An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

COMMON APPRAISAL FRAMEWORK FOR TRANSPORT PROJECTS AND PROGRAMMES

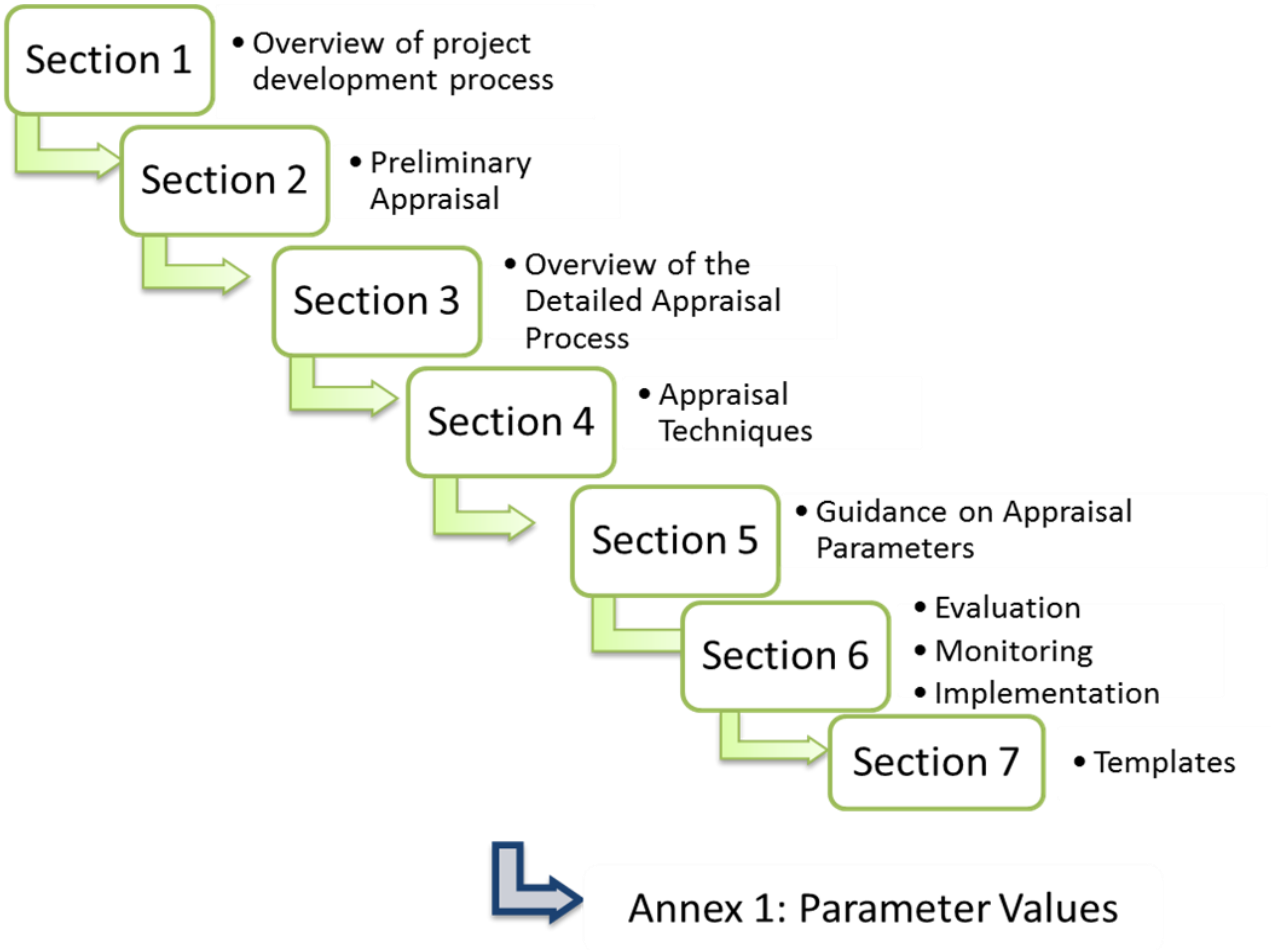
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OVERVIEW OF 2016 COMMON APPRAISAL FRAMEWORK

This guidance document replaces the 2009 Guidelines on a Common Appraisal Framework for Transport Projects and Programmes and explains the steps to be used in the appraisal of transport projects and programmes for which the Department of Transport, Tourism and Sport or its agencies are Sanctioning Authorities. The purpose of this document is to develop a common framework for the appraisal of transport investments that is consistent with the Public Spending Code (PSC) and also elaborates on the Public Spending Code in respect of the appraisal of transport projects and programmes to assist scheme promoters in constructing robust and comparable business cases for submission to Government. For appraisal and evaluation of projects in relation to Tourism and Sport please contact the Department of Transport, Tourism and Sport's Strategic Research and Evaluation Division (SRA@dttas.gov.ie) for assistance.

The document is presented in 7 Sections, each with a number of themed units. The first section provides an overview of the project development process. The second section outlines the process for Preliminary Appraisal. The third section provides an overview of the Detailed Appraisal process and the fourth section provides Detailed Guidance in relation to the appraisal types introduced in the previous section. The fifth section provides guidance on both central Government and transport specific parameters for use in economic appraisal. The sixth section gives details on the processes to be carried out when evaluating, implementing and monitoring a programme or project. The seventh section outlines the templates that should be used when reporting quantitative and qualitative results of the appraisal. The figure below gives a broad indication of how the guidance is presented.

Common Appraisal Framework Overview



For specific guidance or clarification on any of the sections please contact SRA@dttas.gov.ie.

KEY TERMS

Base Case – The current business as usual scenario which the Do-something options are usually compared against, as well as sensitivity analyses.

Cost Benefit Analysis – Comparison of the costs and benefits associated with alternative ways of achieving a specific objective. Monetary values are assigned to both costs and benefits.

Cost-Effectiveness Analysis – Compares the costs of different ways of achieving a particular objective.

Discounting - The conversion of future costs or benefits to present values using a discount rate.

Discount Rate – Used to convert costs and benefits to present values to reflect the principle of time preference.

Do-nothing – This option requires a clear description of what is likely to occur in the absence of the intervention.

Do-minimum – The least burdensome option to maintain an intervention, in some cases (e.g. where legal commitments are in place) this can act as the base case.

DPER – Department of Public Expenditure and Reform.

Do-something –The options that are available to address the objective of the intervention.

DTTaS - Department of Transport, Tourism and Sport.

Internal Rate of Return (IRR) – Maximum rate of interest that a proposal can afford to pay for resources used which allows the proposal to cover its investment and operating expenses and still break even. In other words, the IRR is the discount rate that will make the NPV of a proposal equal zero.

Multi Criteria Analysis – MCA can be used to describe any structured approach to determine overall preferences among alternative options, where the options should accomplish multiple objectives. The term covers a wide range of techniques that share the aim of combining a range of positive (benefits) and negative (costs) effects in a single framework to allow for easier comparison of alternative options in decision-making.

Net Present Value (NPV) – NPV is the sum of the discounted benefits less the sum of the discounted costs.

Opportunity Cost - The value of a resource in its most productive alternative use.

Post Project Evaluation - A post-implementation review of a project's outcome.

Public Spending Code (PSC) – The set of rules and guidelines that all civil and public bodies must follow when considering, incurring, or monitoring expenditure.

Public Private Partnership (PPP) - A structured arrangement between the public sector and a private sector organisation to secure an outcome delivering good value for money.

Real Prices - Prices expressed in real terms, that is after removing the effect of inflation.

Revealed Preference - The inference of willingness to pay for something which is non-marketed by examining consumer behaviour in a similar or related market.

Risk - The likelihood, measured by its probability, that a particular event will occur.

SRAD –Strategic Research and Analysis Division in the Department of Transport, Tourism and Sport.

Stated Preference - Willingness to pay for something that is non-marketed, as derived from people's responses to questions about preferences for various combinations of situations and/ or controlled discussion groups.

Value for Money (VFM) - VFM is generally achieved when the ratio of benefit to cost is optimal for any given activity. VFM studies range from economic appraisals assessing costs and benefits from a national or regional perspective, to smaller scale measurements of economy, effectiveness or efficiency for particular activities.

Willingness to Pay - The amount that someone is willing to give up or pay to acquire a good or service.

Table of Contents

OVERVIEW OF 2016 COMMON APPRAISAL FRAMEWORK 2
Common Appraisal Framework Overview 3
KEY TERMS 4
Section 1 OVERVIEW OF PROJECT DEVELOPMENT PROCESS 7
1.1 Introduction 7
1.2 The Public Spending Code 7
1.3 Appraisal Threshold 8
1.4 Key Stages in Project Appraisal 13
1.5 Engaging with Central Government During Appraisals 14
Section 2 PRELIMINARY APPRAISAL 17
2.1 Problem Definition and Need for Intervention 17
2.2 Setting Objectives 17
2.3 Project or Programme Definition 17
2.4 Defining Scenarios and Cases 17
2.5 Principles for Developing Options 18
Section 3 OVERVIEW OF DETAILED APPRAISAL PROCESS 21
3.1 Introduction 21
3.2 Types of Analysis 21
3.3 General Financial Appraisal 23
3.4 Economic Appraisal 23
3.5 Qualitative Analysis 24
3.6 Risk and Uncertainty Analysis 25
Section 4 DETAILED GUIDANCE ON APPRAISAL TECHNIQUES 26
4.1 General Financial Appraisal 26
4.2 Economic Appraisal 29
4.3 Qualitative Guidance 41
4.4 Risk and Uncertainty 50
4.5 Project Appraisal Balance Sheet 53
Section 5 DETAILED GUIDANCE ON APPRAISAL PARAMETERS 54
5.1 Central Government Parameters 54
5.2 Transport Parameters 54
Section 6 IMPLEMENTATION, MONITORING AND EVALUATION 66
6.1 Implementation 66
6.2 Post- Implementation 69
6.3 Evaluation 69
Section 7 TEMPLATES 71
7.1 Financial Appraisal 71
7.2 Economic Efficiency of the Transport System 73
7.3 Cost-Benefit Analysis Summary Table 75
7.4 Project Appraisal Balance Sheet 76
Annex 1 PARAMETER VALUES 78

Section 1 OVERVIEW OF PROJECT DEVELOPMENT PROCESS

1.1 Introduction

Before the Sanctioning Authority can consider approving expenditure proposals, certain analysis needs to be carried out and presented in a consistent format. The main output needed to consider any type of expenditure is a Business Case. At the very least a Business Case should contain details regarding objectives, scope, feasibility, options appraisal, planning and design, evaluation plan and recommendations.

The level of detail required is dependent on the level of expenditure required. While all appraisals should include an economic, financial and risk analysis, the level of detail should be proportionate to the required expenditure.

To summarise the appraisal, a Project Appraisal Balance Sheet (PABS) should be contained within the Business Case document. The PABS combines both the qualitative and quantitative impacts to give decision makers a snapshot view of all the potential benefits and costs of the project. Templates are provided in Section 7 and should be used when reporting to the relevant Agency or Department.

1.2 The Public Spending Code

In September 2013, a circular (13/13) was issued by the Department of Public Expenditure and Reform (DPER) regarding "The Public Spending Code: Expenditure Planning, Appraisal & Evaluation in the Irish Public Service - Standard Rules & Procedures". This circular was to notify Departments' that the new Public Spending Code (PSC)[1] was in effect as the comprehensive set of expenditure appraisal, value for money requirements and related guidance covering both current and capital expenditure.

The Public Spending Code combines and updates the previous components of the Value for Money (VFM) framework and also includes additional modules. It stipulates that the PSC replaces all previous guidance in relation to appraisal and VFM. The main revised conditions and requirements applicable to appraisals relate to:

1. Central appraisal parameters covering the discount rate and certain shadow prices which are published on the Public Spending Code website;
2. Thresholds for analysis: the threshold for conducting a Cost Benefit Analysis (CBA) or Cost-Effectiveness Analysis (CEA) was reduced from €30 million to €20 million;
3. Current expenditure requirements: the Code now applies to both current and capital expenditure; and
4. Submissions to Department of Public Expenditure and Reform: Business Cases must be submitted for approval in principle to the transport Vote Section in the Department of Public Expenditure and Reform for all significant expenditure. If the value of the capital project exceeds €20 million then the CBA (or CEA) should be submitted to the Department of Public Expenditure and Reform for review, prior to the Sanctioning Authority granting the Approval in Principle. For current expenditure proposals expected to incur over €20 million (with an annual spend of at least €5

[1] Available at www.publicspendingcode.per.gov.ie

million) an economic appraisal should be submitted to the Vote Section of the Department of Public Expenditure and Reform.

1.3 Appraisal Threshold

1.3.1 Introduction

Although every spending proposal should be appraised carefully, resources spent on appraisal should be commensurate with the costs of projects and the degree of complexity of the issues involved. At a minimum, all business cases should include an estimate of the likely costs, financial flows, and likely benefits.

1.3.2 Capital Expenditure Appraisal Thresholds

The thresholds and methodologies for appraisal set out in the PSC are as follows:

- The least detailed 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.
- Prior to the Preliminary Appraisal of any project with life time costs of **over €5 million**, the relevant Sponsoring Agencies and/or Sanctioning Authorities[2] should contact the SRAD to agree assumptions and constraints.
- Projects between **€5 million and €20 million** should be subject to preliminary and detailed appraisal which includes at least a Multi-Criteria Analysis (MCA). Where the DTTaS is the Sanctioning Authority, business cases (including financial and economic appraisal) should be submitted to the relevant division to ensure policy consistency and the SRAD to ensure robust assumptions and methodology.
- Projects with life time costs of **over €20 million** should have a Cost Benefit Analysis (CBA) carried out. Before the business case is submitted for Approval in Principle, it should be submitted to the relevant DTTaS Line Division. It should then be passed on to Central Expenditure Evaluation Unit in the Department of Public Expenditure and Reform for their views. In terms of project financing (including Public Private Partnerships) the Sponsoring Agency/ Sanctioning Authority should seek the advice of the National Development Finance Agency (NDFA) on all projects above €20 million. The Sponsoring Agency/ Sanctioning Authority should also consider the option of procuring by Public Private Partnerships (PPP) as part of the project appraisal. Separate guidance on PPPs is available at www.ppp.gov.ie. All Capital Projects costing greater than €20 million are to be subject of a post-project review.
- Capital Grant Schemes with an annual value in **excess of €30 million and of 5 years or more** duration are to be subject to prior and mid-term evaluation at the beginning and mid-point of each 5 year cycle or as may be agreed with the Department of Public Expenditure and Reform.
- The Public Spending Code determines that as a rule, the Government will be the Sanctioning Authority for very large projects, **costing more than €100 million**, but the Government could also be the Sanctioning Authority for projects below this

[2] For public transport, the National Transport Authority and for roads, Transport Infrastructure Ireland will be the respective Sanctioning Authorities.

value. Where the Government is the Sanctioning Authority, the Government may choose to delegate the day to day oversight functions of a Sanctioning Authority to the line Department or Agency. Where projects incur **large development costs (greater than €5 million)**, the Sponsoring Agency/Sanctioning Authority should submit a preliminary appraisal report to DTTAS assessing the justification for the scale of investment for consideration and discussion in advance of proceeding with the project.

