Guidelines on a Common Appraisal Framework for Transport Projects and Programmes

June, 2009

Table of Contents

	Executive Summary	**i**
1.	**The Project and Programme Appraisal Process**	**1**
2.	**Project Definition and Option Generation**	**5**
3.	**The Appraisal Framework**	**10**
4.	**Economy**	**14**
5.	**Safety**	**22**
6.	**Environment**	**23**
7.	**Accessibility and Social Inclusion**	**28**
8.	**Integration**	**30**
9.	**The Project Appraisal Overview**	**32**
10.	**Risk and Uncertainty**	**44**
	Appendix 1: Application Rules for Cost-Benefit Parameter Values	46
	Appendix 2: Road Vehicle Emissions	59
	Appendix 3: Template for the Business Case	63
	Appendix 4: Measuring Changes in Consumer's Surplus	66

Executive Summary

This document provides guidelines for the appraisal of transport projects and programmes. It draws on and is compatible with the Department of Finance Guidelines for the Appraisal and Management of Capital Expenditure Proposals in the Public Sector (February 2005) and subsequent modifications to those guidelines. It is informed by a body of research undertaken by Goodbody Economic Consultants for the Department of Transport, which is published separately.

It begins by outlining the Department of Finance Guidelines and the manner in which they should be interpreted in the appraisal of transport projects and programmes.. This is followed by advice on defining projects for appraisal and on the generation of project options.

An overall Common Appraisal Framework is then outlined. This is an objectives-led framework that employs both multi-criteria and cost-benefit approaches. The Common Appraisal Framework categorises the impact of projects in terms of Economy, Safety, Environment, Accessibility and Social Inclusion and Integration.

As not all project impacts can be given money values, benefits and costs are considered through the development of a Project Appraisal Balance Sheet, which provides a framework within which the various benefits and costs of a project may be brought together for consideration.

A key element of the Guidelines is advice on the conduct of cost-benefit analyses, which is a requirement for all projects of €30m capital cost or over. Specific advice is provided on the conduct of cost-benefit analyses and parameter values for use in cost-benefit are provided in the Appendices.

Finally, as all projects are subject to risks that impact on project outcomes, the Guidelines recommend a range of sensitivity analyses that test the sensitivity of the appraisal to a set of risk factors.

1. The Project and Programme Appraisal Process

1.1 Introduction

1.1.1 In February 2005, the Department of Finance (DOF) published "Guidelines for the Appraisal and Management of Capital Expenditure Proposals in the Public Sector". These Guidelines were modified by a Value for Money circular letter of 25 January 2006. The Guidelines set out the main steps that should be followed in evaluating and managing capital expenditure projects and programmes, consider the major issues involved, and describe the principal methods of appraisal.

1.1.2 The DOF indicates that Departments and agencies should make arrangements for the implementation of the Guidelines. In this regard, the DOF Guidelines consider that the type and depth of appraisal should depend on the size and nature of the project, and should be proportionate to its anticipated scale.

1.1.3 This document explains the steps to be used in the appraisal of projects and programmes for which the Department of Transport or its agencies are sanctioning authorities. It is the culmination of a process of research which began with an analysis of the basis on which cost-benefit parameters should be valued.

1.1.4 The purpose of this document is to elaborate a common framework for the appraisal of transport investments. It is consistent with the DOF Guidelines and elaborates on them in respect of the appraisal of transport projects and programmes.

1.2 Project Appraisal Process

With regard to project appraisal, the DOF Guidelines require a three-stage process:

1.2.1 Preliminary Appraisal

This aims to assess whether the project has sufficient merit to justify a full, detailed appraisal.

1.2.2 Detailed Appraisal

This aims to provide a basis for a decision on whether to drop or re-scope a project, or to approve it in principle.

The DOF Guidelines recognise that estimates the project costs may change during detailed planning of the project. Where there are significant project cost changes, the detailed appraisal should be updated to reflect these changes. In particular, the Guidelines suggest that the project appraisal should be validate and updated where necessary after the tendering process, when final project costs are known.

1.2.3 Post Project Review

This is an assessment of both the project outturn and the appraisal and project management procedures used. Project outturn is to include an analysis of whether the expected benefits and outcomes materialised.

Appraisals and post-project reviews are the responsibility of the sponsoring agency.

1.2.4 Business Case

The Business Case is a single document that describes the proposed project, establishes the rationale for it, and informs a decision to proceed with it. The Business Case should be established at the preliminary appraisal stage and updated at detailed appraisal, and post tender stages. Figure 1.1 provides an overview of the project appraisal process.

1.3 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.

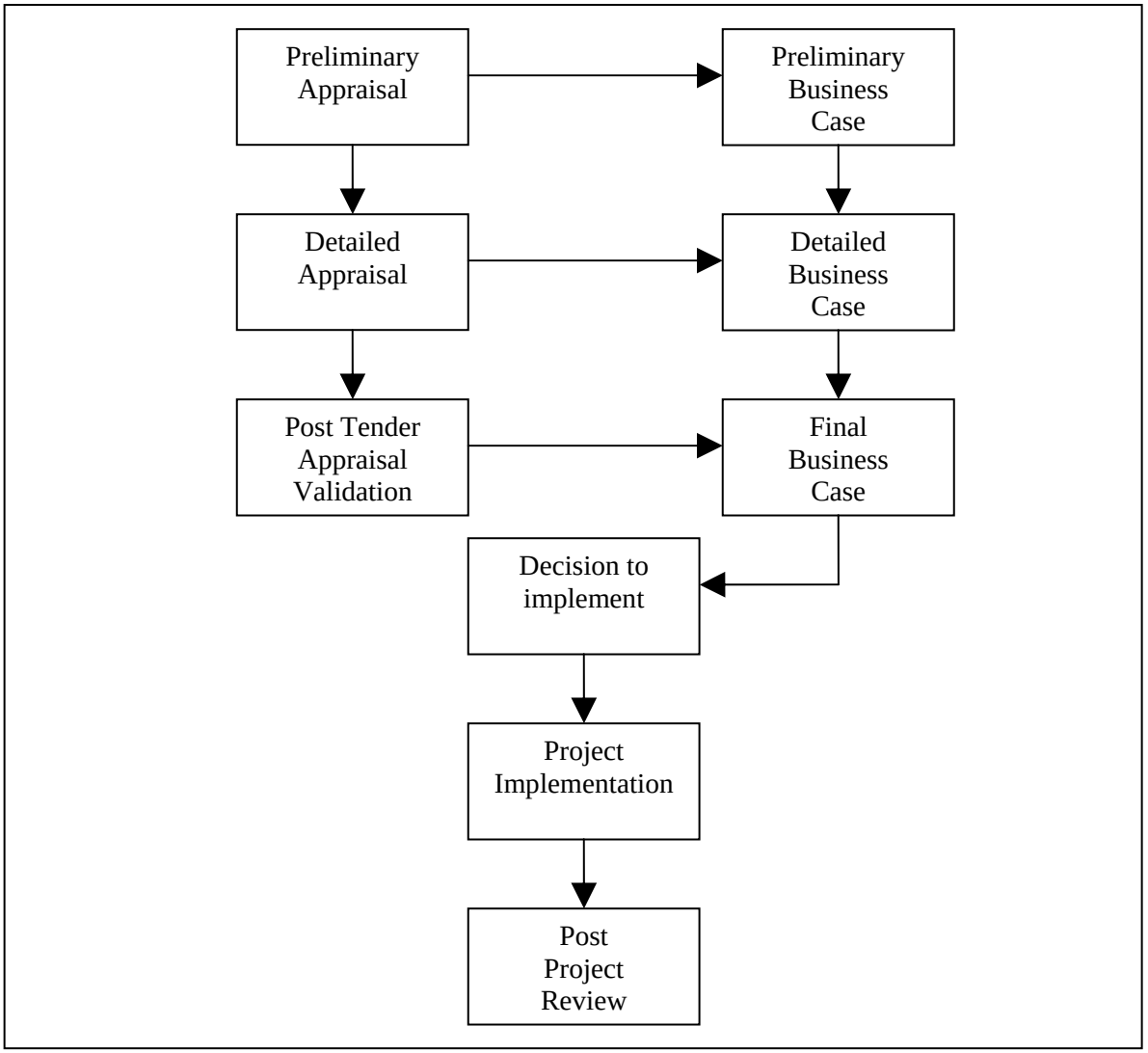
- A simple assessment should be carried out for minor projects with an estimated cost below €0.5 million, such as projects involving minor refurbishment works, fit outs etc.

- 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 €30 million.

- Projects over €30 million should have a Cost Benefit Analysis (CBA) carried out.

Figure 1.1: Overview of the Department of Finance Project Appraisal Process



- 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.

Post project reviews are to be carried out for all projects costing in excess of €30m and a representative 5 per cent sample of all completed projects.

1.4 Methodologies

1.4.1 The DOF Guidelines indicate that analyses from a number of viewpoints may be appropriate including:

- Economic analysis;
- Exchequer cash-flow analysis; and
- Financial analysis;

1.4.2 With regard to economic analyses, the Department of Finance indicates that techniques such as multi-criteria analysis, cost-benefit analysis and cost effectiveness analysis may be appropriate. Cost-benefit analyses are required for projects with a capital cost in excess of €30m.

1.4.3 The key difference between cost-benefit and other techniques is the greater emphasis on the monetisation of benefits. Benefits and costs are to be assessed using standard criteria such as Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio.

1.5 Programme Appraisal

1.5.1 The DOF Guidelines indicate that programmes with an annual value in excess of €50m and of five years or more duration should be subject to prior and mid-term evaluation at the beginning and mid-point of each five year cycle or as may be agreed with the Department of Finance. The DOF Guidelines also state that projects, whether they are part of the programme or not, should be appraised. It may be appropriate in certain circumstances to aggregate a number of small projects for the purposes of appraisal, particularly where there are network effects. This could, for example, apply to Quality Bus Networks or Green Route projects where it may be appropriate to carry out an assessment of the impact of investment on a whole route basis.

1.5.2 Where programmes include a large number of small projects that are generic in nature (e.g. a rail safety programme), it may not be necessary to subject all of these projects to separate appraisal. Instead a generic appraisal may be sufficient, provided it is representative of the projects being undertaken. An example of this type of project might be minor works at railway accommodation crossings.

2. Project Definition and Option Generation

2.1 Introduction

Project appraisal involves the analysis of different project options. It is facilitated by defining projects in a manner that renders them suitable to appraisal. Options for investment in a particular project should also be identified and appraised in comparison to a Base Case. Advice on these issues is presented below.

2.2 The Base Case

2.2.1 The objective of project appraisal is to identify the approach that would best achieve the project's objectives. The appraisal of a project requires the development of a Base Case, which would represent a minimum intervention on the part of the project sponsors. The proposed project is then appraised by comparison with the Base Case.

2.2.2 The approach to identifying the Base Case may vary. For some projects a realistic base case may be a Do-Nothing Scenario, in which no further expenditure on the facility is envisaged. More often than not, however, a Do-Minimum Scenario will be more appropriate. This will occur, for example, where maintenance expenditures are required to maintain the facility in the absence of the proposed project. Do-Minimum scenarios should also include expenditure on the facility, which is already fully committed.

2.2.3 Where the Base Case is represented by a Do-Minimum rather than Do-Nothing Scenario, some explanation of this decision should be presented. For example, reasons should be given why a realistic Base Case could not encompass the running down of the facility.

2.3 Option Generation

General

2.3.1 In order to ensure that good investment decisions are made, it is necessary to appraise a number of Do-Something options. These options should be devised with the objectives of transport policy in mind. That is, the options should reflect identified needs and objectives. Only those elements that are additional and or for which funding is sought should be included in the Do-Something options.

2.3.2 A minimum of three options should be subject to appraisal at preliminary appraisal stage. Where fewer than three options have been considered the project

appraisal report and or Business Case should include a rationale for the approach taken.

2.3.3 For some projects, a large number of options may present themselves. In order to keep the appraisal process manageable, it is appropriate to adopt an approach which subjects a large number of projects to a sketch appraisal, before subjecting a smaller number to a more complete appraisal. A sketch appraisal could encompass a qualitative and quantitative approach, which avoids the complexities associated with the monetisation of benefits.

