

The Principles of Cost Benefit Analysis

Thresholds for Project Appraisal

The DOF Guidelines indicate that project appraisal processes should be commensurate with the costs of projects and the degree of complexity of the issues involved. The thresholds and methodologies set out are as follows.

- A simple assessment should be carried out for minor projects with an estimated cost below €0.5 million, such as projects involving minor refurbishment works, fit outs etc.
- Projects costing between €0.5 million and €5 million should be subject to a single appraisal incorporating elements of a preliminary and detailed appraisal.
- A Multi-Criteria Analysis (MCA) should be carried out at minimum for projects between €5 million and €50 million.
- Projects over €50 million should have a Cost Benefit Analysis (CBA) carried out
- A CBA would also be appropriate for innovative projects costing above €5 million which:
 - Involve complex or specialised issues or untried technology; or
 - Involve issues which have not been previously investigated in-depth; or
 - Are regarded as pilot projects on which larger programmes may be modelled; or
 - Would generate additional substantial ongoing operating or maintenance costs.

Why use cost benefit analysis?

Resources are scarce, especially public sector resources. Therefore all governments are concerned with the securing value for money from public sector investments.

Governments need to be able to understand the value of money a project yields, for example they need to be able to compare the net benefits of a roads project with for example an new hospital.

The profitability of public sector investment is not an equitable way of measuring the worth of projects. For example if a road is tolled it may generate profit, whereas a hospital may not. Therefore governments need a method to valuing the benefits of an investment which may not have easily defined monetary value.

Valuation principles

CBA was developed for sectors that do not have a marketable output, and typically it is geared to measuring the costs and benefits to society at large.

Transport is a classic example of for the application of CBA. The analysis of road projects to date have been lacking in incorporating the full costs and benefits to society. They have tended to examine costs and benefits which are easily examined such as travel time savings and accident savings.

In more recent years the ability to calculate the total social benefit of a project has become more important.

A method of valuing these costs and benefits is to use the 'willingness to pay' (WTP) approach. This method allows a stream of costs and benefits to be identified for each stakeholder (driver, resident etc), and in terms that are more meaningful to each.

For example, whereas an expenditure of €1 on fuel holds a value of €1 to a typical road user, this expenditure contains an element of taxation, and so the actual cost to society is considerably less.