1.3.3 Current Expenditure Appraisal Thresholds

Prior to the publication of the Public Spending Code, project/programme appraisal was only applied to capital expenditure which is typically one off expenditure concerned with the creation of an asset (for example, roads) whereas current expenditure usually involves day to day expenditure. It should be noted that capital projects generally include current costs such as operation and maintenance. The most recent release of the PSC also standardises procedures for assessing and appraising current expenditure.

The guidelines in the Public Spending Code require Departments and agencies to appraise the options for new current expenditure proposals before a determination is made that the proposal is Approved in Principle. The guidance for current expenditure appraisal applies to proposals which involve a total budget of at least €20 million for the duration of the programme or an annual expenditure of at least €5 million. Section B.06 of the Public Spending Code provides more detail. These new rules apply to the following instruments:

- New grant/subsidy scheme[3]
- Extension, renewal or re-orientation of existing scheme
- New delivery mechanism for existing services
- New public services
- New State bodies; and
- National/cross sectoral policy programme and frameworks

[3] This should not be confused with grant-in-aid payments which are payments to State agencies, public and voluntary bodies to cover running costs or payments to a specific public or private agency to cover the cost of a particular activity carried out by that body (Requirements for Grants and Grants-in-Aid, Circular 17/2010, Department of Public Expenditure and Reform).

Table 1: Overview of Appraisal Thresholds and Scale of Appraisal Required

Estimated Project Cost	Scale of Appraisal Required
Below €0.5 million	Simple assessment
Between €0.5 million and €5 million	Single appraisal incorporating elements of a preliminary and detailed appraisal
Between €5 million and €20 million	At a minimum, a Multi Criteria Analysis (MCA)
Over €20 million	Detailed Economic Appraisal - Cost Benefit Analysis (CBA) (or Cost Effectiveness Analysis (CEA))
Current expenditure (with an annual spend of at least €5m	Detailed Economic Appraisal - Cost Benefit Analysis (CBA) (or Cost Effectiveness Analysis (CEA))
Capital Grant Schemes with an annual value in excess of €30 million and of 5 years or more duration	Detailed Economic Appraisal prior and at mid-point of each 5 year cycle or as may be agreed with the Department of Public Expenditure & Reform.

1.3.4 Business Cases for Public Expenditure

In line with the Public Spending Code, Line Departments are required to submit a Business Case for capital projects greater than €20 million and for current expenditure proposals with total expenditure over the duration of the programme/scheme of at least €20m and a minimum annual expenditure of €5m to the Department of Public Expenditure and Reform. The Business Case is a single document that describes the proposed project, establishes the rationale for it and informs the decision on whether or not to proceed with it. The Business Case should be established at the preliminary appraisal stage and updated at detailed appraisal and post tender stages.

Table 2 provides a template for the outline of a Business Case. This is not an exhaustive list of items and headings but acts as a minimum requirement when preparing business cases. Agencies are now required to follow this format only when preparing business cases.

Table 2: Sample Business Case Outline

Stage in Project Appraisal	Business Case Requirement
Stage 1: Preliminary Appraisal	**1: Define the Objective** • Definition of the policy proposal and its objectives • Economic rationale for the proposal • Programme Logic Model showing linkages between inputs, outputs and outcomes **2: Clarify Scope** • Duration of spending proposal (including identification of sunset clause) • Departments affected • Number of clients **3: Assess Feasibility** • Identify constraints (financial, legal, environmental, administrative, etc.) • Previous experience **4: Explore the Different Options to Achieve the Identified Objective** • Options appraisal • Core assumptions • Justification of options/Decision criteria • Quantify the costs of viable options and specific sources of funding
Stage 2: Detailed Appraisal	**5: Analyse the Main Options** ***5a. Financial Appraisal*** • Financial appraisal (Capital costs, Operating and Maintenance, Revenues, etc.) • Exchequer cash-flow appraisal (Capital costs, Tax costs, charges, etc.) • Analysis of sources of funding ***5b. Economic Appraisal*** ○ Quantitative and Qualitative criteria: ▪ Economy ▪ Safety ▪ Environment ▪ Accessibility and Social Inclusion ▪ Integration

	6: Risk Analysis • Identification of risks • Make realistic assumptions about future prices, costs, market growth, and other relevant factors • Sensitivity and scenario analysis • Risk mitigation strategy
	7. Recommendations • Key Results from appraisal • Qualitative issues
Stage 3: Evaluation, Implementation and Monitoring	**8: Planning and Design Issues** • Scheme design (e.g. eligibility, payment rates, etc.) • Administrative issues (e.g. IT, staffing, etc.) • Roles, responsibilities and reporting • Project implementation plan • Procurement issues (e.g. outsourcing) • Cross cutting issues

	9: Evaluation Plan and Proofing
	• Pilot arrangements
	• Performance measurement framework
	  ○ Data collection streams
	  ○ Indicators
	• Techniques to measure outcomes
	• Proposed monitoring/evaluation arrangements
	• Schedule of evaluations

	Step 10: Appendices • Assumptions, parameters, input values • Detailed methodology

1.4 Key Stages in Project Appraisal

1.4.1 Introduction

There are three key stages in the Appraisal Process which contribute to the Business Case:

- Preliminary Appraisal;
- Detailed Appraisal; and
- Implementation, Monitoring and Evaluation.

1.4.2 Stage 1: Preliminary Appraisal

The preliminary appraisal aims to establish whether, at face value, a sufficient case exists for considering a proposal in more depth. It leads to a recommendation on whether or not to proceed to the detailed appraisal stage. A preliminary appraisal of a project includes the background, initial specification of the needs and objectives, identification of potential options and a preliminary assessment of the costs and benefits.

For projects under €5 million, a single appraisal will suffice. This appraisal should incorporate as many elements from both the preliminary and detailed appraisal process as possible while keeping the level of detail proportionate to the spend of the programme. All projects above €5 million should be subject at the very least to a Multi-Criteria Analysis.

In terms of defining particular problems and how they should be addressed, promoters must first clearly identify the objectives that need to be achieved. These objectives should be Specific, Measureable, Accurate, Realistic and Timely (SMART). Project promoters should avoid referring to any mode specific solutions at this initial stage.

For example, an identified problem may be a congested route in a city. The problem is congestion and the objectives could be to reduce congestion on the link to an acceptable level (i.e. Level of Service D) within the next 5 years.

The need for an intervention should then be clearly set out and justified. If an intervention is appropriate, a number of options should be generated with a view to developing a range of alternative measures that look likely to achieve the specific objectives that the project is seeking to address. A Base Case must first be established and then options for investment should be identified and appraised in comparison to this. In line with the Public Spending Code, this requires the analyst to generate a range of realistic options so that benefits and costs can be compared relative to a scenario where very little or no change has taken place. A preliminary assessment of the costs and benefits should be undertaken of the options. The options are then sifted for the better performing options to be taken on to the detailed appraisal stage. Option Development is considered in more detail in Section 3.

A minimum of four options (i.e. Do-Nothing or Do-Minimum and at least 3 Do-Something options) should be subject to appraisal at preliminary appraisal stage. Where fewer than four options have been considered the project appraisal report and Business Case should include a rationale for the approach taken.

1.4.3 Stage 2: Detailed Appraisal

Having established a rationale for intervention, the detailed appraisal stage aims to provide a basis for a decision to proceed with a scheme. It includes the finalisation of the needs and objectives, evaluation of potential options and a detailed assessment of the costs and benefits of the preferred project.

From the preliminary appraisal stage, a small number of better performing Do- Something options will have been identified. The focus of analysis is now on estimating the likely performance and impact of intervention(s) in sufficient detail. This should involve providing more detail on the needs and objectives of the intervention and in particular applying detailed appraisal techniques, such as a full Economic Appraisal (including both quantitative and qualitative analysis and outputs), Financial Appraisal (e.g. General Financial Analysis) and Risk Analysis. The level of economic appraisal carried out should be reflective of the scale of the project.

1.4.4 Stage 3: Implementation, Monitoring and Evaluation

Once the detailed appraisal is of sufficient quality and the project has been approved, the implementation process can commence. It is important to monitor the costs, timelines and any other important information about the project to ensure there are no overruns. At the end of the project or at a pre-selected time in the future, the project/programme should be evaluated against its objectives to ensure that the programme achieved/is achieving its objectives. An evaluation plan is now a requirement within the business case document. This plan ensures that the programme can be evaluated robustly either at the end of the project and/or at the pre-selected time in the future. More detail on these stages is provided in Sections 4, 5 and 6.

1.5 Engaging with Central Government During Appraisals

1.5.1 Introduction

In line with the requirements of the PSC and this Common Appraisal Framework, the Sponsoring Agency or Sanctioning Authority, depending on the projects in question, has the overall responsibility for the proper appraisal, planning and management of projects/schemes (incl. current expenditure). For expenditure that exceeds €5 million on a project, over the life time of the programme, the requirements set out below are also necessary.

1.5.2 Pre-Appraisal (i.e. Stage 1): Engage with the Department of Transport, Tourism and Sport on appraisal assumptions

Pre-appraisal (i.e. Stage 1): Consultation with DTTAS's Economic Financial and Evaluation Unit. This is a new requirement of the Common Appraisal Framework which requires the Sponsoring Agency/ Sanctioning Authority to engage with the Department of Transport, Tourism and Sport around assumptions and inputs to both preliminary appraisal and detailed appraisal of projects or programmes with an expenditure that exceeds €5 million. At this stage, the Department may require the project promoter to revise or adjust their inputs and assumptions to ensure they are in line with central guidance.

This stage seeks to ensure direct comparability across all proposals and allows both parties to agree on inputs before further costs are incurred (e.g. writing up business cases, running models, etc.). This process will also ensure that the investment priorities and programmes

as outlined in the 2015 Capital Investment Plan and the DTTAS's Strategic Framework for Investment in Land Transport are adhered to. This strategy document outlines the main priority areas for future investment as follows:

- Priority 1: Achieve Steady State Maintenance
- Priority 2: Address Urban Congestion
- Priority 3: Maximise the Value of Existing Land Transport Networks

Projects that are inconsistent with these priorities will not proceed to Preliminary Appraisal. For more details see:

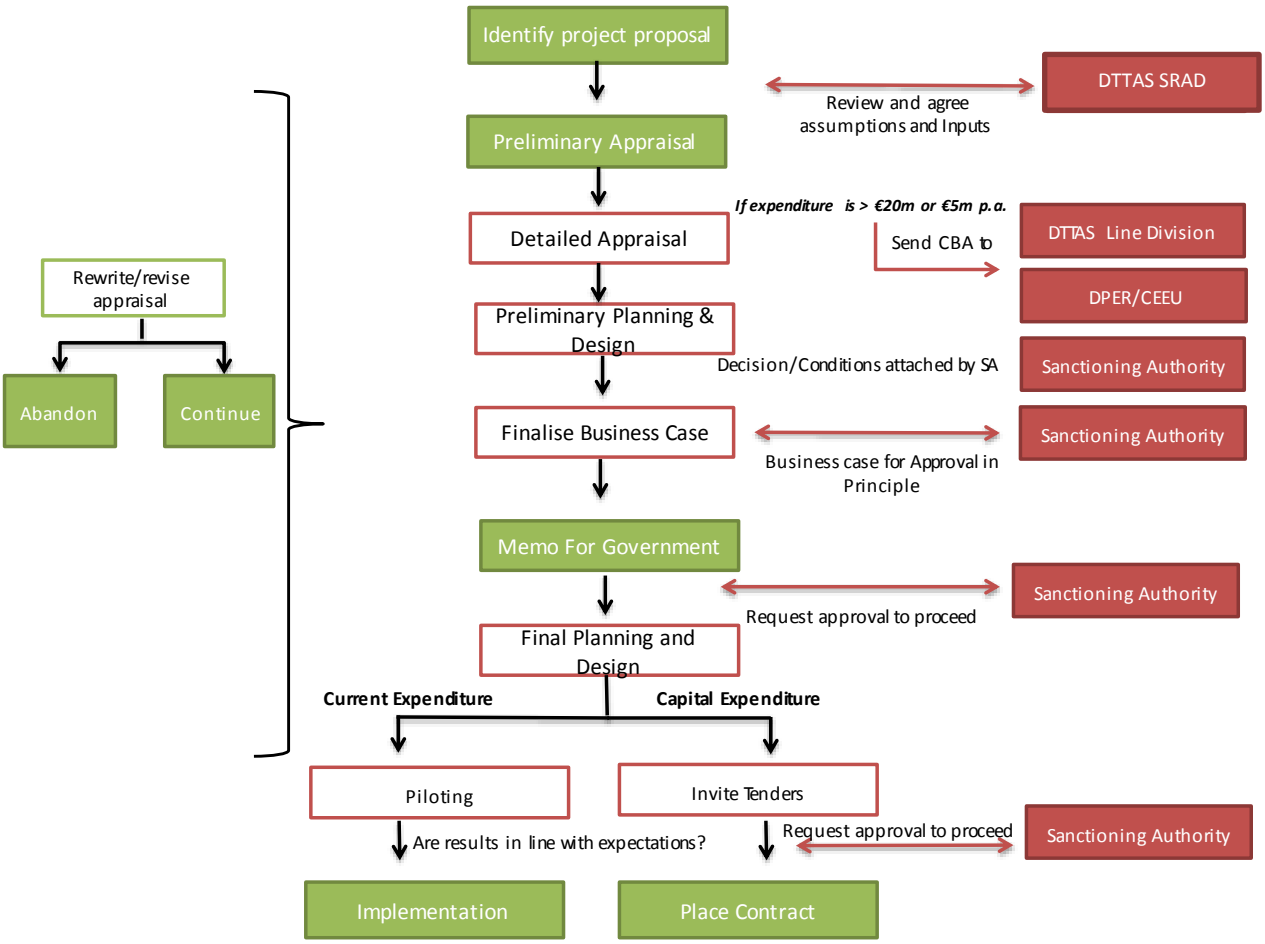
http://www.dttas.ie/corporate/publications/english/investing-our-transport-future-strategic-investment-framework-land

1.5.3 Detailed-appraisal (i.e. Stage 2): Seek Department of Public Expenditure and Reform Approval in Principle

Regardless of which Agency or Department is the Sanctioning Authority, prior to submitting business cases and analysis to the Department of Public Expenditure and Reform, all documents, including the economic appraisal, should first be sent to the relevant division within the Department of Transport Tourism and Sport (for example, Public Transport Investment Division, Roads Division, etc.). When capital expenditure of €20 million or greater is involved, then a full CBA (or a Cost-Effectiveness Analysis (CEA)) should be submitted directly to the SRAD in the Department of Transport, Tourism and Sport.

This approval permits successive steps in planning a project or scheme to proceed, stopping short of the placement of major contracts or the making of any irrevocable commitments to undertake a project or scheme. Further detail on appraisal requirements and key decision points is provided in Sections 2 and 3.

Table 3: Decision Points and Required Approvals for Capital Projects and Current Programmes



Source: Public Spending Code

Section 2 PRELIMINARY APPRAISAL

The preliminary appraisal aims to establish whether, at face value, a sufficient case exists for considering a proposal in more depth. It leads to a recommendation on whether or not to proceed to the detailed appraisal stage. A preliminary appraisal of a project includes the background, initial specification of the needs and objectives, identification of potential options and a preliminary assessment of the costs and benefits.