2.3.4 Issues that should be considered in developing options are:

- Management versus investment options;
- Scale of investment;
- Different technical solutions;
- Different standards;
- The timing and phasing of projects;
- Incremental options;
- Synergistic or complementary projects or packages of measures; and
- Strategic or consistent approaches.

2.3.5 The Management Option

Investment options will not always represent the most appropriate response to identified needs or objectives. Better management or pricing of existing networks and services may either reduce demand or expand the effective capacity of networks. A management option may also be more environmentally acceptable. Project analysts should give explicit consideration to the management approach when developing options.

2.3.6 Incremental Options

A valuable approach to option development is to consider a small scale or lower standard investment initially and then to consider incremental increases in scale. Such incremental investments should then be appraised and the higher level investment accepted if the increment yields net benefits. In this manner, an

investment approach, which yields a net benefit close to the optimum, may be established.

2.4 Developing Packages of Measures

2.4.1 Options for analysis may comprise a package of measures. This will occur where individual measures are considered insufficient to meet the project objectives, or where a package of measures has the potential to provide a more cost effective solution in meeting the objectives.

2.4.2 In developing packages of measures, consideration should be given to:

- Including measures in a package to address different aspects of the project, or programme's objectives; for example, urban transportation plans should comprise investment options which contain measures aimed at the different transport needs arising throughout the urban transportation network for which the plan is being devised;

- Including complementary measures within a package, where measures are aimed at the same aspect of the project's objectives; complementary measures are those where the inclusion of one measure increases the benefits or reduces the cost of another measure;

- Avoiding substitutable measures within a package, where measures are aimed at the same aspect of the project's objectives; substitutable measures are those where the inclusion of one measure reduces the benefits or increases the costs of another measure.

Where options for analysis comprise alternative packages of measures, these packages should be formed so as to present substantially different approaches to meeting the project's objectives.

2.5 Defining Projects with Direct Beneficial Impacts

2.5.1 The measurement of the benefits arising from a project is made difficult if not impossible, if the project does not have direct beneficial impacts. Some projects may be regarded as positioning investments that will facilitate future service expansions. For example, a rail depot may be required to facilitate future rolling stock acquisition and service development.

2.5.2 It is important, in such instances, to define and subject to appraisal the higher level investment, before considering its constituent elements. The higher level investment could in this instance comprise the development of services across a

part of the rail network and include the necessary depot investments. This approach would not preclude a further appraisal of the design and scale of such a depot.

2.6 Defining Fair Options

There is a need to define options in such a way that decision-makers are faced with realistic decisions. For example, in appraising strategies to combat urban congestion, it is necessary to include some options that broadly achieve the same impact on congestion. This is to avoid the situation in which the decision-maker is faced with a simple choice between a low-level option that does not really address the problem and a grandiose or gold plated option.

2.7 Options Falling Outside an Agency's Remit

2.7.1 There are two circumstances in which consideration of options falling outside an Agency's remit might arise. In the first instance, a preliminary appraisal or planning process may already have occurred that has considered a large range of options, including modal options outside the Agency's remit. If, out of this process, a smaller range of options has emerged, and all of these lie within the remit of the Agency, then no further consideration of other options outside the remit of the Agency is required. This may occur, for example, where overall transportation planning has resulted in a programme of projects for each of the major modes. Appraisal of the projects within any modal programme (say, the National Roads Programme) may then occur without reference to other modal options. [1]

2.7.2 On the other hand, if the above process has not taken place, then where an Agency considers that options outside the remit of the Agency could achieve the purpose for which the investment is attended, then that Agency should refer to the Department of Transport for guidance as to how to proceed.

2.8 Summary

In summary the steps involved in defining projects for evaluation are:

- Define the Base Case by considering Do-Nothing and Do-Minimum options;
- If opting for a Do-Minimum Base Case, consider explicitly why a Do-Nothing Scenario is unrealistic;

[1] However, cross modal impacts may need to be addressed.

- Include in the Do-Minimum option only that capital spend that is already fully committed and operation and maintenance spends that are wholly necessary to retain the facility;

- Consider a range of Do-Something options, including management and incremental options; and

- Ensure that the Do-Something options are defined so that decision-makers are offered some options that achieve broadly similar levels of impact.

3. The Appraisal Framework

3.1 Introduction

A Common Appraisal Framework appropriate to transport investment projects is described in the remainder of this document. This Framework can be applied to the appraisal of projects and programmes of different degrees of complexity and scale. The overall approach adopted in the Framework is a multi-criteria analysis supplemented by a monetised cost benefit analysis where appropriate. This section first describes the Framework and then considers its application in the light of the DOF Guidelines. Following this, some guidance is given on the broad principles to be followed in implementing a cost-benefit analysis.

3.2 Types of Appraisal

3.2.1 The Common Appraisal Framework envisages that, for any project or programme, three types of appraisal could be potentially carried out. These are:

- An economic appraisal;
- An Exchequer flows appraisal; and
- A financial appraisal.

The discussion in this and subsequent sections is in terms of the appraisal of projects. Programme appraisal should follow the same approach. The same three types of appraisal should be undertaken, unless the level of detail of the programme prevents this. The same multi-criteria approach should also be adopted. At the same time, it is recognised that the emphasis on particular criteria and the complexity and level at which the appraisal takes place will depend on the extent to and precision with which the programme components are identified.

3.2.2 An economic appraisal assesses the project from the point of view of its impact on the economy as a whole. It is important to note that such an appraisal should not be confined to purely commercial or monetisable impacts of the project, but rather should look at its broader economic, social and environmental impacts.

3.2.3 The Exchequer flows appraisal is concerned with the financial impact of the project on the Exchequer. It is thus concerned with the implications of the project for capital and maintenance spending, public transport subsidies and taxation.

3.2.4 Finally, a financial appraisal is concerned with the financial impact of the project on the finances of the sponsoring agency.

3.2.5 In principle, projects should be subject to all three types of appraisal. In practice, however, a financial appraisal may sometimes be omitted if financial impacts on the sponsoring agency are small.

3.3 Multi-Criteria Analysis

3.3.1 With regard to economic appraisal, an objectives-led approach is required. This embraces the policy goals and objectives set by the political and administrative processes.

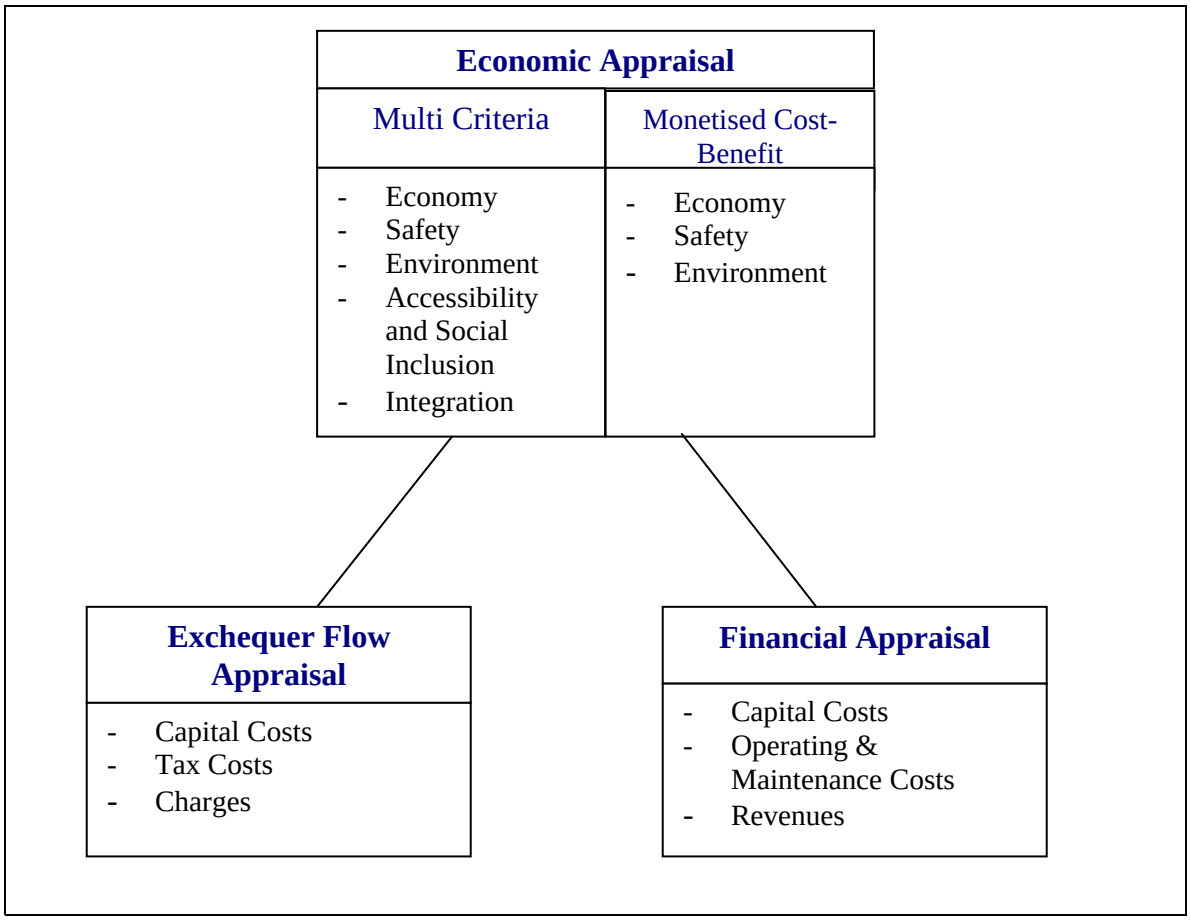
Accordingly, the economic impacts of a project should be appraised using the following criteria.

- Economy;
- Safety;
- Environment;
- Accessibility and Social Inclusion; and
- Integration.

3.3.2 The impacts of a transport investment on economic growth and competitiveness are assessed under the economic impact and economic efficiency criteria. Safety is concerned with the impact of the investment on the number of transport related accidents. Environment embraces a range of impacts, such as emissions to air, noise, and ecological and architectural impacts. Accessibility and social inclusion embraces the notion that some priority should be given to benefits that accrue to those suffering from social deprivation, geographic isolation and mobility and sensory deprivation. Finally, integration considers the extent to which the project being evaluated promotes integration of transport networks and is compatible with a range of Government policies, including the National Spatial Strategy.

3.3.3 Agencies are encouraged to monetise benefits to maximise extent possible, where robust money value parameters are available. However, not all of the impacts under the criteria set out above will be amenable to monetisation. As a result, the framework suggests that a multi-criteria analysis approach to appraisal of these impacts be adopted. This should, in certain circumstances, be complemented with a cost-benefit analysis, which embraces certain economy, safety and environmental impacts. The overall approach is depicted in Figure 3.1 and discussed further below.

Figure 3.1: Overview of the Common Appraisal Framework



Where there is a reliance on the multi-criteria approach only (with no cost-benefit), then every effort should be made to provide a quantification of the impacts arising under each of the criteria.

3.4. The Project Appraisal Balance Sheet (PABS)

3.4.1 Project appraisal involves an assessment of the project and a reporting of its impacts in qualitative, quantitative, and, where appropriate, money values. The extent of that reporting will depend on the scale of the project and the complexity of the appraisal process. A "Project Appraisal Balance Sheet" should be drawn up that summarises the principal results of the appraisal. This will contain three elements:

- A Qualitative Statement summarising the impact of the project in qualitative terms;

- A Quantitative Statement that sets out quantified and monetised indicators of the impact; and

A Scaling Statement that ranks the project on a seven point scale in terms of each criterion.

Where relevant, the qualitative assessment should be undertaken from the perspective of the whole period over which the project is being evaluated (see Section 9.3**).**

3.4.3 Multi-criteria analysis sometimes encompasses a ranking or weighting of these criteria. A standard weighting or ranking is not proposed. Neither is a mandatory project specific weighting or ranking proposed. However, it is, of course, open to project evaluators to suggest and to policy-makers to adopt weightings or rankings with regard to projects in particular transport sectors. The weightings being adopted should be fully documented to ensure the transparency of the assessment process. They should also be consistently applied across similar projects.