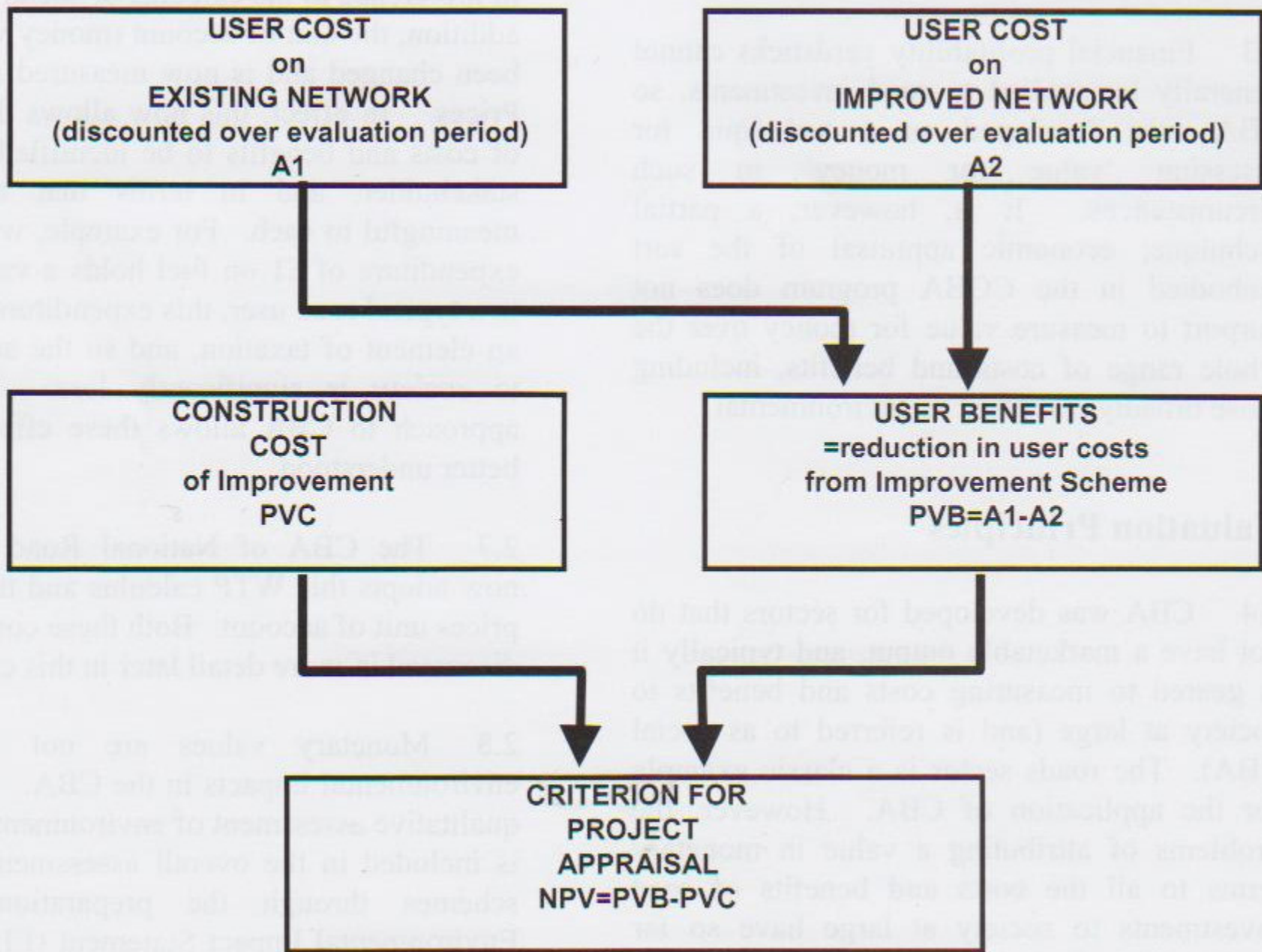
In general monetary values are not placed upon environmental costs, and an Environmental Impact Assessment (EIS) is completed.

In roads schemes in general the following benefits are calculated:

- changes in travel time
- changes in operating cost
- changes in accident costs

The following costs are generally estimated in CBA's:

- capital cost
- changes in the capital cost of maintenance



The COBA Method

The majority of consultancies and national transport authorities use this method when conducting a CBA.

The first stage of this approach is to define the alternative options which are to be defined. In general these options are defined as the do-minimum and do-something options.

Do Minimum

In simplistic terms the do minimum scenario is the road that is currently in place. Essentially it's the current road network or a do nothing scenario.

Do something

The do-something scenario is generally the new road which is under consideration.

The Fixed Trip Matrix

The COBA program itself measures costs and benefits over the entire network affected by the scheme, but assumes that the pattern of trip making is unaffected.

When a road improvement takes place, several changes in trip patterns are possible:

- reassignment: traffic travelling from A to B may transfer to the new route between A and B
- time of day: trips may be made at a different time of day
- redistribution: traffic may change its origin or destination: e.g. traffic may go to C instead of B
- modal shift: trips to the same destination may be made by a different mode of transport
- generation: trips may be made when previously travel didn't take place.

Discounting and Price Basis

When completing a road project, it will generally yield a stream of costs and benefits. In CBA you place a different value on the same cost or benefit according to when they occur.

Costs and benefits arising in different years are transformed to their present values by the process of discounting. To understand this consider the following example.