2.1 Problem Definition and Need for Intervention

The term 'problem' can embrace a range of issues from genuine problems to potential opportunities. In assessing the need for a specific intervention and in developing the case for that intervention, analysts should present a sound body of analysis to show the specific problems that establish the need for an intervention. At this stage of the process, the following should be identified with supporting evidence:

- Current transport-related problems;
- Future transport-related problems; and
- Underlying causes

2.2 Setting Objectives

The objective of the proposals should be clearly set out, identifying what needs are to be met and what is the planned scale on which those needs will be met and measured. The aim of project appraisal is to identify the approach that would best achieve the stated objectives for the investment solution. The objectives should have a clear purpose with a logic linking objectives to both outputs and outcomes. These objectives should be SMART (Specific, Measurable, Accurate, Realistic and Timely) and relevant data should be identified to measure these at the earliest possible stage. If the data does not exist, arrangements should be put in place to collect the data before the project or programme commences or (if a programme's expenditure is above €20 million) before the programme is piloted.

2.3 Project or Programme Definition

Considerable care needs to be taken in appraising transport projects to ensure that the project or programme is a meaningful unit for assessment purposes and that it is properly defined. In particular, the unit of analysis (i.e. the investment proposal) should be specified so as to distinguish projects from programmes. It is best to break down very large schemes into self-contained project/programme units and to conduct the cost-benefit analysis at the individual unit level. All ancillary sub-projects which are essential to the achievement of the benefits of the main project should be included.

2.4 Defining Scenarios and Cases

In carrying out the preliminary appraisal stage it is crucially important to correctly identify the scenarios, options and cases that are to be assessed. As will be detailed, the primary categories of potential scenarios are;

- The Base Case (often referred to as Do-Minimum or Do-Nothing)
- The Do-Something Case

2.4.1 The Base Case

Appraisal requires the development of a Base Case, which would represent a minimum intervention on the part of the sponsors. Proposed options are then appraised by comparison with the Base Case.

An appraisal should clearly identify and examine a benchmark or counterfactual for comparative purposes. The counterfactual involves an assumption about the future state of the world in the absence of the project or programme. Comparisons can be made between competing proposals including the status quo. Commonly used counterfactuals include 'Do Nothing' or 'Do the Minimum' options. However, it should be noted that counterfactuals based on the Do Nothing are often unrealistic as there are generally certain costs associated with current arrangements which must be incurred even if a spending proposal does not go ahead e.g. operational, maintenance or repair costs. The Do-Minimum option is often therefore a better benchmark for analysis. It is important that several realistic options are analysed against the benchmark so that the most effective option can be identified.

2.4.2 Do-Something Options

In order to ensure that good investment decisions are made, it is necessary to appraise a number of Do-Something options. These options should arise when option development is being carried out in the preliminary appraisal stage and should reflect the objectives of the intervention. Only those elements that are additional or for which funding is sought should be included in the Do-Something options. Project sponsors should include a minimum of 3 but preferably at least 5 Do-Something options at the preliminary appraisal stage. The process of identifying and screening options should be clearly documented. Any specific issues with Do-Something options should be discussed with the Department of Transport's Economic, Financial and Evaluation Unit when engaging at the pre-appraisal stage.

For some schemes, a large number of Do-Something 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 options to a preliminary appraisal, before subjecting a smaller number to a more complete appraisal. A preliminary appraisal could encompass a qualitative and quantitative approach, which avoids the complexities associated with the monetisation of benefits. A useful tool for comparing projects or programmes at this stage is Multi-Criteria Analysis (MCA). Detailed guidance on MCA is provided in Section 4.

2.5 Principles for Developing Options

As noted previously, once the need for an intervention has been identified, options can be developed to address a clear set of locally developed objectives which express desired outcomes. There are a wide range of considerations to be borne in mind when developing options. A number of these are set out below.

Objective Assessment: The Sponsoring Agency is responsible for ensuring that the appraisal is done on an objective basis and not as a 'case-making' exercise. Good quality appraisal at this stage will make it easier to complete the planning and implementation stages and minimise the potential for difficulties and risks to arise in the later stages.

Proportionality: The complexity of the appraisal or evaluation of a project or programme and the methods used will depend on the size and nature of the project or programme and should be proportionate to its scale. The resources to be spent on appraisal or evaluation

should be commensurate with the likely range of cost, the nature of the project or programme and with the degree of complexity of the issues involved.

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.

Management versus Investment Options: Investment options will not always represent the most appropriate response to identified needs or objectives. Non-infrastructure options such as regulatory change, provision of improved information, changes to land use planning, bottleneck improvements, road safety works, fiscal or control measures, Intelligent Transport Systems or investment in other modes should always be considered before the major investment options are appraised.

Avoiding Premature Commitments: A sequence of considered decisions will lead to progressively greater commitment of resources, but an irrevocable commitment to a proposal should only be made after all appraisal stages have been satisfactorily passed, and final approval obtained. Where necessary, public bodies should be prepared at any stage to abandon the proposal (even where costs have been incurred in appraising, planning and developing a project), if on balance, continuation would not represent value for money.

Timing and Phasing of a Project/ Programme: Depending on priorities, budget, programme etc., a project may have different possible starting points, which may impact the projects costs and benefits. Therefore, it may be necessary to examine a number of alternative project starting points.

Option of Discontinuation: The alternative to a project could be to discontinue, either immediately or at some point in the future, a particular service or route. The option of discontinuation is not normally considered in the case of certain transport investments, where there is no feasible alternative method of catering for the traffic volumes. But this is not universally the case. It may or may not be desirable, but that is a matter for the CBA to establish.

Developing Packages of Measures: 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. It could be useful to include measures in a package which address different aspects of the project's objectives or which are complementary to those objectives. It is also seen as important to avoid substitutable measures within a package, where measures are aimed at the same aspect of the project's objectives. Examples of packages of measures could involve 'Push' and 'Pull' measures such as a combination of disincentives to discourage status quo travel choices and incentives to encourage new travel behaviour (for example, changes to parking availability for single occupant vehicles and increased availability of premium location carpool parking). Other examples include information strategies to reinforce new or improved travel options (for example, community-based travel behaviour change programmes) or activity changes to

reduce the impact of 'Push' measures (for example, encouragement of remote working along with changes in parking provision).

Defining Projects with No Direct Beneficial Impacts: 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. It is important in such instances to define and subject the higher level investment to appraisal, 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.

Options falling outside an Agency's Remit: 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. On the other hand, if the above process has not taken place, and the detailed appraisal options include some outside the remit of the Agency that could achieve the purpose for which the investment is intended, then that Agency should refer to the Department of Transport for guidance as to how to proceed.

In summary, the steps involved in defining projects for appraisal are:

- Define the Base Case by considering Do-Nothing or Do-Minimum options;
- In the Do-Minimum Base Case, consider explicitly why a Do-Nothing Scenario is unrealistic;
- 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.

Once the options have been considered and sifted for the best solutions, the appraisal should move on to the detailed appraisal stage.

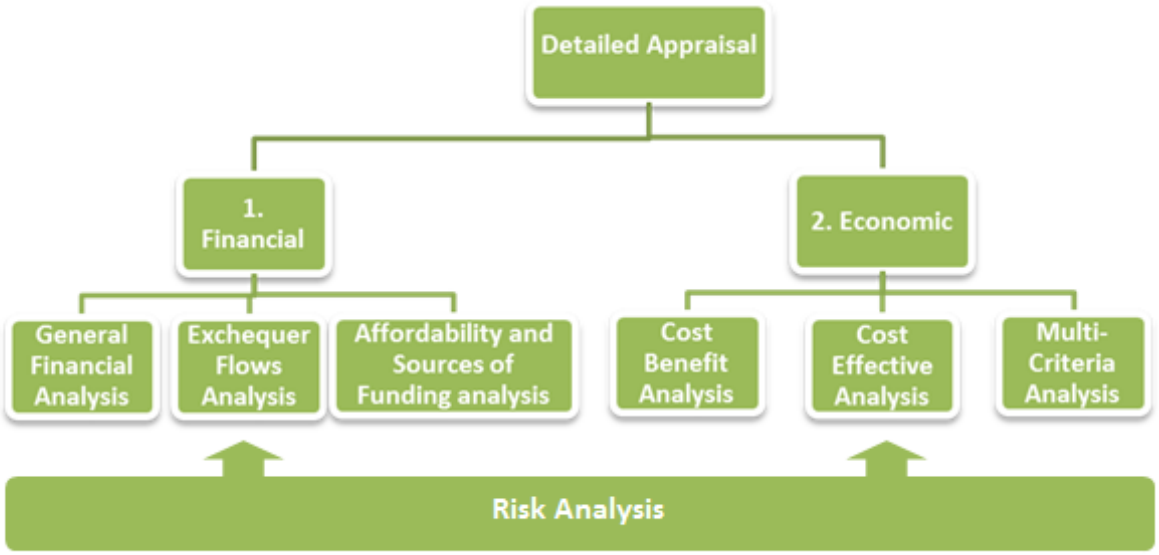
Section 3 OVERVIEW OF DETAILED APPRAISAL PROCESS

3.1 Introduction

The detailed appraisal stage aims to provide a basis for a decision on whether to proceed with a project in principle or not. It includes the finalisation of the needs and objectives, evaluation of potential options and a detailed assessment of the costs and benefits of the project.

This section aims to explain the detail of how appraisal should be carried out, including the level of detail required, the types of acceptable analysis tools and the quantitative and qualitative methods.

Table 4: Overview of Detailed Analysis Methods



3.2 Types of Analysis

The Common Appraisal Framework envisages that for any project, there are at least 3 types of appraisal that could potentially be carried out. These are shown in Table 5 below.

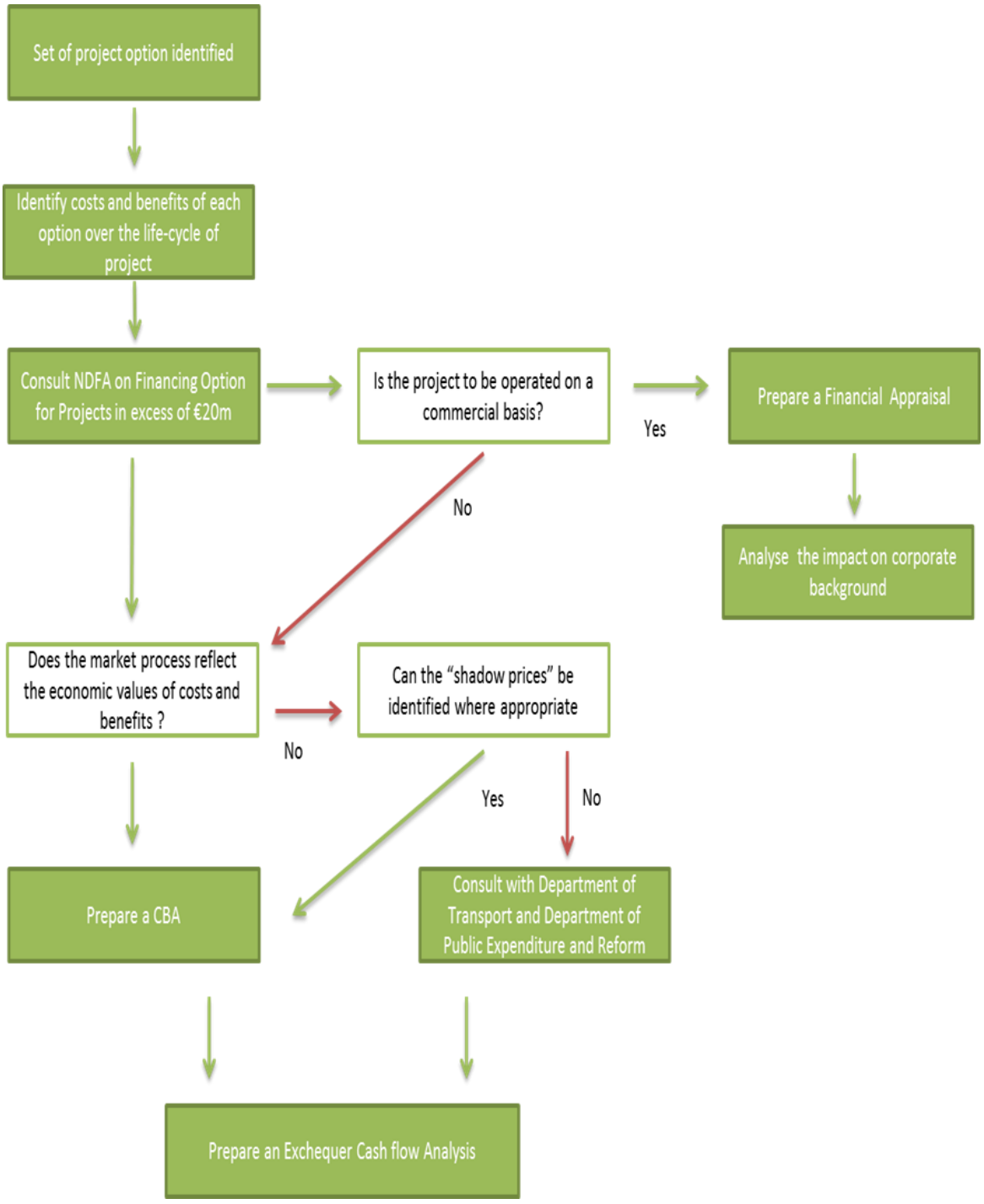
Table 5: Three Main Types of Appraisal

A Financial Appraisal	A financial appraisal is concerned with the financial impact of the project on the finances of the Sponsoring Agency.
An Exchequer Flows Appraisal	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.
An Economic Appraisal	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.

In principle, projects over €20m should be subject to all three types of appraisal.

In addition, Risk Analysis is a fundamental part of the development of scheme costs and should also be a core part of the calculation of the scheme benefits and costs. A risk analysis is a process which identifies the sources of risk, evaluates the probabilities of those risks arising and their impact on the project costs and benefits. In transport projects, risk assessment, which ranges from simple to complex, should be used on the cost side, and sensitivity assessments, which mimic risk quantification, used on the benefits side. Where required, probabilities can be used to calculate varying confidence levels of CBA outputs.

Table 6: Identifying Appropriate Type of Analysis



3.3 General Financial Appraisal

General Financial Appraisal is a broad term which can cover many different types of assessments carried out for different purposes. There is a clear distinction between the General Financial Analysis which should be carried out for every spending proposal, which is reflective of inflows and outflows for the Sponsoring Agency, and an Exchequer Cash Flow Analysis which takes a whole of Exchequer perspective and should accompany every CBA. For projects over €20 million, the minimum requirement is that a financial analysis from the perspective of the Sponsoring Agency and an Exchequer Cash flow Analysis be carried out.

General Financial Appraisal is a method used to evaluate the viability of a project by assessing the value of net cash flows that result from its implementation. This type of analysis allows for an assessment of the budgetary impacts of a project by considering the pattern of projected related cash flows. Financial analysis can cover many different types of assessment:

- Financial Analysis – identifies and quantifies financial inflows and outflows.
- Exchequer Cash Flow Analysis – identifies and quantifies direct and indirect flows which impact on the exchequer.
- Analysis of Sources of Funds – breaks down the sources of finances for a given project.