4. Economy

This section outlines the various economic impacts that may be considered.

Three dimensions of economic impact should be assessed:

- Transport efficiency and effectiveness;
- Transport reliability and quality; and
- Other economic impacts.

4.1 Transport Efficiency and Effectiveness

4.1.1 Transport investment contributes to economic growth through the improvement of the efficiency and effectiveness of transport systems. These effects have traditionally been captured in a cost-benefit analysis, which measures the welfare gain from investment in transport.

4.1.2 The aim of the economic appraisal within the framework is to determine the welfare gain from the investment in terms of economic efficiency and effectiveness. Economic efficiency and effectiveness is measured by the willingness-to-pay of the consumer, the financial impact on transport operators and the effects on government finance.

4.1.3 The best measure of willingness-to-pay is change in consumer's surplus for transport users and change in producer's surplus for transport operators.

- Consumer's Surplus is the difference between what consumers (driver/passengers etc) are willing to pay for transport services and what they actually pay;
- Producer's Surplus is the difference between the cost to transport operators of the service they provide and the price they actually receive.

4.1.4 The quality of benefit estimation depends on the quality of the demand modelling undertaken, on two levels. Firstly, total benefits are a function of the demand arising and, secondly, estimation of benefits per trip is more reliable if it is consistent with demand modelling outputs. Accordingly:

- The complexity of the demand modelling should be commensurate with the scale of the investment being considered and the planning stage at which the project is being appraised;

- In particular, demand modelling for large scale investments that are likely to have area wide effects should be based on network demand modelling; this is most likely to be required for urban investments;
- Demand modelling outputs in terms of transport volumes and user costs should normally be the basis for benefit estimation, so as to ensure consistency between demand and benefit estimation; and
- Demand projections should distinguish between the growth anticipated in the Do-Minimum Scenario and that arising in the Do-Something scenario as a result of the proposed investment.

4.1.5 The elements to be included will at least be a subset of the following longer list of efficiency impacts from a scheme:

- Net transport user benefits
  - Journey time (in-vehicle time, walk and wait time etc.)
  - Charges (fares/tolls/parking etc.)
  - Vehicle operating costs
  - Quality
  - Reliability
- Net transport operator benefits
  - Investment costs
  - Operating and maintenance costs
  - Revenue
  - Grant/subsidy payments

4.1.6 The calculation of the consumer's and producer's surplus forms the major element of the monetised cost-benefit analysis.

4.1.7 Transport user benefits arising from investment in a particular mode will potentially accrue to existing users of a mode, those diverted from other modes, those who change routes, those who change their trip origins and destinations and trips generated by the investment.

4.1.8 Investment costs obviously include infrastructure and vehicle/rolling stock acquisition costs incurred by transport operators over and above those occurring in the do-minimum scenario. An opportunity cost approach should be adopted to measuring these costs.

Where inputs are measured at the prices set in the market place, these prices normally represent opportunity costs. However, where inputs are provided free or

at reduced financial cost, then the investment costs should include the full market value of these inputs.

4.1.9 Increases in transport operator revenues represent benefits to transport providers that may be set against increased transport operating costs. In practice, some (but not all) of the additional revenues accruing will merely represent transfers from transport users to transport providers. However, as transport user benefits are defined above to include consideration of user charges, the impact on transport operator revenues should also be included.

4.1.10 Where an investment leads to a diversion of patronage from another public transport mode, the impact on that mode's profitability (or required subsidy) should be assessed. This assessment should take account of possible re-organisation of the affected mode's operations that would minimise the financial losses or maximise the financial gain arising. These financial gains and losses should then be included in the producer's surplus calculation.

4.1.11 Where developer contributions are raised to finance a transport project, they represent a decrease in welfare for developers and ultimately property owners. However, this decrease in welfare is matched by the income to government that arises, which may be used to offset project costs. Development contributions are thus transfer payments that are ultimately netted out of a cost-benefit analysis. However, they are clearly relevant for the presentation of Exchequer and Financial Flows Analyses.

4.1.12 For large scale investments in urban areas, an assessment of the disbenefits arising in the construction phase should be carried out. This should, at a minimum, take the form of measurement of the increase in transport user costs in the construction phase and an enumeration and of the businesses (including their tenure status) that are affected by reduced access and egress.

4.2 Transport Reliability and Quality

4.2.1 Certain modes may have a higher utility than others and these quality benefits may be valued by consumers. Greater reliability of transport services also provides utility. At present, there is no well proven standardised set of monetary values to be applied to these reliability and quality benefits in all cases.

4.2.2 Where project appraisers consider that these benefits arise and are significant, they may adopt one or more of the following approaches:

- Undertake project-specific research (through, for example, stated preference studies) to estimate the monetary value of these benefits;

- Use monetary values derived abroad in respect of similar transport services, taking account of the issues involved in the transfer of such benefit values; or

- Assess the benefits in a quantitative or qualitative manner.

4.2.3 With regard to reliability, the current state of research limits the guidance that can be given with regard to quantitative and qualitative assessment. However, it is clear that the dimensions of reliability differ as between road vehicles and fixed-track public transport (rail and LRT systems).

4.2.4 For road vehicles, the issue is the variability in travel time. This can be due to both variability due to unexpected traffic incidents and unpredictable variability in travel time around the average expected journey time. With regard to the former, an assessment may take the form of predicting the occurrence of incidents and capacity of the road system to maintain levels of service when incidents occur. With regard to the latter, some insights may be obtained by comparing the variability in road system performance arising from traffic conditions in the Do-Nothing and Do-Something scenarios.

4.2.5 For fixed-track public transport, the reliability is concerned with both departure time and arrival times. Once again, it is useful to consider incident related and operational reliability separately. Incidence-related reliability may consider issues such as the possibility of power failures and incidents caused by interactions with other transport users (at level crossings, for example), and the capacity of the system to maintain or resume normal service levels. Operational reliability should consider lateness in terms of the difference between passengers' actual and timetabled departure and arrival times due to operating conditions (such as increase in station dwell times at periods of high demand). With regard to operational reliability, it should be noted some anticipated delays may be reflected in timetabling and are therefore reckoned in the time savings calculated under the transport efficiency and effectiveness criterion, and therefore need not be considered further.

4.2.6 Where these benefits are not monetised, a useful approach to the appraisal of them (particularly, with respect to public transport) would be to consider how frequently problems of reliability would arise and what monetary value would have to be placed on reliability to have an impact on the NPV and thus on the choices to be made.

4.2.7 With regard to quality of travel, it may be useful to consider three aspects:

- Traveller care;
- Travellers' views; and
- Traveller stress.

For road users, including bus users, the quality of a trip is influenced by the facilities and information provided along the route. For public transport users, the quality of the vehicles and rolling stock are also relevant. For the latter, the availability and quality of seating is very important, as well as other facilities, information provision and the general environment.

The views that travellers have of the surrounding landscape also affects journey quality. Roads or rail systems in tunnel of cuttings have a negative impact in this regard.

Traveller stress refers to the discomfort and annoyance created by use of the transport system, and in particular, by crowding in public transport systems. Crowding is obviously determined by load factors and its effects will be felt by both standing and seated passengers.

Again, where these benefits are not monetised, a useful approach to the appraisal of them (particularly, with respect to public transport) would be to consider how frequently quality benefits would arise and what monetary value would have to be placed on them to have an impact on the NPV and thus on the choices to be made. For example, if investment in public transport capacity reduces overcrowding, then this could positively impact on seat availability. Analysis could therefore focus on the reduced incidence and duration of standing.

4. 3 Other Economic Impacts

4.3.1 In a perfectly competitive economy with prices reflecting full marginal social costs, the efficiency and effectiveness benefits described above would encompass the full economic impact of the transport investment. As markets are far from perfect, it is certain that other economic impacts occur. Examples of market imperfections are transport investments that give rise to spillover effects that are not charged for, or that facilitate economic market restructuring that yield greater competition or economies of scale. Another means by which the transport efficiency and effectiveness measure falls short is when the method of computing these benefits (rather than their scope) does not encompass the full effects. There are a number of specific impacts that need consideration in this regard:

- Re-organisation impacts
- Agglomeration effects;
- Increased competition in the economy;
- Increased output of firms;
- Tax benefits arising from increased labour supply;
- Employment impacts; and

- Inward investment impacts.

4.3.2 **Re-organisation impacts**: where as a result of time-savings, firms can reorganise their transport and logistic operations. This effect is not amenable to quantification or monetisation at present, but could be considered in a qualitative fashion as appropriate.

4.3.3 **Agglomeration effects**: these arise because firms may derive productivity benefits from being close to each other. If the transport investment influences the decision of firms to locate in a cluster, then agglomeration benefits could arise that are not included in transport user benefits. Greater productivity in agglomerations arises from the fact that, in such locations, firms have access to larger product, input and labour markets. Knowledge and technology spillovers are also important.

There are two aspects to agglomeration effects that need to be considered:

- The impact on existing firms and workers: firms are brought closer together and workers closer to jobs; and
- The impact on relocation of firms and workers into clusters.

Agglomeration effects are related to the proximity of firms, workers and markets. A proxy for this for any one location is the density of jobs in the areas surrounding that location. However, the agglomeration effects are also influenced by the *proximity* of that location to other locations of high density. This has suggested a measure of effective density as the employment in surrounding areas weighted by their proximity to the location.

Transport investments increase the effective density by reducing journey times and costs. Intra-urban transport investments are particularly likely to yield positive agglomeration benefits as they increase the effective density of the urban area.

The scale of the agglomeration benefits will be determined by:

- The extent to which the transport investment offers reduced journey times and cost to *commuters and business users*;
- The extent to which the transport investment improves access to areas of high job density; and
- The extent to which the transport investment increases access to from areas where significant land use development is possible to areas of existing high job density.

4.3.4 **Increased competition**: increased competition enhances economic efficiency and transport costs are often a barrier to competition. Lower transport costs increase competition by extending the geographical reach of a firm and also increasing the level of competition that it faces. This economic impact is most likely to occur where new transport links are being created or significantly improved by providing a step change in accessibility

4.3.5 **Increased output of firms**: where there is imperfect competition in the market, output is restricted and prices are higher than marginal costs. As these benefits fall to consumers and not producers, time savings accruing to firms do not capture the full benefit. This benefit is a function of total time savings to businesses viz. freight time savings plus in-work passenger benefits.

4.3.6 **Tax Benefits of Improved Labour Supply:** Reduced commuting times could result in a better matching between the skills of the workforce and jobs taken up. This is because at the margin, workers may be prepared to commute longer distances to obtain higher skilled better paid employment. The result is a more efficient labour market. A transport improvement could also have a positive impact in terms of the number of people entering the labour market and the hours people are willing to work.

If these improvements in the labour supply lead to increased output, then there are also tax revenues arising from the higher levels of employment, earnings and profitability. The research evidence shows that the two major impacts arise from an increase in the labour force and increased working in more productive jobs. However, at full employment, the latter impact arises only when low paid jobs are extinguished and high paid jobs created. For this to happen, the transport improvement would have to be significant and the differential in wage rates across the urban area would have to be large. Even where these conditions are met, there are other barriers, to the flow of people between jobs, so that only a small minority of the labour force in the transport “catchment” might alter their labour market behaviour.

Where there is substantial unemployment, a transport improvement could be valuable if it widens the catchment area within which unemployed persons will seek jobs. Again, this may lead to a greater matching of the labour supply with the available jobs, with consequent lower labour costs and or higher employment rates

Al of the benefits of improved labour supply, as described above, are critically dependent on the degree to which the transport improvement offers commuters reduced costs.

4.3.7 **Employment impacts**: where there is a divergence between wages and the marginal resource cost of labour and transport investments give rise to employment creation. The scale of this impact depends on the rate of unemployment. Where unemployment rates are high, employment creation benefits could be large. Even where national unemployment rates are low, there may be regional development impacts to which employment creation benefits are relevant.

4.3.8 **Inward investment impacts**: where the transport investment is a significant factor in motivating foreign industrialists to invest in Ireland. This is potentially an additional benefit. However, it is more likely to arise in the context of large transport investments. It is also more likely to be a factor in promoting regional balance and is considered under the Integration criterion outline below

4.3.9 Other economic impacts may not always occur and may be significant only in special circumstances. Benefits arising under this heading need to be supported by clear economic arguments. It is anticipated that only qualitative assessments of such benefits will be generally forthcoming.

