. RUUTA will add financial costs to both the industry and the Government.

As there are both positive and negative impacts for the new legislation, a Cost Benefit Analysis (CBA) was conducted to compare the two options.

If Option 1 is chosen, the one-off and recurrent cost to the Government and industry to search and dispose of radioactive materials, and also the recovery and operational costs for 20 years from 2000 to 2019 is RM 2,425,441,536.21. On the other hand, if Option 2 is chosen, the one-off benefit is approximately RM 42,000,000. Taking into account the cost and benefits, the Net Present Value in 2020 is RM -4,179,379,160.90.

Although the two options clearly show that quantitatively, Option 2 is the better one, a public consultation was held to solicit feedback and address the qualitative costs and benefits for RUUTA. 95.8% of those who responded via survey and forum agreed with the RUUTA legislation to replace the existing Act.

It is clear from both quantitative and qualitative impact analysis that Option 2, i.e. going ahead with the legislation of RUUTA in place of Act 304 is the more viable option.

The scenarios and processes depicted in the legislation of RUUTA show the importance of impact analysis in aiding decision making, especially when there are many stakeholders involved and a huge amount of costs is expected to be attached to a particular legislative activity. In this case, CBA has indeed provided a clear cut on ensuing the best option is chosen.

9.0 Conclusion

Cost benefit analysis (CBA) is a significant tool in ensuring the right option is selected in implementing best practices in regulations and policies for the benefit of the nation and its people. A growing nation that aims to be productive in every possible way requires a thorough examination in carrying out projects weighing both pros and cons in terms of monetary values, technicalities, manpower, and other resources involved as well as matters pertaining to respective stakeholders. CBA is required to ensure the sustainability of economic values and boosting return on investments and hence its implementation should be emphasised in every country that vouches for progress, productivity and a balanced economy.