A sensitivity analysis of the key financial variables should accompany the General Financial Appraisal. The sensitivity test should aim to show decision makers the effects of a change in variables that are important to the success of the project (delay in release of funds, change in the cost/source of funding, etc.). More detail on Sensitively Analysis is provided in Section 3.5.

General Financial Appraisal must be carried out for all spending proposals while a General Financial Analysis and an Exchequer Cash Flow Analysis must accompany every business case above €20 million over the life time of the project or €5 million annually. Project and programme specifics will determine whether any other type of financial analysis should be carried out. The programme promoter should enquire with the Department of Transport, Tourism and Sport and the Vote section within the Department of Public Expenditure and Reform to clarify the level and types of financial analysis required.

3.4 Economic Appraisal

The main types of economic appraisal are introduced below. Section 4 provides more detail on the primary quantitative and qualitative analysis methods.

Quantitative Analysis examines the monetised costs and benefits of the intervention. Some costs and benefits can be translated into monetary values (e.g. Value of Time, Emissions Values, etc.). The types of economic analysis, approvals required and scale of appraisal are outlined below. These are in line with Section B.03 of the Public Spending Code.

Cost-Benefit Analysis: Investment proposals valued over €20 million for capital expenditure or current programme values over €5 million annually are required to undergo a detailed cost-benefit analysis which assesses whether or not the social and economic benefits associated with a project are greater than the social and economic costs. Typically CBA is used for transport appraisal.

Cost-Effectiveness Analysis: Cost-Effectiveness Analysis (CEA) is a useful tool for project screening or ranking. This type of analysis compares the cost of different projects/programmes with their intended impact, where the projects/programme has an identifiable primary goal and where the measurement of benefit is difficult or impossible. CEA will assist in the determination of the least cost way of determining the capital project objective. A choice can then be made as to which of these options is preferable. Where there are multiple objectives of the same priority, Multi Criteria Analysis is a more robust method of analysis.

Multi Criteria Analysis: MCA can complement a CBA if certain important parameters are not monetisable. In this way, it can provide a useful framework to evaluate different transport options with several criteria. In line with the Public Spending Code, a Multi Criteria Analysis (MCA) should be carried out at minimum for projects between €5 million and €20 million. Conventionally, MCA can be either qualitative and/or quantitative – both are valid approaches to MCA.

A sensitivity analysis of the economic forecasts and parameters is necessary, particularly for CBAs. The sensitivity test should aim to show decision makers the effects of a change in variables that are important to the success of the project (demand, material costs, etc.). More detail on Sensitivity Analysis is provided in the risk chapter of this section.

3.5 Qualitative Analysis

Not all costs and benefits of transport projects can be monetised. This section provides guidance for those costs and benefits that cannot be translated into a monetary amount. Qualitative analysis should be used to assess and report the impact of investment on:

- Environment;
- Accessibility and Social Inclusion;
- Integration;
- Other Government Policies; and
- Non-quantifiable economic impacts.

A realistic and accurate assessment of these qualitative factors is important as this information is presented in the Project Appraisal Balance Sheet (Section 5 and Section 7) which is the only appraisal sheet that contains qualitative factors. The Project Appraisal Balance Sheet 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.

3.6 Risk and Uncertainty Analysis

Risk in its most basic form is the probability of a negative occurrence that is caused by external or internal exposures that could be avoided through preventative action. Effective risk management helps the achievement of wider aims such as effective change management, the efficient use of resources, better project management, minimising waste and fraud and supporting innovation.

Projects and programmes tend to carry risk in relation to both expenditure and project outturns. 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.

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 first approach of applying standard optimism bias factors can be simply done by increasing costs and or decreasing benefits of a programme by a predetermined factor. This factor should be based on an average of bias contained in previous similar programmes. These factors can be easily established from post project reviews or similar ex-post evaluations.

The second approach of evaluating risks to the fullest extent possible is recommended as it results in a project-specific response to risk that takes account of the rapidly accumulating experience of implementing projects or programmes.

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. Risk mitigation strategies are extremely important because they have the potential to avoid or minimise cost overruns, time delays and resource availability. Risk mitigation is about understanding those risks that can impact the objectives of the project/programme, and taking the appropriate steps to reduce the risks to an acceptable level.

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.

Section 4 DETAILED GUIDANCE ON APPRAISAL TECHNIQUES

This section seeks to give detailed explanations of the types of techniques that should be applied when carrying out a detailed appraisal. The detail of how each of the types of financial, economic and risk analysis are carried out is presented below.

4.1 General Financial Appraisal

General Financial Appraisal is a method used to evaluate the viability of a project by assessing the value of net cash flows that result from its implementation. Financial Analysis looks at the impact of the project on the finances of the Sponsoring Agency while the Exchequer Analysis is concerned with the impact of the project on the Exchequer.

As previously stated, there are at least two types of financial analysis which must be carried out for projects over €20m:

- A financial analysis from the perspective of the Sponsoring Agency
- An Exchequer cashflow analysis

4.1.1 What is Financial Analysis?

A financial appraisal is concerned with the financial impact of the project on the finances of the Sponsoring Agency. Financial analysis focuses on cash flows as opposed to economic flows and in particular considers sustainability and profitability. Some of the general objectives associated with this type of analysis are:

- Identifying and estimating financial cash flows;
- Assessing financial suitability – sustainability occurs if the net flow of cumulated generated cash flow is positive for all years considered;
- Calculating performance indicators (e.g. Net Present Value, Internal Rate of Return); and
- Assessing funding sources for the project.

4.1.2 When to carry out a Financial Analysis?

A financial analysis incorporating an analysis of cash flows, even at a simple level, should be carried out for all spending proposals regardless of scale because an understanding and quantification of financial flows is critical to the approval decision. The level of detail involved should be commensurate with the scale of expenditure.

The financial analysis should be carried out as one of the first steps in the overall appraisal stage because an understanding of the pattern of the cashflows is a critical building block for the overall business case as well as the CBA.

4.1.3 Main Steps in carrying out a Financial Analysis

The main steps for carrying out a financial analysis are set out below:

Step 1: Identify the time horizon

Identify the time horizon (often the same as a cost-benefit analysis time horizon) based on the useful economic life of the asset.

Step 2: Identify the incremental cash inflows and outflows for each option

Cash outflows could include investment costs, operating costs, start-up costs, maintenance and lifecycle costs and decommissioning costs whereas cash inflows could include operating revenues, residual values, and dividends. The analysis should take account of both direct, including EU finance, and indirect flows associated with the proposal. The following flows should not be included as part of the financial appraisal:

- Depreciation –which is an accounting transaction and not a cash flow;
- Cash Reserves;
- Sunk Costs – these can be omitted from the analysis but note should be made in the business case of quantum of sunk costs to date; and
- Value Added Tax (VAT) - in the event that additional VAT revenue is generated as a result of the scheme, this revenue can be included but only if it is additional and net of deadweight.

Table 7: Main Types of Cashflows in a Financial Appraisal

Outflows	Description
Investment Costs	The initial capital outlay, usually a once off cost incurred at the outset of a project
Operating Costs	On-going running costs for a project e.g. utilities, labour, material, accommodation costs, administrative costs, including renewals costs
Start-Up Costs	Preparatory studies, consulting, training, R&D, design, planning
Decommissioning Cost	Costs associated with removing an asset from use
Inflows	
Operating Revenues	Revenue from charges or tolls / dividends
Residual Value	The value of an asset at the end of its useful life or at a point in time, usually a once off value. The residual value of an asset should usually be the discounted value of net future revenue after the time horizon. It can also be considered as the value of the asset in its best alternative use e.g. scrap.
Dividends	

Step 3: Quantify the Costs

This process often requires accountants, economists, engineers and other specialists to accurately estimate the costs. Estimates should be as realistic as possible and presented in constant or current prices, allowing for sector specific price changes.

Step 4: Identify the pattern and discount the cash flows

The real discount rate for economic appraisals is set by the Department of Public Expenditure and Reform and is available in the Annex to this document or alternatively it is available in Section E of the Public Spending Code.

Step 5: Sensitivity Analysis

Carry out sensitivity analysis of the most critical cost and revenue variables.

Step 6: Reporting

The results of the analysis should be reported in General Financial Analysis tables highlighting any areas that are likely to cause cash flow or financial difficulty at any stage during the projects/programme life cycle.

As per the requirements of the Public Spending Code, appraisers should seek to use values in real terms and numbers in the first instance.

4.1.4 General Financial Appraisal: Exchequer Analysis

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. For projects or programmes exceeding the capital or current thresholds of €20 million or €5 million respectively, an exchequer appraisal should be carried out. This is a more detailed financial appraisal. In the context of transport projects, an Exchequer Analysis should follow the steps above for financial analysis and 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.

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

4.1.5 General Financial Appraisal: Analysis of sources of funds

An analysis of sources of funding should outline each of the different types of financial funding and instruments that are used to financially support the project. A summary of the sources of finance for the preferred option(s) should be outlined. The analysis should focus on funding over the duration of the project and programme. When finalising this analysis it is important that the percentage of public funding for the project is clearly identified and the exchequer budgetary impacts clearly outlined.

4.2 Economic Appraisal

This section gives detailed guidance of economic appraisal in two broad areas; quantitative and qualitative. A detailed explanation of the acceptable quantitative appraisal tools is provided below. These include: Cost-Benefit Analysis, Cost-Effective Analysis and Multi-Criteria Analysis.

4.2.1 Economic Appraisal: Cost-Benefit Analysis

What is a Cost-Benefit Analysis?

Cost-benefit analysis is the main technique for public sector project appraisal. It quantifies in monetary terms, the social costs and benefits of particular projects or programmes to all affected groups. The basic rationale behind cost-benefit analysis is the idea of maximising economic efficiency for the spending of public money which has competing alternative uses. At the centre of cost benefit analysis is the concept of opportunity cost which gives the real cost of withdrawing resources from other uses.

When to use a Cost-Benefit Analysis?

Cost-benefit analysis is generally used before projects are undertaken (ex-ante) but can also be used to evaluate the costs and benefits of particular projects after the money has been invested (ex-post). As cost-benefit analysis values costs and benefits using a common monetary value, it can help with the ranking of different alternatives for projects within sectors, once the public money has been sectorally distributed. The results of a cost-benefit analysis should at a minimum be presented in the Economic Efficiency of the Transport System Table and the Summary of Costs and Benefits Table. Templates and explanations for each of these tables are contained in Section 7.

What information is needed to carry out a Cost-Benefit Analysis?

Generally the information needed to carry out a cost-benefit analysis includes:

- A monetary value of each benefit/cost (i.e. value of time, air quality, collisions, etc.);
- The monetary value of all discounted costs and the profile of costs over the lifetime of the programme;
    - Inclusive of both capital costs (i.e. construction costs, capital maintenance and renewals) and current costs (i.e. maintenance and operation); and
    - The monetary value of discounted benefits (including residual values) and the profile of benefits over the lifetime of the programme.

Steps involved in carrying out a Cost-Benefit Analysis

The CBA is one part of the overall appraisal process for a programme, project or scheme. Document B01 of the Public Spending Code sets out the standard appraisal steps for a project or programme. These are:

(i) Define the objective

(ii) Explore options taking account of constraints (see pre-appraisal)[4]

(iii) Quantify the costs of viable options and specify sources of funding

(iv) Analyse the main options

(v) Identify the risks associated with each viable option

(vi) Decide on a preferred option

(vii) Make a recommendation to the Sanctioning Authority

This section focuses mainly on **steps (iii) to (vii)** which comprise the key tasks in a CBA. Prior to undertaking the CBA, the objective of the proposals should be clearly outlined and they should be Specific, Measurable, Accurate, Realistic and Timely (SMART), i.e. what needs are to be met and what is the planned scale on which those needs will be met and measured. The realistic alternative ways in which the objective can be achieved should also be listed. This should include the option of doing nothing or a consideration of whether an objective could be achieved by ways other than expenditure by the State. In general, at least 3 realistic Do-Something options should be included at the detailed appraisal stage.

Step iii: Quantify the Costs of Viable Options and Specify Sources of Funding

A comprehensive approach should be taken to ensure that all relevant costs and benefits are included. It can be useful to consider the different costs and benefits arising by considering the impacts on different stakeholders affected by the project being appraised.

The costs of a project should reflect the best alternative uses to which resources can be put or opportunity costs. Opportunity costs should usually be reflected in market prices. It can be useful to categorise the various types of incremental costs which arise in a project. One approach to identifying costs involves the distinction between fixed, variable and semi variable costs:

- Fixed costs which remain static over a given level of activity or output e.g. rent.
- Variable costs which change in line with changes to the volume of activity or output e.g. operating costs.
- Semi variable costs which can include a fixed and a variable component e.g. maintenance costs.

It is also important that costs are calculated on a marginal instead of an average basis, i.e. the costs which apply specifically to the incremental project outputs. For example, the marginal cost for road maintenance on a particular stretch of road included in a project proposal may be lower than the average costs applying to an entire route. Capital and operating costs should be included in the analysis. Capital costs will tend to arise in the earlier time periods whereas operating costs arise on an on-going basis throughout the project.

In respect of each chosen alternative, the following should be provided:

[4] Development and sifting of realistic options should be clearly documented and form part of the business case process.

- A list of the benefits and costs that are expected to arise over the economic life of the project and the assumptions that underlie these benefits and costs. Section 5 on Transport Parameters provides more detail on transport-specific costs and benefits. Table 8 below gives examples of typical project costs and benefits.
- A quantification of the benefits and costs over time brought back to present values and a 2011 base year.

Table 8: Examples of Typical Project Costs and Benefits

Typical costs arising in projects	Typical benefits arising in projects
Labour costs	Travel time savings
Investment costs e.g. construction costs, materials etc.	Reductions in vehicle operating costs
IT costs	Reductions in collisions
Fixed assets	Reduced environmental emissions
Equipment	Health and absenteeism benefits
Overheads	Lower operating and maintenance costs
Operating costs	Job creation
Maintenance costs	Travel time savings
Negative externalities (e.g. noise pollution, congestion, community severance, etc.)[5]	Other positive externalities (ability to provide emergency services, increases in land use, etc.)

Sunk costs are costs incurred before the appraisal period and for which there is no opportunity cost. Sunk costs could include expenditure on previous feasibility studies. CBA is only concerned with costs about which decisions can still be made.

Allowance should be made where contingencies are part of the expected costs of the proposal and included in the CBA. As set out in Section D.03 of the Public Spending Code, projects with large initial capital outlays should include sufficient contingency provision for escalating construction costs or delays. As projects progress through the various stages of appraisal, more precise quantification of project costs becomes possible. Therefore, the scale of this provision may be reduced as the design elements of the project become more certain. Appraisers should agree contingency levels when discussing key assumptions with SRAD.