5. Safety

5.1 Projects in the transport sector often have a significant impact in terms of improving the safety record of transport infrastructure. Transport policy has a specific focus on the reduction of accidents, and project design in roads and public transport emphasises accident reduction. Higher capacity roads, and especially motorways, tend to be safer as a result of the segregation of traffic flows and a reduction in the number of road accesses. Where, as a result of a public transport investment, car users switch to the public transport mode, there will tend to be an accident benefit. This is particularly the case for the rail mode. These impacts therefore need to be captured by the appraisal framework.

5.2 The measurement of accident costs distinguishes between costs that relate to the casualties of accidents and costs that relate to the accident itself.

The casualty related costs are:

- Lost output;
- Human costs (suffering and pain); and
- Medical costs.

The accident related costs are:

- Damage to property;
- Insurance administration; and
- Police costs.

5.3 The parameter values to be used in valuing accidents are set out in Appendix 1. Although the cost of a casualty set out in the guidance on parameter values is the same regardless of mode, the cost of an accident will vary between modes due to the number of casualties involved and the severity of the injury to the casualty. Thus, accident values for, say, rail and air modes will be higher by virtue of the multiple casualties involved.

6. Environment

6.1 Environmental Impacts

The environmental impacts that should be included under this criterion are

- Air quality;
- Noise and vibration;
- Landscape and visual quality;
- Biodiversity;
- Cultural, archaeological and architectural heritage;
- Land use, soils and geology; and
- Water resources.

6.2 Monetised Impacts

It is recommended that certain air quality and noise impacts be monetised.

6.2.1 Air Quality

Transport investments have a significant contribution to make to meeting Ireland's Kyoto commitment to limit the growth of greenhouse gas emissions. Any transport appraisal should therefore take account of contributions to greenhouse gas reductions, and in particular to emissions of CO_2, the most important greenhouse gas. Methane CH_4 also has substantial greenhouse impacts.

6.2.2 With regard to local air quality, NOx, together with CO, NMVOC, SO_2, lead and PM10, which are emitted from transport, can cause local air quality problems, and associated health impacts, particularly when they occur at high concentrations. High levels of such pollutants also have potential to lead to secondary effects on water quality (e.g. through acid rain), nature conservation resources and the built heritage.

6.2.3 Road modes are the primary source of these emissions and the recommended approach to evaluating these emissions is as follows:

- Estimate the vehicle kilometres arising for motorways and urban and rural non-motorway networks separately;

- Apply a rate of emissions per vehicle mile appropriate to motorways and urban and rural non motorway settings;

- Derive total emissions arising for motorway and rural and urban non-motorway settings; and

- Apply a value to the emissions thus calculated.

6.2.4 Appendix 2 of this report provides default data to support such a calculation, distinguishing between CO_2 and Non-CO_2 emissions. While information relating to the volume of all emissions is presented in the Appendix, value parameters are presented for a subset of emissions as follows: CO_2, NO_X, NMVOC, and SO_2, as these are the only emissions for which values are now available.

6.2.5 Again, as these emissions are related to vehicle kilometres of travel, road investments will rise to give a significant negative impact, only if generated traffic levels are substantial. In the case of motorways, diversion from other roads will lead to small positive emission impacts, as travel on motorway networks is less environmentally polluting.

6.2.6 Public transport investments are likely to yield positive emissions benefits to the extent to which private road users divert to public transport modes.

6.2.7 Where monetary values have been ascribed to emissions, the monetary value of emissions changes should be included both the Project Appraisal Balance sheet and in the cost-benefit analysis (see Sections 9.2 and 9.3)

6.3 Noise and Vibration

6.3.1 Transport can be a major source of noise, which in turn can affect quality of life and in extreme circumstances can result in health impacts. However, noise impacts are likely to be route specific for two reasons:

- Infrastructure design may include measures to reduce noise propagation; and

- The size of the population impacted by noise depends on the settlement pattern close to the infrastructure.

6.3.2 Accordingly, it is not proposed to estimate noise impacts at the preliminary appraisal stage of projects (as defined in Section 2.2), or in respect of the appraisal of programmes. However, once detailed design including route choice analysis has been conducted it is possible to assess noise impacts.

6.3.3 Much research is needed to arrive at definitive values for noise impacts. However, based on two recent surveys, a value of €28 per DB(A) per person per year is

proposed (2002 prices). [2] It is recommended that this value be applied to both road and rail noise impacts. Noise impacts below a certain level may not be significant and may not therefore carry an economic value. While there is some controversy over this threshold, it is recommended that $L_{den}50$ be used as the threshold for the moment. This means that only incremental noise impacts above this value should be assessed.

6.3.4 The National Roads Authority has issued guidelines for the treatment of noise and vibration effects of road schemes. These guidelines present a methodology for estimating noise impacts and set a design goal of $L_{den}60$. [3]

6.4 Landscape and Visual Quality

Transport infrastructure has potential to impact on both the intrinsic character of the landscape or townscape and the quality of views experienced by people in their homes, workplaces, recreational and outdoor areas. Such effects can occur through the introduction, removal or alteration of infrastructure or natural landscape features, such as landforms, trees, and hedges as well as from changes in numbers of traffic movements. The presence of lighting in previously dark areas can also contribute to the level of impact.

6.5 Biodiversity

Effects on biodiversity are generally considered in terms of impacts on specific flora or fauna, or on defined habitats. The construction, presence and operation of transport infrastructure can impact on nature conservation resources through direct loss or damage to habitat or specific species, creation of barriers to population movement or indirect effects resulting from, for example, changes in water quality of levels, air quality or noise and light levels.

6.6 Cultural Heritage

Effects on cultural heritage can be considered in terms of impacts on below ground archaeological remains, historic buildings (individual and areas), and historic landscapes and parks. The construction, presence and operation of transport infrastructure can impact directly on such cultural heritage resources through physical impacts resulting from direct loss or damage, or indirectly through changes in setting, noise and vibration levels, air quality, and water levels.

---

[2] See: ECMT. Efficient Transport for Europe: Policies for internalisation of External Costs, 1998. Stole Navrud. The State of the Art on Economic Valuation of Noise. Report to DG Environment, 2002.

[3] National Roads Authority. Guidelines for the Treatment of Noise and Vibration in National Road Schemes. 2004.

6.7 Land Use

In addition to the indirect effects on land use (air, noise, visual etc) identified above, the construction and presence of transport infrastructure can result in temporary or permanent effects on land use through land- take, severance or reduction of viability, which prevents or reduces its value for intended use. Such uses include residential, commercial, recreational, open space, agriculture, minerals and public facilities (hospitals, schools, and places of worship).

Soils in areas close to transport routes and particularly road may be affected by pollution from run-off. Similarly, soils may be used or degraded during construction. These impacts should also be considered under this heading.

6.8 Water Resources

6.8.1 Water resources comprise surface waters, ground waters and coastal waters. The construction, presence and operation of transport infrastructure can impact directly on flows, levels and quality of such waters and through this can result on effects on people, biodiversity, agriculture, and soils. For example, pollution or increased sediment loads can increase pollution of littoral environments or of aquifers used for drinking water supply, while new structures could affect the capacity of flood plains.

6.8.2 The most common pollutants arising from road runoffs are Polycyclic Aromatic Hydrocarbons (PAHs), metals, and chloride. Metal emission rates are primarily dependant on traffic volumes, PAH emission rates on traffic volumes and road type and chlorides on the severity of the winter, due to the application of de-icing salts during winter conditions.

6.8.3 Because these pollutants are traffic dependant, they will not generally increase where a new road is being built, because traffic volumes will largely transfer from existing roads. Additionally, new roads may incorporate pollution control systems such drainage, filtration and sedimentation systems that mitigate the impact of the environment. The implications are that new roads that do not result in significant generated traffic are likely to yield positive benefits in terms of reductions in water pollution associated with run-offs. In determining the scale and direction of these effects, the analyst should consider:

- The extent of diverted and generated traffic that will be associated with the new road;
- The mitigation measures in place on existing competing roads;
- The mitigation measures to be put in place in respect of the new road; and

- The sensitivity of the local environment to pollution through run-offs.

6.8.4 Where public transport or other investments cause a transfer from road to public transport modes, there will be positive benefits for water quality. The scale of such benefit will be related to:

- The degree of road traffic diversion to public transport;
- The mitigation measures in place on existing competing roads; and
- The sensitivity of the local environment to pollution through run-offs.

6.8.5 The analyst is referred to the following source for guidance on the scale and nature of these impacts: Pollution from Roads and Vehicles and Dispersal to the Local Environment. Final Report and Handbook. POLMIT Project, European Union, 2002.

6.9 Environmental Impacts and Project Appraisal Stage

It is recognised that some environmental impacts are route specific and may not be assessable at the Preliminary Appraisal stage. It is also recognised that some choices between investment options would be better exposed by highlighting sub-criteria that fall within the overall criteria set out above. Flexibility in implementing the CAF in respect of environmental criteria is permitted in this regard.

7. Accessibility and Social Inclusion

7.1 Government policy in respect of the socially excluded is articulated through the National Anti Poverty Strategy (NAPS). The Strategy has the objective of reducing and, ideally, eliminating poverty and social exclusion particularly as it affects vulnerable groups such as vulnerable women, children and young people, older people, people with disabilities and ethnic minorities. NAPS emphasises the benefits of addressing these issues on an area basis, as both urban and rural communities in certain areas may suffer from multi-faceted social exclusion.

7.2 Government has put two programmes in place to address deprivation on an area basis. The CLÁR programme is a targeted investment programme in rural areas. The investments support physical, community and social infrastructure across a variety of measures. The measures introduced under the programme reflect the priorities identified by the communities in the selected areas.

7.3 RAPID is its urban equivalent and has two strands. Strand I targets the twenty five most disadvantaged urban centres for priority funding under the National Development Plan. Strand II is targeting 20 provincial towns in a similar fashion.[4]

7.4 Transport investment, by its nature, has a particularly strong role to play in respect of people living in rural areas with poor access and people who suffer from mobility and sensory deprivation.

7.5 Because of data and resource issues, a comprehensive analysis of the impact of a transport project on the NAPS objectives will not generally be feasible. In practice, therefore, there are a number of steps that the analyst should take. These centre on the impacts on:

- Vulnerable groups; and
- Deprived geographic areas.

7.6 Vulnerable Groups

The appraisal framework requires the following steps to be undertaken by the project appraisal analyst:

- Consider the distribution of impacts by income group, and the vulnerable groups identified above, such as people with disabilities; [5]

[4] Further information on these programmes is available from the web site of the Department of Community, Rural and Gaeltacht Affairs (http://www.pobail.ie/en/RAPIDandCLR/)

- Consider whether the project improves access to jobs, key facilities (such as town centres and schools) and social and recreational opportunities for such groups;

- If suitable data from the core cost-benefit analysis are available, analyse the distribution of user benefits by income group and other characteristics;

- As lower income groups have low levels of car ownership, consider the impact on car owners and non car owners; and

- Consider, in particular, the impacts on people with mobility and sensory impairment.

7. 7 Deprived Geographic Areas

- Establish whether the project improves accessibility for people in socially deprived areas, particularly Clar and Rapid areas.

Again, assessment of these impacts should be undertaken through Qualitative, Quantitative and Scaling statements as set out in paragraph 3.5.

[5] With regard to public transport, analysts should have regard to the targets and policies contained in the Department of Transport's Outline Sectoral Plan for Accessible Public Transport (www.transport.ie/upload/general/5589-0.pdf)

8. Integration

A number of aspects of integration need to be considered:

8.1 An Integrated Transport Policy

The planning for each transport infrastructure and mode needs to take account of other elements of transport infrastructure and services. Thus, for example, the development of roads and railways needs to take account of the requirements of seaports and airports.

8.2 Integration of Transport Policies with Other Government Policies

Transport policies should complement and reinforce other Government policies. In particular they should take account of Government policies on land use, balanced regional development, social inclusion and sustainable development.

8.3 Modal Integration

This is concerned with integration across and within transport modes with the objective of creating a seamless transport policy.