If €1 is invested at a real interest rate of r , at the end of year one the €1 will be worth $€(1+r)$. After two years it would be worth $€(1+r)^2$

Similarly if I receive €1 in n years time, it is worth $€1/(1+r)^n$

Because discounting involves the process of charging interest against a project, rather than paying interest to an investor. r is known as the discount rate. The discount rate can be gotten by using the following formula.

$$\sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

r = discount rate

T = year

To get the present value of a stream of costs or benefits over the lifetime of a project, they are summed.

The discount rate recommended by the Department of Transport is 5%.

The appraisal period

The appraisal period is the period over which costs and benefits are calculated.

The appraisal period for most big transport infrastructural projects is 30 years (National roads, Metro, Luas).

The COBA method calculates the net scheme benefits over the assessment period, in this case 30 years. However, some transport infrastructure may have benefits which could accrue past the 30 year time period, consider the oldest Tube lines in London. Thus arguments exist to extend this time period.

The two main reasons why one does not go beyond the stated time period are:

1. The uncertainty as to events in distant periods
2. The effect of discounting is significantly reduced in future years

The use of CBA in road schemes

The overall design of a new road can be said to follow seven phases:

1. Overall project planning
2. Constraints study
3. Route selection
4. Preliminary design / land acquisition procedures
5. Construction documents preparation / tender / award
6. Scheme construction
7. Final account / closeout.

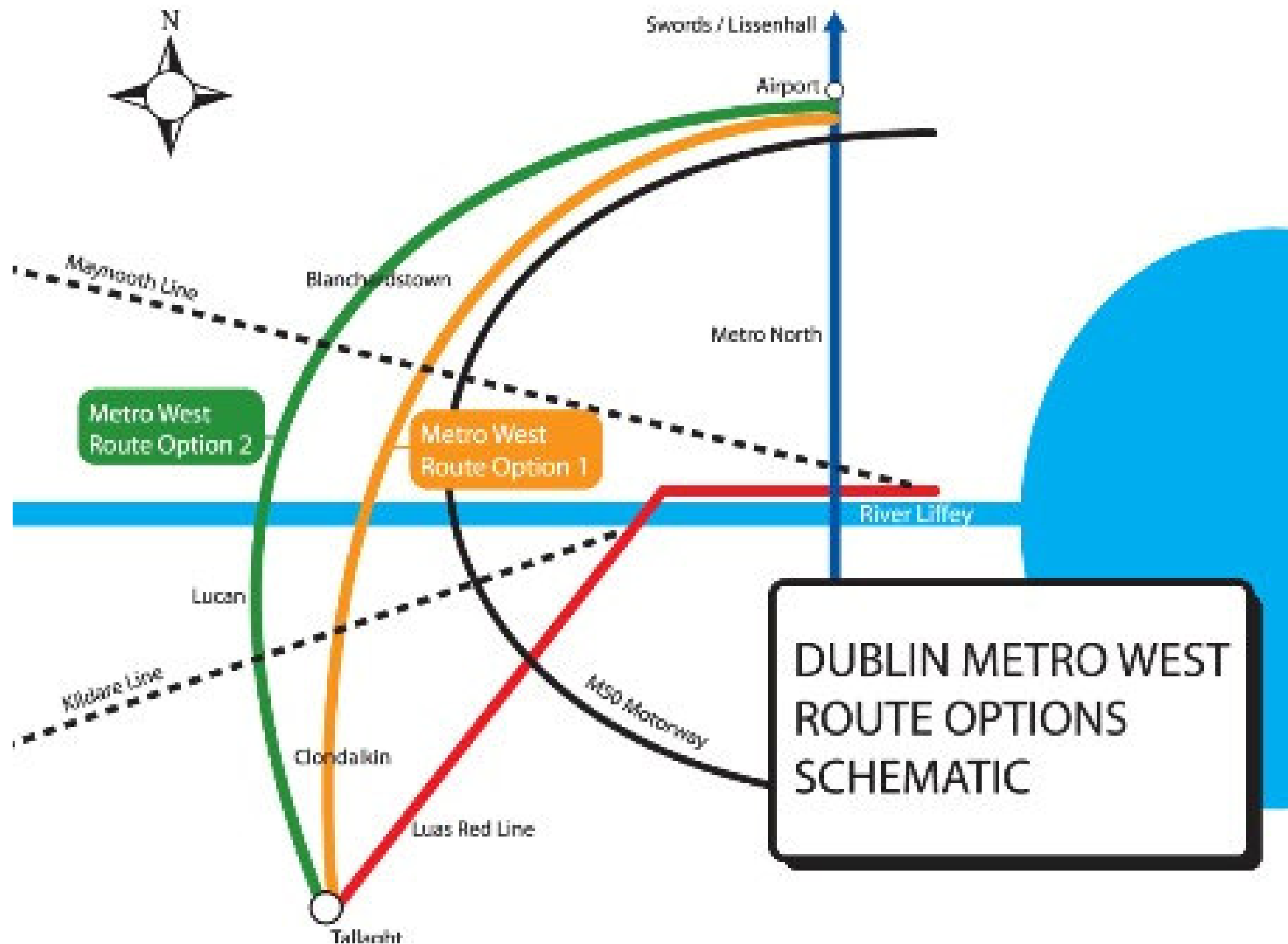
CBA is generally used in stages 3, 4 and 7