Market prices are the value of costs and benefits in consumer prices and normally reflect the best alternative uses to which the goods or services could be put or the opportunity cost. While market prices are generally reliable and verifiable, in some cases market prices do not reflect opportunity costs due to market failures. Shadow prices may then be used although there should be clear and convincing reasons for doing so. The Public Spending Code under Section E provides guidance on a number of key shadow prices such as the shadow price of public funds, shadow price of labour and shadow price of carbon. These

[5] Externalities can be benefits or costs which affect third parties who are not charged for the benefit or compensated for the cost. External benefits include public good effects and beneficial spillover effects for third parties (e.g. new tourist facilities may benefit local businesses). External costs include congestion effects and pollution.

parameters must be included alongside transport parameters when carrying out economic appraisal.

Benefits should always be valued based on willingness to pay. Where market values are not available (e.g. value of life, value of time), other techniques can be used. These include stated preference techniques such as contingent valuation as well as revealed preference techniques such as hedonic pricing and travel cost analysis. Ideally, revealed preference techniques should be used because this reflects real behaviour whereas stated preference techniques reflect hypothetical choices in response to questionnaires and surveys.

An important driver of the quality of a cost-benefit analysis is the rigour of demand estimates. The projections of demand for a proposal must be based on reliable evidence and subject to independent, expert validation. The project analyst should carry out a demand analysis which takes into account the role of determinants such as price and non-price factors like income levels, expectations etc. Demand forecasting techniques include, among others, extrapolation methods, consultation with experts and econometric analysis.

The appraisal timeframe should be the economically useful life of the project. In line with Section E of the Public Spending Code, transport infrastructure projects such as road and rail should be appraised over a thirty year period whereas shorter-lived projects should be appraised over the life time of the asset. Appraisers should agree the appropriate time period when discussing key assumptions with SRAD. If the project has capital assets that have a useful life exceeding the time period of the CBA, the residual values of the assets should be calculated and included as a benefit. It is important that residual values are accurately estimated and include any offsetting costs such as decommissioning or remediation costs. Residual value should be understood as the market value for the fixed assets (or liquidation value of assets in the case they are sold out at end year) and includes the appraisal of the net revenues the project can generate beyond the time horizon. Section 5 provides more detail on how to calculate residual values.

Deadweight occurs when public expenditure is incurred to achieve benefits which would have been achieved in the absence of the project scheme being funded. Deadweight is closely linked to additionality. Additionality takes place when the funded project achieves benefits which otherwise would not have been achieved and these benefits can be attributed to the intervention. Benefits should be valued net of deadweight and should reflect the best estimate of additionality accruing to a project.

In general, transfer payments should be excluded because from society's perspective such payments have no effect on real resources and benefits are merely transferred from one part of society to another e.g. unemployment benefits. However, to the extent that the economic activity arising from the project will be additional (i.e. not displaced), the tax revenues arising, including PRSI, should be included as a benefit. Care should be taken to avoid double-counting in this regard; taxation is a portion of the total value-added (benefit) generated by the project, it is not a benefit in addition to the total value-added generated. Grant-aid and subsidies to the project should be included as a cost. Exchequer cash flows (taxes and grants) should be shown separately from other cash flows.

A common error made in CBA analysis relates to the double counting of the same benefits. Any type of benefit that is not deemed to be additional should not be included in a CBA. Examples of double counting which should be avoided include:

- Applying both commercial revenue from usage charges and only benefits to users;
- Value of time savings for a road project and benefits for local shops;

The monetary value of costs and benefits should be expressed in real terms and through applying sector specific values where available so that the effects of inflation do not distort future cost and benefit streams.

People generally prefer to receive benefits as early as possible while paying costs as late as possible. Costs and benefits occur at different points in the life of the project so the valuation of costs and benefits must take into account the time at which they occur. This concept of time preference is fundamental to CBA and so it is necessary to calculate the present values of all costs and benefits. To assist in discounting costs and benefits, the Public Spending Code provides that a common discount rate should be used for appraising public expenditure.

Step iv: Analyse the Main Options

Having identified and quantified the costs and benefits there are a number of methods/performance metrics which can be used to differentiate between options. These include:

Net Present Value Method (NPV): The Net Present Value (NPV) is the sum of the discounted cash flows over the period. This criterion is simply based on whether the sum of discounted benefits exceeds the sum of discounted costs.

Benefit Cost Ratio (BCR): This is the ratio of discounted benefits to discounted costs. If the benefit cost ratio is greater than one the project may be accepted as there are more benefits than costs. Unfortunately however this method does not take the size of the project into account so the results can be misleading. Generally a BCR of greater than 1:1 is an indicator that a proposal's benefits exceed the costs. As with the other performance indicators, a positive BCR does not automatically mean a proposal is accepted as other issues are relevant such as affordability constraints and qualitative factors.

Internal Rate of Return (IRR): The internal rate of return is the maximum rate of interest that a project can afford to pay for the resources used which allows the project to cover the initial capital outlay and on-going costs and still break even. It can also be described as the discount rate that equates the present value of benefits and costs. The IRR is generally compared to a hurdle rate of return (normally the test discount rate for public investment appraisal) which corresponds to the opportunity cost of funds. If project appraisers have difficulty calculating the IRR in some cases, they should contact the SRAD to discuss.

Templates for the presentation of these values are provided in Section 7.

Step V: Identify the Risks Associated with Each Viable Option

Project appraisal involves forecasting the values of costs and benefits using the best information available. An inherent problem with the CBA approach is the difficulty in predicting these values. The estimated values of costs and benefits may not materialise as expected due to uncertainty and risk. There may also be biases in the analysis. The risks of adverse conditions and the potential uncertainty associated with each option should be identified and factored in to the decision making process. Realistic assumptions should be made which reduce the element of uncertainty and risk minimisation strategies should be put in place.

It is important that steps are taken to manage risk and uncertainty as part of the appraisal process. The assessment of risk and uncertainty is one the most important components of a CBA and should be given significant attention. There are a number of key steps which should be taken:

1. Ensuring the data and assumptions underlying the estimation of costs and benefits are reliable and realistic
2. Identifying risks e.g. examining each variable to assess the level of uncertainty involved
3. Using risk assessment techniques to assess the level of risk and the impact of risk on project performance including such techniques as:
    a. Sensitivity analysis
    b. Scenario analysis
    c. Expected values
    d. Monte Carlo analysis
4. Devising a risk management strategy, including measures to contain, avoid and mitigate risks, as appropriate
5. Communicating the risk management strategy to relevant stakeholders

More detail on dealing with Risk and Uncertainty is presented in Section 4.4 of this Section.

Step vi: Decide on a Preferred Option

Decide on the preferred option, specify it and a clear and detailed time profile for actions (including time for planning and decision making) and for expenditure. Excessively high quality and cost specifications should be avoided. A balance must be struck between specifications which are excessive relative to needs and low quality specifications which may generate short-term economies but which lead to greater costs in the long-run.

Step vii: Make a Recommendation to the Sanctioning Authority

The rationale for recommending the preferred option should be clear and sufficient evidence presented to decision makers to check the evidence and assumptions leading up to the selection of that option. It may be that the preferred option is not the proposal with the highest NPV due to some critical non-quantifiable or qualitative factors. If this is the case, the specific reasons for disagreeing with the quantitative analysis should be explicitly stated. If there is a budget constraint, the proposal which maximises the benefits within the spending constraint should be chosen as the preferred option.

The results of the Cost-Benefit Analysis should be presented appropriately and summarised in the Monetised Cost and Benefits Tables (Section 7) through the calculation of the Present Value of Benefits (PVB), Present Value of Costs (PVC), and Net Present Value of Costs and Benefits (NPV).

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.

Where other significant costs and benefit exist but are not monetisable, the analyst should insert a comment below the BCR result to indicate that other qualitative benefits and costs

are available and that the BCR result does not provide a good measure of value for money and should not be used as the sole basis for decisions.

4.2.2 Economic Appraisal: Cost-Effectiveness Analysis

Cost-effectiveness analysis (CEA) compares alternative policies, programmes or projects with a common effect. It presents alternatives in order to identify the most appropriate option to achieve the most effective result at least cost. The aim of the analysis is to select the project that for a given output level, minimises the net present value of the costs or alternatively for a given cost, maximises the output level.

The tool can compare different measures with identical objectives, can establish a visibility of the intervention effectiveness and can be used as a communication tool which summarises outcomes using a single quantifiable indicator. A limitation of this tool is that it focuses on the primary expected impact of intervention, while other secondary or tertiary impacts may be ignored thus making the use of a cost-effectiveness analysis counterproductive.

When to use a Cost-Effectiveness Analysis?

This type of analysis is particularly useful when considering programmes or projects whose benefits are very difficult to monetise. A single unit of output is required in order to compare options. This type of analysis lends itself to assessment of projects with high environmental aspects. For these types of projects simple CEA ratios are used such as the cost per unit of emission reduction. CBA is more useful than CEA when a money value can be given to both costs and benefits. Generally, CEA solves a problem of resource optimisation that usually presents itself in two ways:

- Given a fixed budget and a number of alternative projects, how can project promoters maximise the outcomes, measured in effectiveness;
- Given a target level of effectiveness, how can project promoters minimise costs.

What information is needed to carry out Cost-Effectiveness Analysis?

In broad terms the information needed to effectively derive a CEA is:

- Primary objective of the intervention;
- An indicator that measures the objective; and
- Comparable estimates of costs of each intervention under consideration.

Steps involved in carrying out a Cost-Effectiveness Analysis

Step 1: Define the conditions for its use - in cases where a priority outcome or quantifiable outputs can be determined, the use of Cost-Effectiveness Analysis should be employed. The method is adapted for projects or programmes for which expected outcomes are clearly identified and whose costs are easily measurable. Identifying the relevant data at this stage is very important. Where data is not available, either directly or through appropriate proxies, Cost-Effectiveness Analysis should be avoided.

Step 2: Determine the effectiveness criteria and develop the relevant indicator - the choice of effectiveness criteria depends on the main objective of the intervention. Where there is a clear primary objective, the identification of effectiveness criteria is straight forward. For example, where an intervention is to reduce emissions, the indicator could be the reduction in emissions per user. But where the intervention's main objective is broad or unclear, the identification of this objective should be determined through stakeholder consultation.

Step 3: Evaluate the total cost of the programme. - both indirect and direct costs should be included in this calculation as well as any other costs that may result as an impact of the programme. Direct costs could include financial transfers, decreases in taxes, costs for financing the project and activities, staff costs, etc. Indirect costs could include the cost monitoring the programme or effects on other transport users as a result of the programme or project. Other types of costs such as opportunity costs may also be factored into the analysis.

Step 4: Measure the impacts of the project/programme - depending on the intervention, data availability and the stage (i.e. ex-ante, ex-post or interim), the appraiser may have to forecast the quantitative results of the programme. This information could be gathered from other counties and micro simulation techniques may be required. When this tool is employed for evaluation either at the end or during a programme, the appraiser should use primary data to estimate the impacts.

Step 5: Establishing a Cost-Effectiveness Ratio - when deriving the Cost-Effectiveness Ratio (CER), the interventions that are being compared have to have a common unit of comparison, applying the same realistic assumptions and ensuring all costs are included for all interventions. When for the same objective the analysis compares different types of interventions with identical costs, it is supported by qualitative elements.

What information is needed to carry out a Cost-Effectiveness Analysis?

Where costs are the same as the costs in the financial analysis, the measurement of effectiveness depends on the chosen outcome. In the case of transport, the measures of effectiveness could be number of hours saved per user, collisions avoided, etc. The box below briefly explains the methodology of CEA. This approach allows appraisers to rank and select the option with the lowest Cost-Effectiveness Ratio or a combination of the strategies that use the budget in the most efficient way.

COST-EFFECTIVENESS ANALYSIS

When the alternative projects are competitors and mutually exclusive, an incremental analysis is required in order to rank the projects and single out the one that is most cost-effective. Generally cost-effectiveness analysis is pursued to test the null hypothesis that the mean cost-effectiveness of one project (a) is different from the mean cost-effectiveness of some competing intervention (b). Where C is cost and E is effectiveness. It is calculated as the ratio (R):

$R = (C_a - C_b) / (E_a - E_b) = \Delta C / \Delta E$

defining the incremental cost per unit of additional outcome.

When a strategy is both more effective and less costly than the alternative ($C_a - C_b < 0$ and $E_a - E_b > 0$), it is said to 'dominate' the alternative. In this situation there is no need to calculate cost-effectiveness ratios, because the decision on the strategy to choose is obvious.

However, in most circumstances, the project under examination is contemporaneously more (or less) costly and more (or less) effective than the alternative(s) ($C_a - C_b > 0$ and $E_a - E_b > 0$ or, alternatively, $C_a - C_b < 0$ and $E_a - E_b < 0$). In this situation, the incremental cost-effectiveness ratios allow appraisers to rank the projects under examination and to identify, and then eliminate, cases of 'extended dominance'. This can be defined as the state when a strategy is both less effective and more costly than a linear combination of two other strategies with which it is mutually exclusive. More operationally, extended dominance is where the incremental Cost-Effectiveness Ratio for a given project is higher than that of the next more effective alternative.

Source: Guide to Cost-Benefit Analysis of Investment Projects, European Commission, 2014

4.2.3 Economic Appraisal: Multi-Criteria Analysis

Multi-Criteria Analysis (MCA) is an appraisal tool used to evaluate alternatives based on identified criteria and ranked on the basis of an aggregation procedure. The criteria would normally reflect policy, programme or project objectives and other considerations as appropriate, such as value for money, environment, social inclusion, etc. Scores achieved do not necessarily need to be conveyed in quantitative monetary terms, but can simply be expressed in physical units or in qualitative terms.

While MCA can be expressed in either qualitative or quantitative terms, it is common to apply numerical analysis to a performance matrix in two stages:

- Scoring: the expected consequences of each option are assigned a numerical score on a strength of preference scale for each option for each criterion. More preferred options score higher on the scale, and less preferred options score lower. In practice, scales extending from 0 to 100 are often used.
- Weighting: numerical weights are assigned to define, for each criterion, the relative valuations of a shift between the top and bottom of the chosen scale.

When to use a Multi-Criteria Analysis?

The Public Spending Code determines that Multi-Criteria Analysis (MCA) should be carried out at a minimum for projects between €5 million and €20 million.

MCA can be used as an alternative or complementarily to appraisal techniques which primarily use monetary valuations (Financial Analysis, Cost-Effectiveness Analysis and Cost-Benefit Analysis) when there are different impacts that may be quantified but not monetarily valued, such as social impacts or environmental impacts (for example, impacts on landscape). In this way, it can provide a useful framework to evaluate different transport options with several criteria. MCA can complement a CBA if certain important parameters are not monetisable.

MCA enables projects to be assessed against more than one objective. It is also worth noting that the application of MCA is not restricted to situations where the aim is to find only the single most appropriate option to follow through. MCA is particularly useful when it can offer a quick and cost effective way of short listing projects and comparing them against strategic objectives in a structured way.

What information is needed to carry out a Multi-Criteria Analysis?

In general terms, the information necessary to perform a multi-criteria analysis are:

- The options, alternatives, scenarios, policy measures or strategies that have to be compared to each other;
- The evaluation criteria that will be used to assess these options;
- The importance of these criteria (that is, the weights); and
- The evaluation of the options on the different criteria. These evaluations can be given a numerical or ordinal (comparative) scale.