8.4 Geographical Integration

This refers to integration of transport networks across geographical and juridical boundaries.

8.5 Integration Criterion

The Integration Criterion has been subdivided into a number of elements to aid the analysis process. The elements reflect the Department's integration goals and concerns. However, integration with social inclusion and environmental sustainability polices is considered in two separate criteria viz. the Environment Criterion and the Accessibility and Social Inclusion Criterion.

The proposed elements of the Integration Criterion are as follows:

- Land Use Integration
- Transport Integration
- Geographical Integration

- Other Government Policy Integration.

8.6 Land Use Integration

8.6.1 The integration of transport and land use is the single most important element of the Integration criterion. This is because the distribution of land uses plays an important part in determining travel demands and the viability of public transport and non-vehicular modes. These modes, which are an alternative to the use of the private car, have an important contribution to make to reducing transport energy use and environmental and greenhouse gas emissions.

Land use integration needs to be considered at two levels:

- Integration with land use policies and objectives; and

- Integration with regional and local land use plans.

8.6.2 The reason why these aspects require separate consideration is that while regional and local policies may promote integration of transport and land use at the local level, they may run counter to national goals by, for example, promoting long distance commuting.

8.6.3 National land use policies promote the vitality of urban centres, seek to focus development on public transport nodes and corridors and advise against land use development that promotes long distance commuting especially by car. Projects should be assessed as to whether they support such national land use and transport objectives. Some land use factors that should be taken into account include the extent to which the proposed project:

- provides opportunities for high density development, particularly at public transport nodes;
- Promotes the development of mixed land use neighbourhoods;
- Supports infill development;
- Supports the location of housing within existing urban areas rather than in greenfield locations;
- Provides opportunities for use of non-vehicular modes, such as walking and cycling.

8.6.4 Separate consideration should then be given to compatibility with statutory planning documents, such as the Regional Planning Guidelines and the local authority development plans.

8.7 Transport Integration

8.7.1 This addresses the promotion of the integration of transport infrastructure and services through the development of missing transport links, and improving opportunities for interchange and through ticketing.

8.7.2 This element may constitute double counting where all of these benefits may be captured in the core cost-benefit analysis, which may consider, for example, the time and money cost savings arising from better integration of modes and the resultant lower transfer penalties.

8.7.3 However, a core cost-benefit analysis may not be undertaken in all cases and this element is needed to ensure that these benefits are captured in such circumstances. Moreover, the sophistication of the demand modelling exercise that underpins the core cost-benefit may vary, so that network integration effects may not be fully captured.

8.7.4 Accordingly, this element should be assessed in all evaluations. However, the analyst should also note whether any aspect of transport integration has already been captured in the core cost-benefit analysis, and provide quantification of those effects.

8.7.5 Consideration of transport integration effects is likely to centre on both the improved services made possible and the infrastructure provided.

8.7.6 Transport **service** integration may lead to the following benefits and indicators:

- Reduced in-vehicle journey times (for both passenger and freight);
- Reduced walking and waiting times associated with interchanges;
- Greater reliability and frequency in interchange; and
- Simpler fare systems and reduced fare costs and ticket purchasing time associated with through ticketing (including fares integration).

Some of these effects may be captured in the core cost benefit analysis.

8.7.7 This Analysis should also assess the potential disbenefits to other transport users such as increased journey time due to rerouting or rescheduling of services caused by the establishment or operation of the proposed project.

8.7.8 Transport **infrastructure** integration may include the following benefits and indicators:

- Improved capacity of interchange infrastructure and reduced overcrowding;

- Improved quality of interchange infrastructure such as physical layout, services provided, amenities and environment;
- Improved integration with non-mechanised modes, such as walk and cycle;
- Improved traveller information.

These are unlikely to be captured in the core cost-benefit.

8.7.9 Potential disbenefits to other transport infrastructure projects should also be identified, such as disruption of services during a lengthy construction phase, delay in construction of a project which is in proximity or is linked in some way to the project under construction and attraction of passengers from another mode e.g. rail to road for outer urban commuters.

8.8 Geographical Integration

8.8.1 The Department of Transport Statement of Strategy highlights two aspects of geographical integration:

- Improved internal transport links with Northern Ireland; and

- Access transport links with Europe and the rest of the world.

8.8.2 The National Development Plan recognised the benefits that could accrue to the whole of the island through closer economic co-operation with Northern Ireland. Efficient and competitive integrated public and private transport services were identified as critical to the development of trade. Inward investment and tourism and the provision of equality of access to employment opportunities through improved labour market mobility are also important considerations.

8.8.3 Cross border infrastructure and service improvements and internal improvements on key north-south corridors will contribute to geographical integration with Northern Ireland.

8.8.4 Trans European Networks of Transport (TENs-T) is the building block of the European transport network, with traffic on the network accounting for half of all goods and passengers transported in the Union. it provides the underlying framework for the "quick-start" list of priority projects which are to give new impetus to the European Economy.

8.8.5 The TENs programme includes 30 priority projects across the Union. For Ireland, priority projects include - the Cork-Dublin-Belfast Rail line, and - the Cork-Dublin-Belfast Road. There is also a new concept, 'Motorways of the Sea', which is of particular interest to Ireland as an island nation.

8.8.6 Transport projects within the Tens-T programme should rank highly in terms of the Integration Criterion.

8.9 Other Government Policy Integration

8.9.1 Introduction

There is a need for transport projects to be compatible with Government policies generally. There is a requirement therefore to consider the wide range of Government policies to determine whether in principle the project in hand could impact to significant degree on one or more of them. Any significant effects should be highlighted.

8.9.2 Regional Balance

However, the major Government policy to which transport investments could potentially contribute is the National Spatial Strategy.

8.9.3 The National Spatial Strategy (NSS) is a twenty-year planning framework designed to achieve a better balance of social, economic, physical development and population growth between the regions.

8.9.4 Gateways are large towns or combinations of large towns that have the critical mass in terms of social and economic infrastructure to drive the development of regions. Gateway development is emerging as a key focus for policies aimed at promoting regional balance.

8.9.5 The focus of the NSS is on balanced regional development. Inherent in this concept is the notion that some regions are lagging behind and that measures are required to "support a better balance of activity and development between areas experiencing rapid development and congestion and areas that are economically under utilised". This suggests that, within the appraisal framework, the Integration criterion should assess the extent to which the transport investment project that is being appraised promotes regional balance.

8.9.6 Infrastructure and Regional Balance

Based on a review of economic theory and the spatial distribution of economic activity in Ireland, the following types of transport projects are regarded as positive to regional balance:

- In Gateways or giving local access to Gateways in the peripheral regions;

- Between Gateways in the peripheral regions;

- On routes accessing international ports and airports; and

- On radial routes to the East region, where such routes improve access to international ports and airports.

8.9.7 In contrast, the following transport projects are regarded as at best neutral to regional balance:

- Those that link the peripheral and East regions without enhancing access to international gateways; and

- Transport improvements within the East region that are aimed primarily at improving mobility within that region could be regarded as less beneficial to regional balance than the other types of infrastructure identified above.

8.9.8 Enhancing Regional Income

As well as increasing accessibility, transport infrastructure has the potential to promote regional balance through enhancing regional income. The most obvious example of this is in terms of infrastructure such as ports and airports, where their expansion may lead to ongoing employment and income through direct employment and increased tourism in the region. While these impacts are not important from a national viewpoint, they are important in regions where average earnings are particularly low. This impact may thus arise in a minority of infrastructure investments.

8.9.10 This benefit category should be considered only for projects in regions with relatively low average earnings. Quantification of this benefit involves estimating the direct, indirect and induced incomes and employment demand arising from the project. Regional and national input-output models are the most appropriate means of measuring this impact.

8.9.11 Again, assessment of Integration impacts should be undertaken through Qualitative, Quantitative and Scaling statements as set out in paragraph 3.4.

9. The Project Appraisal Overview

9.1 Business Case Approach

9.1.1 This section brings together the various elements of the appraisal process. It is envisaged that project appraisal will be embedded in a document that adopts a "Business Case" approach. This means the multi-criteria and cost benefit appraisal will constitute one element of the overall evaluation process.

9.1.2 The Business Case is a single document that describes the proposed project, establishes the rationale for it, and informs a decision to proceed with it. In its final form, it encompasses not only the appraisal of the project but also the assessment of risks and an outline of proposed method of project implementation.

9.1.3 The Business Case will form the basis on which the Agency makes a decision to continue with the project planning and, ultimately, sanctions or seeks sanction from the Department of Transport for the implementation of the project.

9.1.4 The Business Case should be prepared and updated at preliminary appraisal, detailed appraisal and post tender validation stages of project planning (See Figure 1.1). The Final Business Case will also be an important source of information for the post-project review.

9.1.5 The Business Case should be presented to the project sanctioning body in advance of critical decision-making points identified above. This will enable the Department or other sanctioning body to review the Business Case in its entirety, and seek any necessary amendments, before making its decision.

9.1.6 As the Business Case proceeds through the various project planning stages it should aggregate and summarise information on the project so that the Final Business Case contains a complete and succinct rationale for the project.

9.1.7 The Business Case should include the following elements:

- Brief description of project
- Identification of need for the project;
- Key underlying assumptions and analysis of need;
- Objective setting;
- Demand analysis
- Design of options;
- Appraisal of options;
- Budgeting and costing;
- Risk assessment of preferred option;
- Procurement of the project, and

- Proposals for implementing the project.

9.2 Implementing the Project Appraisal Balance Sheet

9.2.1 The PABS will contain three elements:

- A Qualitative Statement summarising the impact of the project in qualitative terms;
- A Quantitative Statement that sets out quantified and monetised indicators of the impact; and
- A Scaling Statement that ranks the project on a seven point scale in terms of each criterion.

Table 9.1 presents an outline of the components of the Project Appraisal Balance Sheet (PABS).

9.2.2 The Qualitative Statement should be backed up with research that allows for a justification of the summary comments made to be justified. This may be in the form of environmental assessments where undertaken, benchmarking against previous experiences where appropriate, or review of policy documentation as required.

9.2.3 While the quantitative indicators used will often be specific to the type of project being appraised, the PABS, as set out, includes some indicators of a general nature.

9.2.4 With regard to the Scaling Statement, this should be based on impacts **relative** to the scale of the project. Where impacts are monetised a Scaling Statement is not required.

9.2.5 For some projects, some of the impact criteria may not be relevant. For example, rolling stock investments may have no impact on cultural heritage. In such circumstances, a “not applicable” rating may be entered in the PABS.

9.2.6 Additionally, some impacts, such as environmental impacts, may not be assessable at the Preliminary Appraisal stage. In these circumstances, a “not assessable” rating may be entered.