Phase 3: Route selection

The purpose of the route selection stage is to carry out a technical evaluation of route options and to recommend a particular solution. A route selection report, documenting the evaluation of a series of potential routes, outlines in detail the method used to arrive at the cost estimate and the basis of the CBA.

This route selection phase feeds into the overall evaluation of the proposed road option.

At the route selection stage the CBA must identify the relative benefits of competing options. Default parameters for traffic composition and accident rates are therefore generally acceptable.



Phase 4: Preliminary Design

During the preliminary design phase the objective is to prepare a design of the scheme at a suitable level of detail so that an accurate land acquisition requirement can be determined for formal approval.

This phase will involve the refinement of the preferred route including the alignment of the route, preliminary structure designs and proposed junction layouts.

At this stage it is important to conduct a more detailed CBA.

Phase 7: Final Account / Closeout

The purpose of this final stage is to determine how the outturn costs and impacts of a scheme compare with forecasts, and how these affect the overall economies of the scheme.

Analysis of the final account CBA can help identify issues relating to the assessment and provide useful information to feed into future assessments.

DTO example of a Do-minimum scenario



DTO example of a Do-maximum scenario



Table 10.4 Costs Associated with Preferred Package

Item	€ million
Capital Costs	
<i>Congestion Charge</i>	
System set-up – over 3 years	50
Complementary traffic management measures – over 2 years	44
Education / awareness programme – one-off	5
<i>Work Place Parking Levy</i>	
Inventory & database development – one-off	1
Complementary traffic management measures – over 3 years	25
Education / awareness programme – one-off	1
<i>TDM Support Measures</i>	
Establishment costs – one-off	2
Complementary traffic management measures – over 3 years	25
Launch costs - one-off	1.5
Total Capital Costs (over 3 years)	154.5
Recurrent Costs	
<i>Congestion Charge</i>	
Scheme administration – recurrent	5 pa
Scheme operations – recurrent	60-120 pa
<i>Work Place Parking Levy</i>	
Scheme administration – recurrent	1.3 pa
<i>TDM Support Measures</i>	
Scheme administration – recurrent	1.0 pa
Total recurrent costs	67-127 pa

DTO example of a Do-maximum scenario

Table 10.5 Unpriced Benefits Associated with Preferred TDM Package (Annual)

Item	€ million
Benefits	
Vehicle operating cost savings (cars only)	53
Road traffic accident savings	47
Environmental benefits	20
Travel time savings & road user decongestion (car, bus, cycle and walk)	313
Increased public transport subvention	-22