Steps Involved in carrying out a Multi-Criteria Analysis

Step 1: Establish decision context **-** a first step is always to establish the decision context. Central to this are the objectives of the decision making body, the administrative and historical context, identification of the people who may be affected by the decision and an

identification of those responsible for the decision. In applying MCA it is important to identify a single high level objective, for which there will usually be sub-objectives. A common component of this step can be to refer to underlying policy statements.

Step 2: Identify the options - having established the decision context, the next step is to list the set of alternative options to be considered. Sometimes the problem will be a very wide range of possible options and it will be the role of the MCA in the first instance to provide a structured sifting of alternatives to identify a shortlist, using basic data and quick procedures. It is sometimes worth carrying out some informal sifting against established constraints (e.g. legal, structural, environmental, etc.). It is not worth considering and putting effort into gathering data about clearly infeasible propositions. This step may have to be repeated, particularly in cases where there is a lack of acceptable alternatives.

At this stage, engagement with a mix of stakeholders and key players is often used to identify the most important options. Options are important only for the value they create by achieving objectives. It is better to consider objectives first, particularly when the options are not given and have to be developed.

Step 3: Objectives and criteria - the criteria and sub-criteria are the measures of performance by which the options will be judged. 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. The criteria are included in the table below and further discussed in section 4.3.

Table 9: Project Appraisal Criteria

Economy	The impacts of a transport investment on economic growth and competitiveness are assessed under the economic impact and economic efficiency criteria.
Safety	Safety is concerned with the impact of the investment on the number of transport related accidents.
Integration	Integration considers the extent to which the project being evaluated promotes integration of transport networks and is compatible with Government policies, including national spatial and planning policy.
Environment	Environment embraces a range of impacts, such as emissions to air, noise, and ecological and architectural impacts.
Accessibility and Social Inclusion	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.
Physical Activity (where applicable)	This relates to the health benefits derived from using different transport modes

Step 4: "Scoring" - describe the expected performance of each option against the criteria - A basic MCA will present the decision maker with the performance matrix itself. A performance matrix presents how each alternative option performs on each of the criteria that form part of the analysis. The task for the decision maker is then to study the matrix, and come to a view on the ranking of the options – probably assisted by some supplementary advice from those who constructed the matrix on their views of how the information should be interpreted.

The measures used in performance matrices of this kind can be qualitative or quantitative. Often qualitative descriptions are used (e.g. scaling statement) or natural units (e.g. price or length), or sometimes a crude numerical scale (e.g. number of stars), or even a scale of 0 to 100. When a qualitative approach is to be used, analysts should refer to section 4.4. on qualitative appraisal techniques.

When assessing the project with performance levels the first consideration in setting up consistent numerical scales for the assessment of criteria is to ensure that the sense of direction is the same in all cases, so that (usually) better levels of performance lead to higher value scores. This may mean a reversal of the natural units. For example, access to a facility might be recorded in terms of distance to the nearest public transport, where the natural scale of measurement (distance) associates a low number with a good performance. The thresholds at which a project "passes" each criterion should be agreed in advance of scoring. If no weighting is proposed, analysts should proceed to Step 7.

Step 5 (Optional): "weighting" - assign weights for each of the criteria to reflect their relative importance to the decision - 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.

The weighting of alternative criteria can be used to clarify the relative importance of each of the individual criteria in the overall decision. While all criteria can be given equal weighting, different weightings can be applied to different criteria reflecting their importance in the objectives.

The use of weightings between factors is not mandatory, but where weightings are to be used, they should be proportionate. In particular, where "Economy" is used as a criterion, it would be expected that criterion, or criteria category, would have a high proportion of the weighting. If no weighting is given, then all criteria are weighted equally.

Where weighting is used, the key idea is to construct numerical scales. It is conventional to allocate a value score to each criterion between 0 and 100 on an interval scale. The advantage of an interval scale is that differences in scores have consistency within each criterion. When combined with appropriately derived importance weights for the criteria, the use of an interval scale measurement allows weighted averages to be calculated across the preference scale and a full MCA to be carried out.

Step 6 (Linked to Step 5): Combine the weights and scores for each of the options to derive an overall value **-** if weighting is applied, the weighted scores for each option are then calculated. Normally this process is carried out in a spread sheet analysis or computer model. The method for calculating the overall preference score for each option is simply the weighted average of its scores on all the criteria. Basically one can multiply an option's score on a criterion by the assigned weight for that criterion, do this for all criteria, and then sum the products to give the overall preference for that option.

Step 7: Examine the results and make recommendations **-** the top-level ordering of options is given by the average of all the preference scores. The ranking of the various alternatives gives an indication of how much better one option is over another and also the strong and weak points of the proposed alternatives. Another useful display of overall results is to move down a level. If costs and benefits constitute the next level down, then a graph of benefits versus costs can be instructive, for it essentially shows a relative value-for-money picture. The outer surface of the plot gives the most cost-effective options. Options appearing on the outer surface are said to 'dominate' options inside because they are both more beneficial and less costly.

Step 8: Conduct a sensitivity analysis of the results to changes in scores or weights **-** the stability of the ranking can be assessed through a sensitivity analysis. Sensitivity analysis provides a means for examining the extent to which vagueness about the inputs or disagreements between people makes any difference to the final overall results. Especially for appraisal of schemes or projects that attract public interest, the choice of weights may be contentious.

4.3 Qualitative Guidance

As mentioned above, not all impacts of a programme can be captured in a quantitative appraisal, and for these impacts a qualitative appraisal will be necessary.

The topics considered in a qualitative appraisal are:

- Economy
- Safety
- Environment
- Accessibility and Social Inclusion
- Integration
- Other Government Policies
- Non-quantifiable economic impacts

4.3.1 Economy

The measurement of economic impacts within the Project Appraisal Balance Sheet (PABS) aims to determine the relative welfare gain from implementation of the proposed project. At the Business Case stage of project delivery, more detailed costings for the preferred option will be available and economic analysis will be completed. The appraisal of economic impacts therefore utilises a summary of both qualitative and quantitative data from these assessments.

In a perfectly competitive economy with prices reflecting full marginal social costs, the efficiency and effectiveness benefits would encompass the full economic impact of the transport investment. As markets are far from perfect, it is certain that other economic impacts occur that although not always quantifiable, are still important. Examples of market imperfections are transport investments that give rise to spill-over 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:

- Transport Quality
- Transport Reliability
- Re-organisation impacts
- Agglomeration effects
- Increased competition in the economy
- Increased output of firms
- Tax benefits arising from increased labour supply
- Employment impacts
- Inward investment impacts

For example, agglomeration effects 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. Similarly, 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.

4.3.2 Safety

Transport sector proposals 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 collisions, 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 a collision reduction benefit.

A qualitative assessment can be used to highlight matters including, but not limited to:

- The user groups affected by safety improvements, for example car occupants, pedestrians and cyclists;
- A change in the balance of accidents; for example, fewer fatalities or serious injury accidents, but an increase in slight injury accidents; and
- Any uncertainties in the assessment.

4.3.3 Environment Impacts

Air Quality

Transport is a significant contributor to Ireland's 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 (CH4) also has substantial greenhouse impacts.

With regard to local air quality, NO_x, together with CO, NMVOC, SO_2, lead and PM, 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.

Noise and Vibration

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.

Accordingly, it is not proposed to estimate noise impacts at the preliminary appraisal stage of projects, 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.

Landscape and Visual Quality

Transport infrastructure has the 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. Qualitative information detailing the key landscape characteristics affected or effects on key views may be presented in the PABS.

Biodiversity

At the top of the hierarchy, and forming the cornerstone of Europe's nature conservation policy, are the EU Birds Directive and EU Habitats Directive. Together they give effect to the Natura 2000 network of protected sites and a strict system of species protection. The Natura 2000 network provides an ecological infrastructure for the protection of sites that are of particular importance for rare, endangered or vulnerable habitats and species within the EU and include both Special Areas of Conservation (SAC) and Special Protection Areas (SPA).

These directives have been transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011, which consolidates the European Communities (Natural Habitats) Regulations 1997 to 2005 and the European Communities (Birds and Natural Habitats)(Control of Recreational Activities) Regulations 2010.

Effects on biodiversity are generally considered in terms of impacts on specific flora or fauna, or on defined habitats. The EU Habitats Directive (94/43/EEC) on the conservation of natural habitats and of wild fauna and flora should be considered if 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. If this is likely to be the case, an Appropriate Assessment of the projects implications may be necessary. It should also be noted that requirements for Appropriate Assessment are becoming more stringent, reflected in the growing case law in this area, and there is a risk to the delivery of projects if provision is not made at the outset of investment decisions to ensure that transport projects are compliant with biodiversity and ecology obligations.

Qualitative statements that detail the potential impact on biodiversity objectives such as the direct and indirect impact on protected species or designated sites should be included in the PABS.

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. For example, the project appraiser may include the percentage of such sites that directly impacted by the scheme.

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 religious institutions). Soils in areas close to transport routes and particularly roads 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. For example, the area/volume of the soils affected by pollution or use could be reported along with the overall impact on property, soils and geology.

Water Resources

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.

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.

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.

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.

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.

Environmental Impacts and the 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 this guidance in respect of environmental criteria is permitted in this regard.

4.3.4 Accessibility and Social Inclusion

Government policy in respect of the socially excluded is articulated through the National Action Plan for Social Inclusion (NAPSI). 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.

Transport investment, by its nature, has a particularly strong role to play in respect of people living in rural areas with poor access, people who suffer from mobility and sensory deprivation, connecting young people, particularly those who live in disadvantaged areas, to services education and work opportunities and improving women's access to a number of services in line the National Women's Strategy.

Because of data and resource issues, a comprehensive analysis of the impact of a transport proposal on the NAPSI 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.

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;
- 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.

The output for vulnerable groups in the PABS detail the impact on groups such as non-car owners, people with a disability or those on low incomes. Appraisers should try to quantify the change in service levels to these groups and/or the distribution of consumer surplus.

Deprived Geographic Areas

Establish whether the proposal improves accessibility for people in socially deprived areas, particularly those areas covered by the Area Based Childhood programme, Rural Social Scheme and/or for those with a disability. Again, assessment of these impacts should be undertaken through Qualitative, Quantitative and Scaling statements.

4.3.5 Integration

A number of aspects of integration need to be considered in the qualitative assessment of the project options:

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.

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, climate change and sustainable development. For example:

- Modal Integration: This is concerned with integration across and within transport modes with the objective of creating a seamless transport policy.
- Geographical Integration: This refers to integration of transport networks across geographical and juridical boundaries.

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

<u>Land Use Integration</u>

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.

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.

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.

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

Transport Integration

Transport integration 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.

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.

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.

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.

Consideration of transport integration effects is likely to centre on both the improved services made possible and the infrastructure provided. 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 ticketing (including fares integration).

This analysis should also assess the potential dis-benefits 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. 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.

Potential dis-benefits 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.

Geographical Integration

The Department of Transport, Tourism and Sport's Statement of Strategy highlights three aspects of geographical integration:

- Improve integration of rural and local services;
- Improved internal transport links with Northern Ireland; and
- Access transport links with Europe and the rest of the world.

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.

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

Trans-European Networks of Transport (TEN-T) is the building block of the European transport network, this policy aims to close the gaps between Member States' transport networks, remove bottlenecks that still hamper the smooth functioning of the internal market and overcome technical barriers such as incompatible standards for railway traffic. It provides the underlying framework for the "quick-start" list of priority projects which are to give new impetus to the European Economy.

The TEN-T programme under the Connecting Europe Facility will co-fund investments that qualify under the rules for this type of funding. For Ireland, pre-identified priority projects include the Cork-Dublin-Belfast Rail line, and the Dublin- Cork-Southampton Port and Rail link. Transport projects within the TENs-T programme should rank highly in terms of the Integration Criterion.

4.3.6 Other Government Policy Integration

Regional Balance

The major Government policy to which transport investments could potentially contribute is the successor to the National Spatial Strategy (NSS) which was published by the Government in 2002. A new national spatial planning framework will set a strategic, national context for the proposed new regional, spatial and economic strategies to be prepared by the three new regional assemblies as replacements for the current regional planning guidelines (RPGs), which expire at the end of 2016.

It is likely that the regional, spatial and economic strategies will, as with the previous Regional Planning Guidelines, play an important part in translating the broad national level spatial planning objectives into more actionable development objectives and requirements at the level of the local authority statutory development plan.

It is also probable that the focus of the successor to the NSS will at least in part be 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 underutilised". 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.

From an infrastructure perspective, 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 large towns and cities or giving local access to large towns and cities in the peripheral regions;
- Between large towns and cities 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.

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.

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 on-going 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.

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

Again, assessment of Integration impacts should be undertaken through Qualitative, Quantitative and Scaling statements.

4.4 Risk and Uncertainty

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.

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

A number of potential steps involved in evaluating risk and uncertainty are set out below. The effort applied at each step should be proportionate to the funds involved, outcomes at stake and the stage of the appraisal.

4.4.1 Steps Involved in Evaluating Risk and Uncertainty

Step 1: Risk identification

A risk register lists all the identified risks and the results of their analysis and evaluation. Information on the status of the risk should also be included. The register should be continuously updated throughout the course of a project. The types of risk that may be encountered could include policy risk, risk on delivering the asset (i.e. construction risk), risk on operating the asset (i.e. operating costs may increase), risks on demand and/or revenue, or other type of risks (i.e. Reputation risk, Technology Risk, etc.).

Developing a risk register is a useful tool to identify, quantify and value the extent of risk and uncertainty relating to proposal. This tool can be used to identify the bearer of risk and uncertainty associated with the project being appraised, provide an assessment of the likelihood of each risk occurring, and estimate the impact on project outcomes.

To identify the main areas of risk and the bearer of each risk it could be useful to organise expert workshops that bring all the relevant experts who understand the risks associated with the project together. Where the private sector has clear ownership, responsibility and control, it should be encouraged to take all of those risks it can manage more effectively than the procuring authority. If the public body seeks to reserve many of the responsibilities and controls that go hand-in-hand with service delivery and yet still seek to transfer significant risk, there is a danger that the private sector will increase its prices. Catastrophic risk such as natural disasters is one of the factors that make up the discount rate so it not necessary to identify such risks as part of the assessment.

Step 2: Assessing the impacts of risks and estimating likelihood of outcomes occurring

Having identified risks, the next process is to assess the impact of each risk, or combination of risks, should they be realised, in terms of the cost outcomes of the risk. This could be through modelled sensitivity analysis or evidence from similar schemes. The range of outcomes should consider both the upper and lower extremes of the possible range, taking into account any reasonable constraints.

The best methods for quantifying the impact of risk will depend upon the information sources available. The best approach is to use empirical evidence whenever it is available,

and empirical evidence should be gathered when possible. When it is not, common-sense approximations should be used, rather than aiming for unrealistic or spurious levels of accuracy. What this means in practice depends on the nature of the risk. The objective is always to obtain an unbiased estimate of the impacts of the risk on the costs of the scheme.

When assessing the consequences of any risk, analysis should not be restricted to only the direct effects but should be extended to ensure all knock-on effects are included. This requires care, as there could be interaction between different risk events. Some risks will affect the costs of either the construction or operation of the project.

Once the risk impact on the cost outcomes are identified, the analysis should focus on the likelihood for each of the possible outcomes, the likelihood should be based on experience of past events, foreseeable changes rather than spurious estimates.