Table 9.1: The Project Appraisal Balance Sheet

Criteria	Qualitative Statement	Quantitative Statement
Economy		
Transport Efficiency and Effectiveness	Summary of impacts including non-monetised effects	NPV arising from these benefits
Transport Reliability and Quality	Summary of transport reliability and quality impacts not captured in transport efficiency and effectiveness	Supporting monetary valuations and or quantitative data
Other Economic Impacts	Summary of economic impacts not included in Consumer's and Producer's Surplus	Supporting quantitative data
Safety		
	Summary of nature of accident reduction impacts including impacts on particular groups of road users	NPV arising from these benefits Quantification of accident reductions in terms of fatalities and personal injuries
Environment		
Air quality	Summary of greenhouse gas and local air quality effects	NPV of value of emissions avoided Population affected by change in PM10 and NO_2 levels
Noise and vibration	Summary of noise and vibration effects	NPV of value of emissions avoided. Estimated number of people likely to be affected by transport related noise with and without the scheme
Landscape and visual quality	Key landscape characteristics affected; Effects on key views; Impact on landscape character	

Criteria	Qualitative Statement	Quantitative Statement
Landscape and visual quality	Key landscape characteristics affected; Effects on key views; Impact on landscape character	
Biodiversity	Potential compliance/conflict with biodiversity objectives; Indirect impacts on protected species, designated sites; Overall effect on nature conservation resource	%/area of designated sites (by level of designation) directly impacted by scheme (landtake)
Cultural, archaeological and architectural heritage	Overall effect on cultural , archaeological and architectural heritage resource	%/number of designated sites/structures (by level of designation) directly impacted by scheme (landtake)
Land use, soils and geology	Overall impact on land take, property, soils and geology	%/area/number of existing or planned sites lost or severed through landtake including those used for, proposed or zoned for: housing, open space, agriculture, minerals, commercial use, public facilities. Area/volume of soils affected by pollution or use
Water resources	Overall potential significant effects on water resource attributes	

Criteria	Qualitative Statement	Quantitative Statement
Accessibility and Social Inclusion		
Vulnerable groups	Impacts on low income groups, non-car owners, people with disability; Increased access to jobs and facilities for such groups	Quantification of increased service levels to these groups; Quantification of infrastructure and rolling stock improvements aimed at these groups; distribution of consumers surplus
Deprived geographic areas	Impact of project on deprived areas, including Clar and Rapid areas.	Increased service levels to residents in these areas
Integration		
Transport Integration	Impact on scope for and ease of interchange between modes	New interchange nodes and facilities; Reduced walking and wait times associated with interchanges
	Impact on the operation of other transport services both during construction and in operation	Modal shift figures during construction and operations. Changes to journey times to transport nodes.
	Impact on the development of other transport infrastructure projects during construction.	Impact on project roll-out.
Land use integration	Assessment of compatibility with land use strategies and regional and local plans Assessment of support for land use factors identified in Section 8.7.3	Inclusion of project in relevant local and regional planning documents
Geographical integration	Impact on improvement of external links	
Other Government Policy Integration	Impact on regional balance and other Government policies	Improvements in local access to Gateways and international ports and airport; increased service levels in Gateways

9.3 The Cost-Benefit Analysis

9.3.1 For certain projects (see Section 2.3), the Project Appraisal Balance Sheet should be accompanied by a Cost-Benefit Analysis Summary Table. The Cost-Benefit should comprise the following elements:

- Net transport user benefits;
- Net transport operator benefits;
- Safety benefits;
- Air quality benefits; and
- Noise benefits.

9.3.2 The benefits and costs arising from each of these elements should be identified in the Table in discounted present value terms. The Table should be presented at an appropriate level of detail, but in any event should identify the capital, operating and maintenance costs of the projects as separate items.

9.3.3 With regard to implementing the Cost-Benefit Analysis, the preferred approach is for the analyst to express costs and benefits at market prices. This is in keeping with a willingness-to-pay approach. [6] However, analysis at factor costs is also permitted, as both methods give consistent results.

All costs and benefits should be valued at constant 2002 prices.

9.3.4 Parameter values, such as those for journey time, should be those promulgated by the Department of Transport, which are reproduced in an Appendix 1 to this manual.

9.3.5 The discount rate currently advised by the Department of Finance should be adopted. This is currently 4 per cent.

9.3.6 An evaluation period of 30 years should normally be used, where the life of the asset is 30 years or more.

[6] See: Goodbody Economic Consultants in Association with Atkins. Cost Benefit Parameters and Application Rules for Transport Project Appraisal. August 2004. (available at www.transport.ie/)

9.3.7 With regard to short-lived assets less than 30 years, the project should be evaluated over the life of the asset. Otherwise a 30 year evaluation period should be used.

Residual values may be included as appropriate. Two approaches to residual value calculation may be used:

- The first approach is to calculate a residual value based on the net present value of the costs and benefits of the asset over its remaining life. If the asset has a life extending to fifty years, then this approach is equivalent to appraising over a fifty year period;

- The second approach ascribes a residual capital value equal to the original capital cost of the infrastructure, where maintenance and renewal activities in the first 30 years are sufficient to ensure that the infrastructure will continue to provide an identical level of service over the long term in the post 30 year period.

9.4 Cost-Benefit Criteria

9.4.1 The results of the Cost-Benefit should be summarised through calculation of the Present Value of Benefits (PVB), Present Value of Costs (PVC), and Net Present Value (NPV).

9.4.2 An indication of value-for-money should be given through calculation of a Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR). This should compare the present value of the project benefits to the present value of the sum of the capital, operating and maintenance costs of the project. An internal rate of return calculation may also be presented.

9.5 Exchequer Analysis

9.5.1 The purpose of this analysis is to show the impact of the project on the Exchequer.

9.5.2 The DOF Guidelines indicate that this should take the form of a comparison between, on the one hand, Exchequer expenditure on construction works and other capital outlays, and on the other income from items such as user charges. On this basis, in the context of transport projects, the Exchequer analysis should include the following elements:

- Capital costs of the project to the public sector (net of VAT);
- Change in operating costs for State or State-supported undertakings;

- Change in user charges in excess of changes in user charge collection costs (where these user revenues accrue to the public sector);
- Change in development levies in excess of changes in costs of collecting such levies;
- Changes in excise duties on fuels in excess of changes in the costs of collection; and
- Changes in VAT receipts on fuels.

9.5.3 In the case of public transport, the second and third items listed above, when combined, indicate the impact of the project on operating subsidies.

10. Risk and Uncertainty

10.1 Capital projects tend to carry risk in relation to both capital expenditure and project outturns or benefits. In the past, many of these risks, particularly on the capital side, have not been given due consideration, with consequent capital cost overruns. In effect, there has been an optimism bias.

10.2 There are two broad approaches to dealing with such risks in project appraisal. The first consists of applying standard optimism bias factors, while the second attempts to evaluate the risks to the fullest extent possible. The second approach is recommended, as it results in a project-specific response to risk that takes account of the rapidly accumulating experience of implementing large infrastructure projects.

10.3 Risk assessment involves the consideration of the sources of risk, and an evaluation of the probabilities of those risks arising and their impact on project costs and benefits. While it is recognised that such risk assessments are often difficult, such a process would at least identify where risks arise, and facilitate measures to counter optimism bias in relation to these risks, where they are not otherwise quantified. A further danger in applying standard optimism bias factors would be that of engendering complacency with regard to a real assessment of risk.

10.4 The preparation of a risk register in project development is good and standard engineering practice. By applying these processes to the transport planning assessment, the risks of a project can be more fully understood by decision makers.

10.5 Generally, risk mitigation measures will have been put in place and their costs included in project costs. Risk assessment should take account of these measures and their likely efficacy.

10.6 Good project appraisal will highlight the elements that are uncertain, so that the Sponsoring Agency and the Sanctioning Authority are aware of the risks involved in proceeding, or not proceeding, with any proposal.

10.7 Contingencies

Even where an evaluation of risks and their impacts is undertaken, some project risks will remain unanticipated. Additionally, as projects progress through the various stages of appraisal, more precise quantification of project costs becomes possible. Because of these factors, the project capital cost should include a

provision for contingencies. The scale of this provision may be reduced as the design elements of the project become more certain.

10.8 Sensitivity Analysis

10.8.1 Sensitivity analysis should always form a part of the appraisal of projects. This involves evaluating proposals for a range of scenarios that reflect the project elements that are uncertain.

10.8.2 At a minimum, sensitivity to the project costing, transport demand, benefit modelling and impact of significant complementary projects should be tested. This should preferably be implemented by identifying the factors giving rise to risks and testing sensitive to these factors. Alternatively, standard sensitivity test should be undertaken along the following lines:

- Project costing: test sensitivity to plus or minus 20 per cent change in project costs at preliminary appraisal stage and plus or minus 10 per cent at final appraisal stage.

- Transport demand: Test Sensitivity to plus or minus 10 and 20 per cent of demand estimate.

- Quantification of benefit elements: where the modelling of benefits, e.g. de-congestion benefits, is regarded as subject to error, test sensitivity to plus or minus 10 and 20 per cent change in such benefits

- Complementary and substitute projects: normally, projects that are fully committed form part of the Do-Nothing or Do-Minimum scenario against which the project in hand is evaluated. Where there are other such projects that have not commenced, but have the capacity to enhance or reduce the economic return, an evaluation of the sensitivity of the rate or return to such complementary or substitute projects should be presented.

The above sensitivity tests represent a minimum. The Agencies should ensure that sensitivity to other major uncertainties is tested.

10.8.3 A useful approach to sensitivity analysis is to determine the level to which a risk factor would have to fall or rise in order to make the project not worthwhile.

10.8.4 Sensitivity analyses should not be used as a substitute for careful analysis. That is, the fact that sensitivity analysis is carried out should not be used to justify a simpler analysis than is warranted.

Appendix 1: Application Rules for Cost-Benefit Parameter Values

1. General

This note provides information on the parameter values to be applied in the economic appraisal of transport projects, as recommended by the Department of Transport. The parameter values covered by this note relate to:

- The value of time;
- Accident costs; and
- Vehicle operating costs.

At this time, monetary values are not ascribed to environmental costs and benefits generally. However, interim values to be ascribed to certain road vehicle emissions are set out in Appendix 2. More comprehensive data on emission valuation are currently being assessed with a view to their inclusion in a later version of the Guidelines.

As the appraisal of transport projects involves the assessment of the costs and benefits over a future period, it is necessary to project parameter values over such a period. This note also advises on real growth rates to be applied to these parameter values.

The parameter values presented are at year 2002 prices. It is recommended that, until further notice, project appraisals should be couched in terms of prices prevailing in the year 2002. This will facilitate comparisons of the economic return across transport projects generally. The Department of Transport may issue updates of these parameter values from time to time.

The parameter values are those recommended for economic appraisal. Different (behavioural) values may be applied in transport demand modelling, as required.

This note provides values at both market prices and factor costs. Values at factor costs are net of indirect taxes, while those at market prices are inclusive of such taxes**.** It is recommended that economic evaluations adopt a "willingness to pay" approach and measure benefits at market prices**.**

The parameter values set out below were derived through the work of a group convened by the Department of Transport and representative of the following organisations:

Coras Iompair Eireann;
The Department of Transport;
CSF Evaluation Unit;

The Dublin Transportation Office;
The National Roads Authority; and
The Rail Procurement Agency;

A report setting out the rationale for the parameter values and the calculation methodology used is available on the Department's website. The report, which was compiled by Goodbody Economic Consultants and Atkins, is entitled "Cost Benefit Parameters and Application Rules for Transport Project Appraisal".

2. Values of Time

2.1 Introduction

This section presents values of time per person for use in the economic appraisal of transport projects. The values of time presented are equity values. That is, it is not recommended that values be varied according to the incomes of travellers. The values are at year 2002 prices.

Values are presented separately for work and non-work journeys. The latter are further subdivided into commuting and non-commuting (or leisure) values. With regard to non-work journeys, values of time are presented initially for in-vehicle journeys, and then factors to convert these to walk and wait time values are provided.

2.2 Work Time Values

These are values to be used for journeys undertaken in the course of work. It should be noted that the values are to be applied not only to transport users but also to operators of transport vehicles and rolling stock.

The work time values recommended are as follows

At Market Prices (€ per person per hour)	At Factor Cost (€ per person per hour)
26.5	22.2

The difference between market prices and factor costs in the indirect tax correction factor, which is measured as 19.1 per cent for Ireland.

2.3 Non-Work Time Values

These are values to be used for journeys not in the course of business or work. A distinction is made between commuting and non-commuting journeys. Where practicable, economic appraisals should adopt separate values for commuting and non-commuting journeys. Where journey purpose data do not distinguish between commuting and non-commuting journeys, the commuting value of time may be used for all non-work journeys. The non-work time values recommended are as follows:

Journey type	At Market Prices (€ per person per hour)	At Factor Cost (€ per person per hour)
Commuting time	8.1	6.8
Non-commuting time	7.3	6.1

Wait time values should be increased to two and one-half times in-vehicle with walk time values at twice in-vehicle.

3. Vehicle Operating Costs

3.1 Introduction

This section provides recommended vehicle operating cost values. Vehicle operating costs comprise fuel and non-fuel costs. Non-fuel costs comprise costs relating to oil, tyres, maintenance, and depreciation. It is also appropriate to establish cost functions for each of the main vehicle types on the road system. The cost functions set out below are based on those in the COBA system. In that system, the following vehicle types are recognised:

- Petrol car
- Diesel car
- Light goods vehicle (up to 3.5 tonnes gross vehicle weight)
- OGV1 (rigid goods vehicles with up to three axles)
- OGV2 (rigid goods vehicles with four or more axles and all artics)
- Buses and coaches (in excess of 3.5 tonnes gross vehicle weight).