Estimating probabilities is not an exact science and inevitably assumptions have to be made. There is nothing wrong with this, but it is important that the assumptions in the assessment are reasonable and fully documented, as they are open to question when submitted to the Department.

Step 3: Deriving the probability distribution for the costs of the scheme

The aim of the risk assessment is to derive a probability distribution around the costs of the scheme which enables the expected risk adjusted costs estimate to be obtained. The expected outcome is often referred to as the unbiased outcome which is basically the weighted average of all potential outcomes and associated probabilities.

Many risks are linked so if one risk occurs another risk is likely to occur. Where a detailed analysis of the preferred option is to be undertaken, modelling software such as Monte Carlo simulation can assist the project team in establishing a range of costs. The aim is to create a probability distribution or an S curve which gives the probability of the scheme cost estimate being less than or equal to any specific value.

Step 4: Risk Mitigation

Once risks have been identified, project/programme promoters should prepare risk mitigation plans and provide evidence of the approach to responding to risks. Responding to risks will involve:

- Tolerating risks: Tolerating risks should occur when the cost of the taking any action exceeds the potential benefits gained or there are no alternative courses of action available.
- Treating or transferring risks: The purpose of this is to affect the likelihood of the risk while continuing with the activity giving rise to the risk. The type of actions that can be employed to treat risk in this case are Preventive Controls limit the likelihood of an adverse risk occurring; Corrective Controls minimise the impact of adverse outcomes; Directive Controls ensure that a particular outcome is achieved; and Detective Controls identify adverse outcomes once realised to minimise their impact.
- Transferring risks can occur when for example insurance is used to control the risk as it facilitates financial recovery against the realisation of a risk.
- Termination: Some risks will only be treatable or containable to acceptable levels by terminating particular activities. This option is important if it is clear that undertaking certain activities jeopardises the value for money of the scheme.

Step 5: Identify Potential Contingencies

Even where an evaluation of risks and their impacts is undertaken, some risks will remain unanticipated. Additionally, as proposals progress through the various stages of appraisal, more precise quantification of costs becomes possible. Because of these factors, the total cost should include a provision for contingencies. The scale of this provision may be reduced as the design elements become more certain.

Sensitivity Analysis

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

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

Table 10: Overview of Standard Sensitivity Test

Project costing	Test sensitivity to plus or minus 20 per cent change in 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. decongestion 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 proposals	Normally, proposals that are already fully committed form part of the Do-Nothing or Do-Minimum scenario against which the proposal in hand is evaluated. Where there are other such proposals 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 proposals should be presented.

The above sensitivity tests represent a minimum. The agencies should ensure that sensitivity to other major uncertainties is tested. 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 proposal not worthwhile. This is often referred to as the “switching value” which is usually presented as a % i.e. a 20% increase in investment costs reduces project NPV to 0.

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. Scenario analysis involves using a range of different scenarios (or variations on the option under examination) where all of the various factors can be reviewed and adjusted within a consistent framework. A number of scenarios are formulated, such as best case, worst case, etc. and for each scenario identified, a range of potential values is assigned for each cost and benefit variable. When formulating these scenarios, it is important that appropriate consideration is given to the sources of uncertainty about the future (i.e.

technical, political, etc). Once the values within each scenario have been reviewed, the NPV of each scenario can then be recalculated.

4.5 Project Appraisal Balance Sheet

The output of the above analysis should be included in a Project Appraisal Balance Sheet. A PABS contains 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.

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.

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

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.

For some proposals, 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. 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.

More Detail on the PABS is provided in Section 7.

Section 5 DETAILED GUIDANCE ON APPRAISAL PARAMETERS

This section seeks to outline the parameter values which are required for use in the preparation of economic analysis, particularly CBAs.

When approaching a preliminary or a detailed appraisal, certain parameter values and rules should be employed when carrying out economic analysis. These rules and values naturally fall into two categories Central Government parameters and Transport parameters.

5.1 Central Government Parameters

Annex 1 provides detail on central government appraisal parameters that must be applied to all economic analysis of projects or programmes.

Each particular parameter section should be read in detail before application as the summary does not capture all the detailed information needed to carry out an appraisal.

Annex 1 will be updated on a regular basis to ensure consistency with central guidance.

5.2 Transport Parameters

The following section provides information on the transport parameter methodologies to be applied in the economic appraisal of transport projects and programmes, as recommended by the Department of Transport Tourism and Sport. Parameter values are set out in Annex 1. Parameters values are provided for:

- Value of Time;
  - Work
  - Commuting
  - Leisure
- Vehicle Operating Costs;
  - Fuel costs
  - Non-fuel costs
- Emission Values;
  - Noise
  - CO_2, NO_x and PM
- Collision Costs
  - Fatal
  - Serious
  - Slight
  - Damage Only
- Active Travel Values
  - Health benefits
  - Absenteeism benefits

The parameter values in Annex 1 are presented at year 2011 prices. Implementing a transport scheme usually results in a stream of costs followed by a stream of benefits, some of which have monetary values applied to them. These monetised costs and benefits occur over a number of years, and cannot simply be added together as if they all occurred simultaneously. In order to be able to add costs and benefits that occur over a period of time, two distinct issues must be dealt with:

- General changes in price levels over time (inflation); and

- Preferences for consumption now rather than later (time preferences).

The effects of inflation are resolved by means of converting all costs and benefits to a common price base year (using a "price index") and accounting for any sector specific real price adjustments.

It is recommended that, until this guidance is refreshed following Census 2016 publications, project appraisals should be couched in terms of prices prevailing in the year 2011. This will facilitate comparisons of economic return across transport projects generally, and represents common practice across transport appraisal systems.

5.2.1 Value of Time

Transportation projects frequently involve time savings as a benefit. Time savings generally account for a significant share of the benefits of transport schemes.

These values are to be applied when calculating the value of time per person for use in the economic appraisal of transport schemes in Ireland. The value of travel time varies according to journey purpose. Different values are provided for in-work/business journeys, for leisure journeys and for commuting journeys.

The calculation of the value of time benefits often involves the aggregation of time savings across many users as for individual users the time savings may be small.

All values of time presented are equity values. That is, values should not be varied according to the incomes of travellers. The values are provided at year 2011 prices.

Value of in-work travel time

This value is based on the average productivity of workers, which is based on hourly labour costs inclusive of labour overheads. Average hourly labour costs are estimated by dividing aggregate labour costs by annual hours worked.

People who travel have, on average, higher earnings than those who don't (Source: Household Budget Survey, CSO 2009-2010). An additional weighting of 1.12 is added to reflect this.

Taking into account the impact of the indirect tax factor on domestic expenditure provides Values of Time at both factor costs and market prices. The values of in-work time at both factor costs and market prices are presented in Annex 1.

Value of non-work travel time: Leisure

Leisure time valuation is more difficult to assess but is generally valued at a cheaper rate compared to work time.

The value of non-work leisure travel time is calculated at 40% of the hourly earnings of travellers (hourly earnings are calculated as labour costs without employers PRSI and pension contributions).

The 2011 average hourly earnings for travellers and corresponding 2011 values for non-work leisure time is presented at both factor costs and market prices in Annex 1.

Value of non-work travel time: Commuting

Travel Time for commuting journeys is then valued at 10% above the leisure journey value of time. These values are also presented in Annex 1.

Journey Purpose Split

Journey purpose splits are necessary in order to calculate values of time per vehicle for the average vehicle. Journey purpose splits are assumed to remain constant over time. Project appraisers should provide a proposed journey purpose split and contact SRAD to agree on this value.

Forecasting the Value of Time

The value of time should be forecast in line with forecasted growth in real GNP per person employed. Employment and Economic Forecasts are provided in Annex 1.

5.2.2 Vehicle Operating Costs

Use of the transport system gives rise to operating costs for the user. These costs include both fuel and non-fuel operating costs.

Fuel Costs

Fuel costs are estimated by taking a weighted average of the most recent Irish road vehicle fleet and applying standard fuel consumption factors by both vehicle and road type. Tables are presented in Annex 1 that provides the fuel consumption element of VOCs in litres, factor costs and market prices. These fuel consumption factors, when multiplied by the relevant fuel prices, provide the basis for calculating vehicle operating fuel costs.

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)
- Public Service Vehicles - Buses and coaches (in excess of 3.5 tonnes gross vehicle weight).

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

$$C = a1 + b1/V$$

Where:

C= cost in cents per kilometre

V= average link speed in kilometres per hour

a1 and b1 are parameters defined for each vehicle category.

Annex 1 presents the parameter values appropriate for estimating non-fuel costs in 2011 prices. For non-work vehicles the impact of VAT at 13.5 per cent was added to reflect the fact these users cannot net off VAT on inputs. In the case of work vehicles no change to the resource cost was made as users can net off VAT on inputs and therefore perceive the cost net of VAT.

Future Profile of Vehicle Operating Costs

For future fuel costs, fuel efficiency changes are taken into account through forecasting the evolution of the Irish vehicle fleet and applying fuel consumption factors by vehicle and road type. These values are set out in Annex 1.

5.2.3 Emission Values

Noise and Vibration

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.

Accordingly, it is not proposed to estimate noise impacts at the preliminary appraisal stage of projects, 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. Transport Infrastructure Ireland 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 Lden60.

Air Quality

Emission from transport can cause local air quality problems and associated health impacts. High levels of pollutants also have the potential for secondary impacts on water quality, nature conservation resources and the built heritage. Values and guidance to monetising environmental impact are provided under emissions in Section 5. Guidance is provided for monetising the impact of gases such as:

- Carbon Dioxide (CO_2)
- Mono-nitrogen oxides (NO_x)
- Non-methane volatile organic compound (NMVOC)
- Particle matter ($PM_{2.5}$)

The value for each tonne emitted is provided in Annex 1.

For evaluating road based emissions the recommended approach is:

- Estimate the vehicle kilometres arising for motorways and urban and rural non-motorway networks separately;
- Apply a rate of emissions per vehicle kilometre appropriate to motorways and urban and rural non motorway settings; and
- Derive total emissions arising for motorway and rural and urban non-motorway settings; and
- Apply a monetary value to each amount of emission.

Where monetary values have been ascribed to emission the monetary value of emission changes should be included in the PABS and the summary of Costs and Benefits table.

Future Emission Values

The valuation of future emissions will be different for carbon dioxide and other gases. Carbon values are set by the Department of Public Expenditure and Reform to 2050, these values in 2011 prices should be used in CBAs going forward.

For the period 2015 to 2020:

- The price of CO_2 on the EU ETS system on the European Climate Exchange should be used as the cost of CO_2 where possible.
- The European Climate Exchange currently offers futures pricing on the EU ETS until December 2017. In the absence of futures pricing for 2018 and 2019, the Transport sector will use a linear extrapolation for the carbon price between 2017 and 2020 value in the EU reference scenario.

For the period post-2020:

- The Impact Assessment which accompanied the recently proposed EU 2030 Framework for Climate and Energy Policy provides a price projection for the ETS in the event of no further policy developments, the so-called Reference Scenario. The price projection is reported in 5 year intervals until 2050 and is detailed below. All prices are denominated in €2011.

For values that relate to 2020 and beyond the Reference Scenario in the Impact Assessment of the recently proposed EU Framework for Climate and Energy Policy provides a price projection for the ETS.

With regard to all other gases, as they are underpinned by a willingness-to-pay valuation method, it is appropriate that future values should reflect future earnings. This is the approach used to determine future values for time and accidents. It is therefore proposed that values should be related to increases in GNP per person employed.

5.2.4 Valuation of Collision Costs

The severity of collisions varies from damage to vehicles to fatal collisions. Most collisions have elements of police costs, damage to property and insurance and administration costs. Where there are casualties as a result of a collision there are costs associated with lost output, human costs and medical and ambulance costs.

Values for Collision costs

The parameter values to be used in valuing collisions are set out in Annex 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 collision values for, say, rail and air modes will be higher by virtue of the multiple casualties involved.

Estimates based on the Road Safety Authority's Road Accident Facts casualty-related costs and accident-related costs have been combined to arrive at composite values for collisions of varying severity. This data is presented in Annex 1.

Future Collision Values

Collision values are dependent on income, therefore the change in accident values over the evaluation time horizon should follow the growth in real GNP per person employed – the same updating mechanism, as set out in the value of time approach

5.2.5 Active Travel Values

These values should be applied when calculating the benefits of investments in active travel. The total active travel benefit or cost is arrived at by combining the benefits associated with reductions in relative risk and reductions in absenteeism. To ensure consistency in appraisal of transport projects these values are presented in 2011 prices.

Valuing reductions in relative risk

Through the use of active modes physical inactivity, which is a significant public health problem, will be reduced. Evidence from the World Health Organisation (WHO) has shown that by increasing physical activity the relative risk of mortality reduces.

Annex 1 presents the calculation of the reduction of relative risk for walkers and cyclists in Ireland. The average active time per day across individuals making return and single leg trips is based on an assumption that 80% of commuting trips form part of a return journey.

The calculated reductions in relative risk of death and the number of new walkers and cyclists are used to calculate a figure for the potential number of lives saved based on average mortality rates. An average mortality rate of 0.0019 is used, the mean proportion of the population aged 15-64 who die each year. The number of potentially prevented deaths is then multiplied by the value of a prevented fatality used in accident analysis (see collision values) to give a monetary benefit.

It is also assumed that the benefit of using active modes accrues over a five year period, after which new cyclists or pedestrians achieve the full health benefit of their activities.

The below text box presents an example of how the analysis should be carried out.

Case Study A: The example is based on a hypothetical scheme that would deliver a piece of infrastructure that would be used by 1000 cyclists. When there are 1000 new cyclists as a result of a scheme, 200 receiving 20% of the full benefit (as they have been more active for one year), 200 receiving 40% (as they have been more active for two years), 200 receiving 60% (more active for three years), 200 receiving 80% (more active for four years) and 200 receiving 100% of the benefits (more active for 5 years). Please note that any future application of this example will need to be consistent with the values provided in Annex 1.

Table 11: Cycling Benefit Values (Case Study A)

New cyclists /year began cycling/years accruing benefits			Average mortality	Expected deaths	Reduction in RR	% of total benefit accrued	potential lives saved	Value of a prevented fatality (2011 prices)
Began cycling	**Years benefits**	**Number of Cyclists**	**0.0019**	**1.9**	**0.21**			**€2,310,500**
	A	**B**	**C**	**B*C = D**	**E**	**F**	**(D*E)*F = G**	
2007	5 +	200	0.0019	0.38	0.21	100%	0.080	€184,378
2008	4	200	0.0019	0.38	0.21	80%	0.064	€147,502
2009	3	200	0.0019	0.38	0.21	60%	0.048	€110,627
2010	2	200	0.0019	0.38	0.21	40%	0.032	€73,751
2011	1	200	0.0019	0.38	0.21	20%	0.016	€36,876
				Total				€553,134

These calculations must then be repeated for both cyclists and walkers for each year of the appraisal period. For year 2012-2015 similar tables with graduated benefits must be calculated (year 2012, 40% at 5 year benefits, year 2013, 60% at 5 year benefits, year 2014, 80% at 5 year benefits and year 2015 100% at 5 year benefits). From 2015 on, full benefits are assumed for all cyclists. Benefits should be calculated to include real growth in the value of a prevented fatality in line with forecast GDP/capita, then summed and discounted to give a total benefit in 2011 present values.