3.2 Fuel Costs

Fuel consumption is estimated in COBA using a function of the form:

$$C = a + bV + cV^2$$

Where C = cost in cents per kilometre
V = average link speed in kilometres per hour
a, b and c are parameters defined for each vehicle category.

The following tables indicate the parameter values appropriate for estimating fuel operating costs at market prices and then factor costs in the year 2002 prices. The level of fuel operating costs at different link speeds, are set out in the appended Tables 1 and 2.

Market Prices

Vehicle Category	a	b	c
Car	13.7345571694	-0.2300437637	0.0015641543
LGV	15.2098325314	-0.2462401318	0.0019744254
OGV1	35.2424170834	-0.5693064149	0.0041344836
OGV2	71.5372626809	-1.1103327894	0.0075696319
PSV	33.9123368720	-0.5313432130	0.0033505052

Note: in deriving a value for the average car, the petrol: diesel proportions used were 87:13 as per the 2002 Bulletin of Vehicle and Driver Statistics, DOELG, 2003

Factor Costs

Vehicle Category	a	b	c
Car	5.1511891026	-0.0862275123	0.0005852871
LGV	6.9877726406	-0.1131287969	0.0009070998
OGV1	16.1912366475	-0.2615534249	0.0018994839
OGV2	32.8659849420	-0.5101143009	0.0034776758
PSV	26.3808878876	-0.4133394223	0.0026064055

Note: in deriving a value for the average car, the petrol: diesel proportions used were 87:13 as per the 2002 Bulletin of Vehicle and Driver Statistics, DOELG, 2003

3.3 Non-Fuel Operating Costs

The non-fuel element of cost is estimated in COBA using a function of the form:

$$C = a_1 + \frac{b_1}{V}$$

Where:

C = cost in cents per kilometre
V = average link speed in kilometres per hour
a_1 and b_1 are parameters defined for each vehicle category.

The following tables indicate the parameter values appropriate for estimating non-fuel operating costs at market prices and then factor costs in the year 2002 prices.

Market Prices

Vehicle Category	a_1	b_1
Car	6.18	31.58
LGV	8.67	76.50
OGV1	17.64	267.27
OGV2	19.70	541.41
PSV	37.16	623.02

Factor Costs

Vehicle Category	a_1	b_1
Car	5.11	26.10
LGV	7.28	64.29
OGV1	14.83	224.60
OGV2	16.56	454.97
PSV	30.71	514.89

The level of non-fuel operating costs at different link speeds, are set out in the appended Tables 3 and 4.

4. Accident Costs

Traditionally, the measurement of accident costs has distinguished between costs that relate to the casualties of accidents and costs that relate to the accident itself. The casualty related costs are:

- Lost output;
- Human costs (suffering and pain); and
- Medical costs.

The accident related costs are:

- Damage to property;
- Insurance administration; and
- Police costs.

The total costs per accident depend on the number of casualties and the severity of the accident – fatal, serious injury, slight injury and damage only accidents. Accordingly, the parameter values presented below contain information on the costs per casualty and per accident by severity of the accident. The total cost of an accident is obtained by multiplying the cost per casualty by the number of casualties and adding the result to the cost per accident. The following are the recommended accident costs at year 2002 prices.

Accident Types	Values at Market Prices		Values at Factor Costs	
	Per Casualty €	Per Accident €	Per Casualty €	Per Accident €
Fatal	2,018,126	15,882	1,694,480	13,335
Serious Injury	226,757	6,769	190,392	5,683
Slight injury	17,486	3,896	14,682	3,271
Damage only	Not applicable	2,403	Not applicable	2,017

5. Growth Factors for Parameter Values

5.1 Values of Time and Accident Costs

As values of time and accident costs are largely related to the incomes of travellers, future values should be inflated by the rate of increase in real GNP per person employed. The proposed growth rates, which are derived from ESRI forecasts, are as follows:

Period	Forecast Annual Real Growth in GNP per Person Employed (%)
2002 to 2010	2.70
2011 to 2015	2.37
2016 and thereafter	2.29

If the project is evaluated over a period in excess of thirty years, the growth rate for the period from 2016 should be maintained.

5.2 Vehicle Operating Costs

Forecasting operating costs in real terms means that assumptions need to be made as to whether the operating cost elements will inflate at a rate in excess of the Consumer Price Index generally. Although arguments could be made to the effect that oil prices and thus fuel costs will increase in real terms over the medium to long term, this has not always been the case in the past. Accordingly, it is proposed that operating costs in real terms be maintained at 2002 values.

Table 1: Fuel Costs per Kilometre at Market Prices by Vehicle Type (in Cents at 2002 prices)

Average Speed in Km/h	Car	LGV	OGV 1	OGV 2	PSV
5	12.62	14.03	32.50	66.17	31.34
10	11.59	12.94	29.96	61.19	28.93
15	10.64	11.96	27.63	56.59	26.70
20	9.76	11.07	25.51	52.36	24.63
25	8.96	10.29	23.59	48.51	22.72
30	8.24	9.60	21.88	45.04	20.99
35	7.60	9.01	24.59	41.95	19.42
40	7.04	8.52	19.09	39.24	18.02
45	6.55	8.13	18.00	36.90	16.79
50	6.14	7.83	17.11	34.94	15.72
55	5.81	7.64	16.44	33.37	14.82
60	5.56	7.54	15.97	32.17	14.09
65	5.39	7.55	15.71	31.35	13.53
70	5.30	7.65	15.65	30.91	13.14
75	5.28	7.85	15.80	30.84	12.91
80	5.34	8.15	16.16	31.16	12.85
85	5.48	8.54	16.72	31.85	12.96
90	5.70	9.04	17.49	32.92	13.23
95	6.00	9.64	18.47	34.37	13.67
100	6.37	10.33	19.66	36.20	14.28
105	6.82	11.12	21.05	38.41	15.06
110	7.36	12.01	22.65	40.99	16.01
115	7.97	13.00	24.45	43.96	17.12

Table 2: Fuel Costs per Kilometre at Factor Costs by Vehicle Type (in Cents at 2002 prices)

Average Speed In Km/h	Car	LGV	OGV	OGV2	PSV
5	4.73	6.44	14.93	30.40	24.38
10	4.35	5.95	13.77	28.11	22.51
15	3.99	5.49	12.70	26.00	20.77
20	3.66	5.09	11.72	24.05	19.16
25	3.36	4.73	10.84	22.29	17.68
30	3.09	4.41	10.05	20.69	16.33
35	2.85	4.14	11.30	19.27	15.11
40	2.64	3.91	8.77	18.03	14.02
45	2.46	3.73	8.27	16.95	13.06
50	2.30	3.60	7.86	16.05	12.23
55	2.18	3.51	7.55	15.33	11.53
60	2.08	3.47	7.34	14.78	10.96
65	2.02	3.47	7.22	14.40	10.53
70	1.98	3.51	7.19	14.20	10.96
75	1.98	3.61	7.26	14.17	10.04
80	2.00	3.74	7.42	14.31	9.99
85	2.05	3.93	7.68	14.63	10.08
90	2.13	4.15	8.04	15.12	10.29
95	2.24	4.43	8.49	15.79	10.64
100	2.38	4.75	9.03	16.63	11.11
105	2.55	5.11	9.67	17.65	11.72
110	2.75	5.52	10.40	18.83	12.45
115	2.98	5.97	11.23	20.20	13.32

Table 3: Non Fuel Costs per Kilometre at Market Prices by Vehicle Type (in Cents at 2002 prices)

Average Speed In Km/h	Car	LGV	OGV 1	OGV 2	PSV
5	12.50	23.97	71.09	93.54	161.76
10	9.34	16.32	44.37	73.84	99.46
15	8.29	13.77	35.46	55.79	78.69
20	7.76	12.50	31.00	46.77	68.31
25	7.44	11.73	28.33	41.36	62.08
30	7.23	11.22	26.55	37.75	57.93
35	7.08	10.86	25.28	35.17	54.96
40	6.97	10.58	24.32	33.24	52.74
45	6.88	10.37	23.58	31.73	51.00
50	6.81	10.20	22.99	30.53	49.62
55	6.75	10.06	22.50	29.54	48.49
60	6.71	9.95	22.09	28.72	47.54
65	6.67	9.85	21.75	28.03	46.74
70	6.63	9.76	21.46	27.43	46.06
75	6.60	9.69	21.20	26.92	45.47
80	6.57	9.63	20.98	26.47	44.95
85	6.55	9.57	20.78	26.07	44.49
90	6.53	9.52	20.61	25.72	44.08
95	6.51	9.48	23.58	25.40	43.72
100	6.50	9.44	20.31	25.11	43.39
105	6.48	9.40	20.19	24.86	43.09
110	6.47	9.37	20.07	24.62	42.82
115	6.45	9.34	19.96	24.41	42.58

Table 4: Non Fuel costs per Kilometre at Factor Costs by Vehicle Type (in Cents at 2002 prices)

Average Speed In Km/h	Car	LGV	OGV 1	OGV 2	PSV
5	10.33	20.14	59.75	107.55	133.69
10	7.72	13.71	37.29	62.06	82.20
15	6.85	11.57	29.80	46.89	65.04
20	6.42	10.49	26.06	39.31	56.45
25	6.15	9.85	23.81	34.76	51.31
30	5.98	9.42	22.32	31.73	47.87
35	5.86	9.12	21.25	29.56	45.42
40	5.76	8.89	20.45	27.93	43.58
45	5.69	8.71	19.82	26.67	42.15
50	5.63	8.57	19.32	25.66	41.01
55	5.58	8.45	18.91	24.83	40.07
60	5.55	8.35	18.57	24.14	39.29
65	5.51	8.27	18.29	23.56	38.63
70	5.48	8.20	18.04	23.06	38.07
75	5.46	8.14	17.82	22.63	37.58
80	5.44	8.08	17.64	22.25	37.15
85	5.42	8.04	17.47	21.91	36.77
90	5.40	7.99	17.33	21.62	36.43
95	5.38	7.96	19.82	21.35	36.13
100	5.37	7.92	17.08	21.11	35.86
105	5.36	7.89	16.97	20.89	35.61
110	5.35	7.86	16.87	20.70	35.39
115	5.34	7.84	16.78	20.52	35.19

Appendix 2: Road Vehicle Emissions

This Appendix presents default values for emissions per vehicle mile both in volume and value terms. The European Environment Agency's COPERT III model was used to calculate CO2 and non-CO2 emissions from road passenger transport in Ireland in 2004. The Non-CO2 emissions include CO (Carbon Monoxide), NOX (Nitrogen Oxide), VOC (Volatile Organic Compounds), CH4 (Methane), N20 (Nitrous Oxide), NH3 (Ammonia), SO2 (Sulphur Dioxide), and NMVOC (non-methane volatile organic compounds) emissions. The emissions were classified by road type - Urban, Rural, or Highway emissions. Using number of vehicles and vehicle mileage data, Urban, Rural and Highway emissions per vehicle mile were calculated (see Table 1).

Table 1: Emissions per Vehicle Mile (grams), by Type of Vehicle

Emissions per vehicle mile			Urban Emissions per vehicle mile		Rural Emissions per vehicle mile		Highway Emissions per vehicle mile	
Vehicle Type	**Fuel Type**	**Size**	**CO2**	**Non CO2**	**CO2**	**Non CO2**	**CO2**	**Non CO2**
Passenger Car	Petrol	<1.4	182.47	16.15	150.3	2.3	135.7	1.8
		1.4 - 2.01	239.95	16.30	181.4	2.7	152.2	1.8
		>2.01	299.19	17.67	200.9	3.3	160.8	1.7
Total Petrol Passenger Cars			205.55	16.25	162.4	2.5	142.1	1.8
Passenger Car	Diesel	<2.01	165.52	1.64	157.0	1.0	147.6	0.7
		>2.01	165.59	1.65	157.0	1.0	147.5	0.7
Total Diesel Passenger Cars			165.53	1.64	157.0	1.0	147.6	0.7
Total Passenger Cars			198.16	13.55	161.4	2.2	143.1	1.6
Light Duty Vehicles	Petrol	<3.5t	280.21	29.37	274.5	11.2	218.0	6.2
	Diesel	<3.5t	190.98	1.84	223.9	1.9	222.4	1.8
Total Light Duty Vehicles			192.99	2.47	225.0	2.1	222.3	1.9
Heavy Duty Vehicles	Diesel	3.5 -7.5t	246.87	3.96	245.8	3.9	421.3	5.0
		7.5-16t	439.64	6.06	491.1	6.0	694.4	7.6
		16-32t	691.29	6.36	780.9	7.1	1031.2	9.2
		>32t	907.99	6.92	1052.9	8.1	1384.4	10.5
Total Heavy Duty Vehicles			362.27	4.66	386.5	4.8	582.7	6.1
Urban Bus			3644.79	46.60	216.7	0.6	1036.0	2.5
Coach			636.05	6.90	795.6	8.4	812.5	8.2
Moped		< 50 cm3	95.50	39.65	79.6	33.0	59.7	24.8
Motorcycle		4 stroke > 50cm3	109.60	39.42	76.6	25.5	70.5	24.1
		4 stroke 250 - 750 cm3	145.16	34.70	87.4	22.5	72.2	18.7

Source: Goodbody Economic Consultant's estimates

To estimate the costs associated with the road transport emissions outlined in Table 1, cost of emission values were applied to the vehicle emissions per mile. Emission cost values were available from the ECMT for the following emission types: CO2, NOX, SO2 and NMVOC (see Table 2). These were adjusted to 2002 prices. The composite non-CO2 emission costs outlined in Table 3 thus refer to NOX, SO2 and NMVOC emissions only.

Where available, cost of emission values by road type were used (i.e. Urban, Rural and Highway). Emission cost values associated with NOX and NMVOC on urban and highway roads were available. An average of these values was then used to estimate the costs of NOX and NMVOC emissions on rural roads. The costs associated with both CO2 and SO2 emissions were available for just one road type - highways. The highway emission cost values were used to estimate the costs of emissions for all road types for both CO2 and SO2 emissions.

Table 2: Costs per gram of Emissions, (€)

Emission Type	Rural €	Urban €	Highway €
NOX	0.006374	0.010199	0.005099
NMVOC	0.006374	0.010199	0.005099
SO2	0.001020	0.001020	0.001020
CO2	0.000061	0.000061	0.000061

Source: The European Conference of Ministers of Transport (ECMT) Emission Values and Goodbody Economic Consultants

Table 3: Costs (€) of Emissions per Vehicle Mile, by type of Vehicle, 2002 Prices

Costs of emissions per vehicle mile			Urban Emissions per vehicle mile		Rural Emissions per vehicle mile		Highway Emissions per vehicle mile	
Vehicle Type	**Fuel Type**	**Size**	**CO2**	**Non CO2**	**CO2**	**Non CO2**	**CO2**	**Non CO2**
Passenger Car	Petrol	<1.4	0.011	0.014	0.009	0.003	0.008	0.002
		1.4 - 2.01	0.015	0.013	0.011	0.003	0.009	0.002
		>2.01	0.018	0.015	0.012	0.004	0.010	0.003
Total Petrol Passenger Cars			0.013	0.014	0.010	0.003	0.009	0.002
Passenger Car	Diesel	<2.01	0.010	0.008	0.010	0.004	0.009	0.003
		>2.01	0.010	0.008	0.010	0.004	0.009	0.003
Total Diesel Passenger Cars			0.010	0.008	0.010	0.004	0.009	0.003
Total Passenger Cars			0.012	0.013	0.010	0.003	0.009	0.002
Light Duty Vehicles	Petrol	<3.5t	0.017	0.027	0.017	0.015	0.013	0.010
	Diesel	<3.5t	0.012	0.011	0.014	0.008	0.014	0.006
Total Light Duty Vehicles			0.012	0.012	0.014	0.008	0.014	0.006
Heavy Duty Vehicles	Diesel	3.5 -7.5t	0.015	0.021	0.015	0.012	0.026	0.014
		7.5-16t	0.027	0.039	0.030	0.024	0.043	0.025
		16-32t	0.042	0.045	0.048	0.032	0.063	0.032
		>32t	0.056	0.053	0.065	0.039	0.085	0.040
Total Heavy Duty Vehicles			0.022	0.028	0.024	0.017	0.036	0.019
Urban Bus			0.223	0.345	0.013	0.002	0.063	0.009
Coach			0.039	0.049	0.049	0.038	0.050	0.029
Moped		< 50 cm3	0.006	0.108	0.005	0.058	0.004	0.035
Motorcycle		4 stroke > 50cm3	0.007	0.027	0.005	0.008	0.004	0.004
		4 stroke 250 - 750 cm3	0.009	0.023	0.005	0.006	0.004	0.004

Source: Goodbody Economic Consultant's estimates

Appendix 3: Template for the Business Case

1. Brief Description of the Project

Brief summary of what the proposed project entails so as to orientate the reader. Identification of funding now sought.

A project may be a package of related measures and each of these should be clearly identified (e.g. infrastructure, fleet, facilities, etc).

2. Need for the Project, Problem Identification and Objective Setting

Context for the project (previous plans, studies etc.); description of previous related investments; description of current situation and problems or prospective problems that the project aims to address; objectives (quantifiable where possible) that the project seeks to meet.

3. Demand Analysis

Demand forecasts for each of the options should be established. Key assumptions in arriving at the demand forecasts should be identified. There should be a realistic benchmarking of demand projections with experience elsewhere in the transport network. An analysis of demand as compared with current capacity of the system should be provided.

4. Design of Options for Meeting Needs

Description of feasible options for meeting needs and comparison of these options with current situation. For example, in relation to rail: what would the options mean for track infrastructure and operational capacity. Diagrammatic and pictorial representation of options as appropriate.

An analysis should be presented of how service levels will change under each of the main options now identified, with an indication of the phasing of service improvements. These service levels will be contrasted with existing service levels, to identify increments in service. For public transport projects, indicative timetables should be presented.

5. Preliminary Appraisal of Options

Where there are a large number of options, a preliminary and brief appraisal of them should be carried out to identify a small number of main options (usually no more than three) for more detailed appraisal. The preliminary appraisal will normally be a multi-criteria appraisal which will encompass consideration of

appropriate technical, capacity, economic and financial aspects. Economic considerations will include such wider issues as land-use and transport integration impacts. Special note should be made of the implications of any of the options for the wider network or for future development of the network (e.g. closing off or opening up future development of the network).

6. Capital and Operating Costs

Capital and operating costs for each main option should be set out with explanations as to their derivation. Benchmark cost data should be provided where available or applicable.

7. Economic Evaluation of Options

Cost-benefit evaluation of options should be the norm, using standard parameter values and appraisal criteria, for projects in excess of €30m. The impact of the options on other issues and fit with other strategies should be considered as appropriate: regional development, integration of modes, compatibility with other plans, social impact etc.

8. Financial Evaluation of Options

Net financial return to the company. Highlighting of third party contributions. Implications for subvention levels.

9. Exchequer Appraisal of Options

Net financial position of the Exchequer based on: capital costs of the project to the public sector (net of VAT); Change in operating costs for State or State-supported undertakings; Change in user charges; Change in development levies in excess of changes in costs of collecting such levies; Changes in excise duties on fuels in excess of changes in the costs of collection; and Changes in VAT receipts on fuels.

10. Risk Assessment

Consideration of the risk factors likely to affect project costs, benefits and financial return and sensitivity tests of the economic and financial evaluation to the risks.

11. Funding and Procurement Proposals for the Preferred Option

Source of funds: own resources, Exchequer, EU, third parties including development levies and contributions and consideration of PPP / NDFA options

for projects costing in excess of €20m. Proposed schedule for Exchequer fund draw down. Proposed arrangements for procurement of project. Next steps.

12. Business Case Presentation

It should be noted that the Department of Transport will accept for consideration only those Business Cases that:

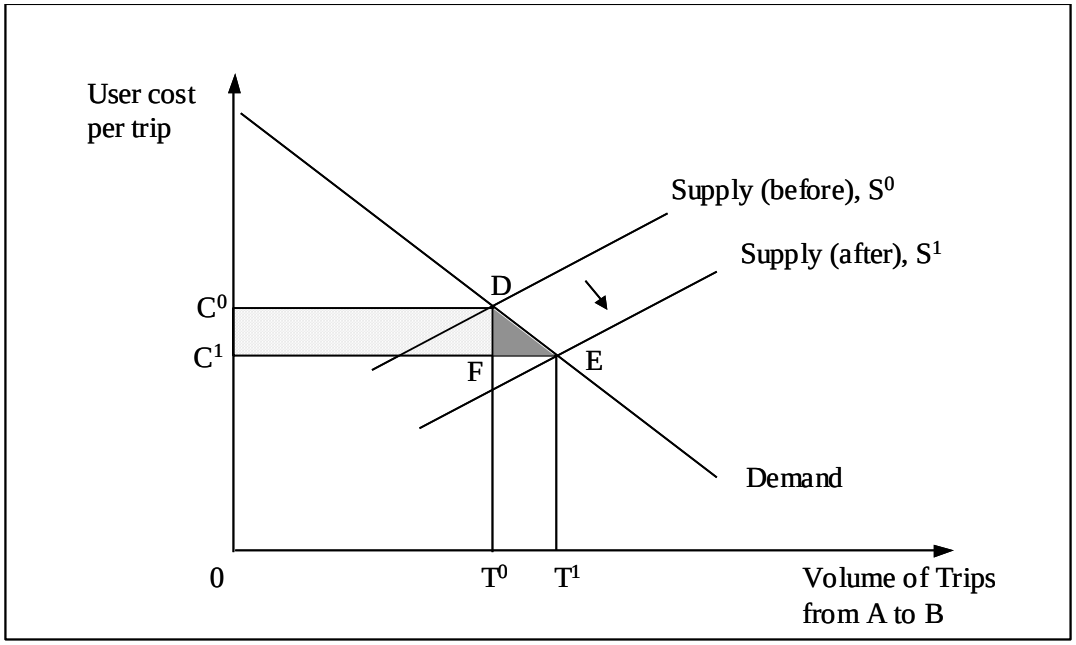
- Deal with all the relevant elements as set out above;
- Reach high standards in terms of presentation and structure;
- Are readily interpretable; and
- Are accompanied by well structured and documented spreadsheets and other analyses.

Appendix 4: Measuring Changes in Consumer's Surplus

Consumer' Surplus is the benefit to the consumer from consumption of a good over and above the costs of that good. Where as a result of an investment the cost of the good to the consumer falls, then the Consumer's Surplus will rise.

Figure 4.1 depicts a typical situation where there is an investment which lowers the cost of supply of a transport facility as depicted by the movement of the supply curve from S^0 to S^1. The price facing the trip-maker falls from C^0 to C^1, and the volume of trips increases from T^0 to T^1.

Figure 4.1: Estimation of Consumer's Surplus



For existing users, the benefit to them is measured by the rectangle C^0DFC^1 or by $(C^0 - C^1)*T^0$.

For new users attracted to the mode by the investment, the Consumer's Surplus is measure by the shaded triangle DEF or by $0.5*(C^0 - C^1)(T^0 - T^1)$. This calculation is made possible by the assumption that the demand curve is linear, an assumption that will hold true for small shifts in the supply curve.

The total Consumer's Surplus (CS) is therefore measured by:

$CS = (C^0 - C^1)*T^0 + 0.5*(C^0 - C^1)(T^0 - T^1)$, or by rearranging

$CS = 0.5* (T^0 + T^1) (C^0 – C^1)$

The following should be noted:

- Where there are investments that induce mode changes, the benefits are calculated by applying the above formula to each mode separately and summing the results. The benefits are thus not based on a comparison between the costs of the two modes.

- Where, there are no additional trips generated on a mode as a result of the investment - the assumption of a fixed trip matrix – the CS is measured by $(C^0 – C^1)*T^0$.

- The costs include both the money and time costs of travel. Public transport fares are not to be considered a transfer payment but to be included in travel costs in the same way as vehicle operating costs and toll charges.

- The overall benefit calculation can be broken down into its cost components and the above formula applied to each component and summed.