Valuing Absenteeism Impacts

Increasing physical activity increases productivity in the economy by reducing short-term sick leave. The median absenteeism rate for short terms sick leave is 4.6 days and 5.8 days for the private and public sector, respectively.

The number of employees in public sector employment is about 21% of total employment in Ireland, based on CSO employment tables. Calculating average sick leave taken in Ireland by weighting the relative proportions of private and public sector employment gives an overall estimate of 4.9 days per year.

A cycling or walking intervention of 30 minutes per day reduces absenteeism in a reduction in short-term sick leave by between 6% and 32% per annum (WHO 2003). The lower bound of 6% is to be applied in appraisals to estimate the reduction in absenteeism per employee per year.

Thus, a conservative estimate of the expected reduction in absenteeism as a result of an intervention delivers activity levels of 30 minutes per day is about 0.3 days per employee

per year (= 4.9 * 0.06). As in the case of mortality, the research in this area is scarce but it is assumed that the full benefits accrue to all new users.

The monetary value of the total benefit is then the product of the total hours per year saved and value of work time per hour. The full calculation for Case Study B (cycling) in 2011 is set out in the table below. The values should then be calculated, with graduated benefits to 2015, and full benefits from 2016 on, including real growth in the value of work time per hour in line with forecast GDP/capita, then summed and discounted to give a total benefit in 2011 present values.

Table 12: Monetised Absenteeism Benefits (Case Study B)[6]

New cyclists /year began cycling/years accruing benefits			Average sick leave p.a.	Average hours worked per day	Average benefit per minute of active travel	% of total benefit accrued	Reduction in absenteeism for new cyclists	Hours saved	Value of time (2011 prices)
Began cycling	**Yrs benefits**	**New cyclists**	**4.9**	**7.5**	**0.002**				**€34.33**
	A	**B**	**C**	**D**	**E**	**F**	**((C*E)*average travel time)*F = G**	**D*G = H**	
2007	5	200	4.9	7.5	0.002	100%	0.29	2.21	€15,140
2008	4	200	4.9	7.5	0.002	80%	0.24	1.76	€12,112
2009	3	200	4.9	7.5	0.002	60%	0.18	1.32	€9,084
2010	2	200	4.9	7.5	0.002	40%	0.12	0.88	€6,056
2011	1	200	4.9	7.5	0.002	20%	0.06	0.44	€3,028
					Total				€34,733

5.2.6 Residual Values

The appraisal period should cover the period of use of an asset but assets may still have some value at the end of the appraisal period. Residual values may be included in CBA of projects as appropriate.

Two approaches to residual value calculation may be used (project appraisers should agree approach with SRAD at pre-appraisal stage discussion):

- 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;

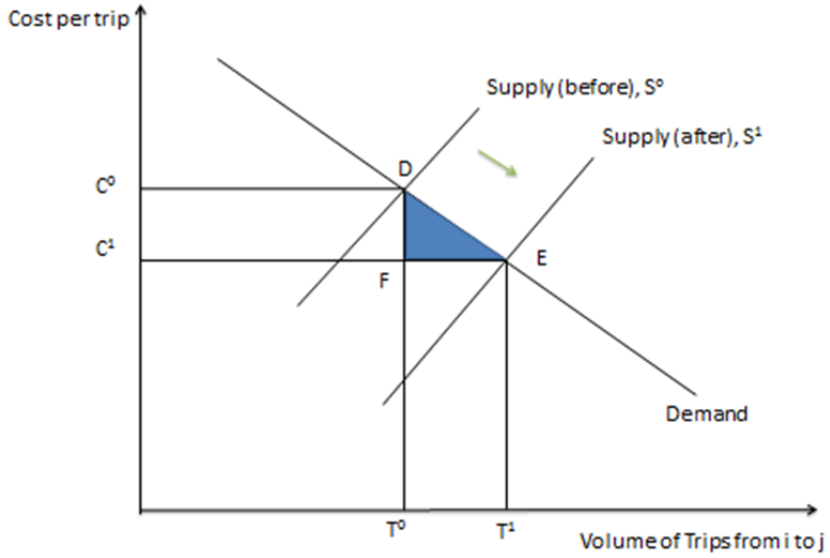
[6] Please note that any future application of this example will need to be consistent with the values provided in Annex 1.

- 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.

5.2.7 Transport User Benefit Calculation

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 Consumers' Surplus will rise. Figure below 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.

Table 13: Transport User Benefit Calculations



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 Consumers' Surplus is measured 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 change in total Consumers' Surplus (CS) is therefore measured by:

$$\text{Change in CS} = (C^0 - C^1)*T^0 + 0.5*(C^0 - C^1)\,(T^1 - T^0), \text{ or by rearranging}$$

$$\text{Change in CS} = 0.5*\,(T^0 + T^1)\,(C^0 - C^1)$$

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 change in 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.

The extent to which the appraisal is disaggregated by mode, purpose, vehicle type, time period, vehicle availability or other category will be for analysts to decide. Whatever choice is made, the following calculations are applicable to the trip matrix for each category. However, it is important to distinguish between work and non-work trips, for two reasons:

- For non-working trips, some costs are assumed to be unperceived; and
- Different (overall) indirect taxation rates apply to work and non-work trips, because VAT is levied only on final consumption (and thus only applicable to non-work trips), whereas duties are levied on all purchases (thus applying to work and non-work trips alike).

To accommodate these distinctions, the following discussion presents separate results for work and non-work trips.

The notation in this appendix is based on that from Sugden (1999). The superscript i represents the scenario (0 for the without-scheme case and 1 for the with-scheme case), while the subscripts i and j denote values for specific zone to zone movements. As described in section 3, benefit calculations should be carried out by mode of transport, with benefits attributed on the basis of where changes in cost occur. Therefore the calculations described here should be applied at a modal level. For simplicity a modal subscript has not been included. The following list provides a summary of all the terms used in this appendix.

S^I_{ij} Consumer Surplus for travellers between i and j;

P^I_{ij} perceived cost of trip between i and j;

F^i_{ij} fuel cost of highway trios between i and j, including indirect taxes;

N^i_{ij} non-fuel vehicle operating costs (such as tyres, maintenance, depreciation) of highway trips between i and j, including indirect taxes (note that, for non-work highway trips, Ni ij is assumed to be unperceived);

M^i_{ij} fares, tolls and other charges including parking, for trips between i and j;
(Note that, for work trips, values of F^i_{ij}, N^i_{ij} and M^i_{ij} should exclude VAT but include all other indirect taxes.)

V^i_{ij} perceived' time cost of trips between i and j (note that $V^i_{ij} = J^i_{ij} * K_T$);

J^i_{ij} journey time between i and j

D^i_{ij} distance between i and j;

L^i_{ij} fuel consumed between i and j;

T^i_{ij} number of trips between i and j;

K_T value of time;

K_F cost of fuel;

t average rate of indirect tax on final consumption;

t_F rate of indirect tax on fuel as a final consumption good;

$t_{F'}$ rate of indirect tax on fuel as an intermediate good;

t_N rate of indirect tax on non-fuel operating costs as final consumption goods;

$t_{N'}$ rate of indirect tax on non-fuel operating costs as intermediate goods;

t_m rate of indirect tax on fares, tools and other charges as final consumption goods;

$t_{m'}$ rate of indirect tax on fares, tools and other charges as intermediate goods.

(Note that the taxation rates relating to costs as intermediate goods are applicable to work trip costs, while the rates for costs as final consumption goods are applicable to non-work trip costs.)

User Benefits

Total user benefits are defined as:

- For work trips: $(S^1 - S^0)(1+t) - ½ (1+t) \sum_{ij} \left(T_{ij}^0 + T_{ij}^1\right)\left(P_{ij}^0 - P_{ij}^1\right)$
- For non-work trips: $(S^1\text{-}S^0)\text{-}(N^1\text{-}N^0) = ½ \sum_{ij} \left(T_{ij}^0 + T_{ij}^1\right)\left(P_{ij}^0 - P_{ij}^1\right)$ - $\sum_{ij}\left(T_{ij}^1 N_{ij}^1 - T_{ij}^0 N_{ij}^0\right)$

For work trips, costs are perceived in the factor cost unit of account and so are multiplied by (1+t) to convert to market prices. For non-work trips, non-fuel operating costs are assumed to be unperceived costs so the change in non-fuel operating cost (N1 – N0) must be added to the rule of a half calculation.

Perceived costs comprise user charges (M), vehicle operating costs (F for fuel and N for non-fuel) and travel time (V = J x KT). The impacts of a scheme should be calculated and reported for each of these components of perceived costs.

Fares and charges (M) will often not be directly related to distance travelled. For example, tolls may be restricted to selected links in the network, and may be 'entry point' based, rather than distance based. Bus and train fares may vary by route, and do not apply to the access stages of journeys.

Fuel costs (F) should be based on the cost of fuel and fuel consumed: Fiij = KFLiij, where KF should include VAT for non-work trips but should not include VAT for work trips. The preferred method of calculating Liji is by application of the Transport Economics Note (TEN) formula (parameters adjusted) on a link by link basis, since this allows variations in speed during the journey to be taken into account, but this is not possible within a matrix-based appraisal package. The values in Annex 1 of the transport appraisal guidance is an acceptable approximation of consumption per kilometre and can be multiplied by trip distance (Diij) to give fuel consumed (Liji).

Non-fuel operating costs (N) should be calculated using the formula described in section 5.2.2 of the transport appraisal guidance and time costs should be calculated by multiplying journey time (Jiij) by the appropriate value of time (KT).

For work trips the disaggregated benefits are given by:

- User charges: ½(1 + t) $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(M_{ij}^{0} - M_{ij}^{1}\right)$
- Vehicle operating costs: ½(1 + t) $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(F_{ij}^{0} + N_{ij}^{0} - F_{ij}^{1} + N_{ij}^{1}\right)$; and
- Travel time: ½(1 + t) $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(V_{ij}^{0} - V_{ij}^{1}\right)$

And for non-work trips the disaggregated benefits are given by:

- User charges: ½ $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(M_{ij}^{0} - M_{ij}^{1}\right)$
- Vehicle operating costs: ½ $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(F_{ij}^{0} + N_{ij}^{0} - F_{ij}^{1} + N_{ij}^{1}\right)$; and
- Travel time: ½ $\sum_{ij}\left(T_{ij}^{1} + T_{ij}^{0}\right)\left(V_{ij}^{0} - V_{ij}^{1}\right)$

The benefits to non-work trips should be split by commuting and other trip purposes. Therefore the calculations should be performed separately for these journey purposes.

Impacts on Indirect Revenue

The impacts on indirect tax revenue form part of the Exchequer analysis but are included here because the calculations are closely related to those carried out for the calculation of user benefits. t is important to note that indirect tax revenues should be included in the Present Value of Benefits (PVB), rather than the Present Value of Costs.

Calculating the changes in indirect tax revenue is a little more complicated than user benefits:

Calculating the changes in indirect tax revenue is a little more complicated than user benefits:

- work trips: $(F^{1}\text{-}F^{0})t_{F'}(1+t)/(1+t_{F'})+(M^{1}\text{-}M^{o})t_{m'}(1+t)/(1+t_{m'})+(N^{1}+N^{0})t_{N'}(1+T)/1+T_{N'})$
- non-work trips: $(F^{1}\text{-}F^{0})(t_{F'}\text{-}t)/(1+t_{F'})+(M^{1}\text{-}M^{o})(t_{m}\text{-}t)/(1+t_{m'})+(N^{1}+N^{0})(t_{N}\text{-}t)/1+T_{N'})$

Where:

$$(F^{1}\text{-}F^{0}) = \sum_{ij}\left(T_{ij}^{1}F_{ij}^{1} - T_{ij}^{0}F_{ij}^{0}\right)$$

$$(M^{1}\text{-}M^{0}) = \sum_{ij}\left(T_{ij}^{1}M_{ij}^{1} - T_{ij}^{0}M_{ij}^{0}\right)$$

$$(N^{1}\text{-}N^{0}) = \sum_{ij}\left(T_{ij}^{1}N_{ij}^{1} - T_{ij}^{0}N_{ij}^{0}\right)$$

Section 6 IMPLEMENTATION, MONITORING AND EVALUATION

This section seeks to explain the responsibilities that the Department, Agencies and other public bodies have once a proposal has been appraised. It outlines how to set up the programme/project so that impacts can be measured at a later stage and the types of formal analysis that are used for evaluation. It also considers the responsibilities during implementation as well as the monitoring requirements.

6.1 Implementation

The implementation stage of a project begins once final approval for the award of a contract has been secured. Capital Grant Schemes or Current Expenditure programmes enter this stage once final approval is secured. The critical tasks at this stage are management and monitoring to ensure that what is planned is executed satisfactorily, within budget, to standard and on time. Implementation is the responsibility of the Sponsoring Agency/ Sanctioning Authority where appropriate.

Systems and system checks should be in place to ensure that the proposal is delivered as per the contract, approved specification, within the approved budget and in compliance with these guidelines.

Actions or responsibilities at the Implementation Stage can vary depending on whether you are responsible for:

- a large capital project i.e. expenditure greater than €20 million
- a capital project of a smaller scale
- a programme of capital expenditure
- a capital grant scheme
- an area of current expenditure

Each type of scheme above requires:

Assigned Responsibility for Delivery: For capital projects, a Project Manager should be appointed within the sponsoring Department or Agency at the planning/procurement stage of the project. The person appointed to the role should be a senior official including an official at MAC level or equivalent where appropriate. The project manager should be assigned personal responsibility for monitoring progress on the project against the contract requirements and for reporting progress and issues arising to the Project Board. Similarly responsibility for capital programmes, capital grant schemes and current expenditure programmes should be assigned within Departments and Agencies.

Appropriate Structure for Monitoring and Management: All expenditure, whether capital or current, has to be actively managed. This will involve monitoring against plans and expectations, monitoring and assessing changes in the broader environment that may impact on the underlying need and making decisions on adjustments or even termination. Capital projects will have a Project Board with appropriate expertise and authority. It will include the Project Manager and a representative of the Sanctioning Authority. Capital programmes, capital grant schemes and current expenditure programmes also need formal structured arrangements to ensure that there is systematic co-ordinated monitoring and management of programmes. Responsibility for putting these structures in place may primarily rest with the Sanctioning Authority or the Sponsoring Agency depending on the nature and scale of the expenditure. These structures may include a programme co-

coordinator to coordinate implementation of the programme and a monitoring committee to monitor and review progress. Where the programme is a cross-cutting programme the monitoring committee will be representative of relevant Government Departments, implementing public bodies and sectoral interests.

Regular Reporting: Monitoring of all types of expenditure is required to ensure that milestones are being met and expenditure is within budget. Regular reports should be submitted to the Project Board or other structure as discussed above. If adverse developments occur such as potential cost overruns or delays the progress report should include recommendations to address the situation, including where warranted the option of scheme termination. For proposals costing over €20 million a separate progress report must be submitted to the Department's MAC for Departmental projects and to Management and/or the Board for Agency projects and then to the relevant Minister on a quarterly basis. These reports may be subject to audit by the Department of Public Expenditure & Reform.

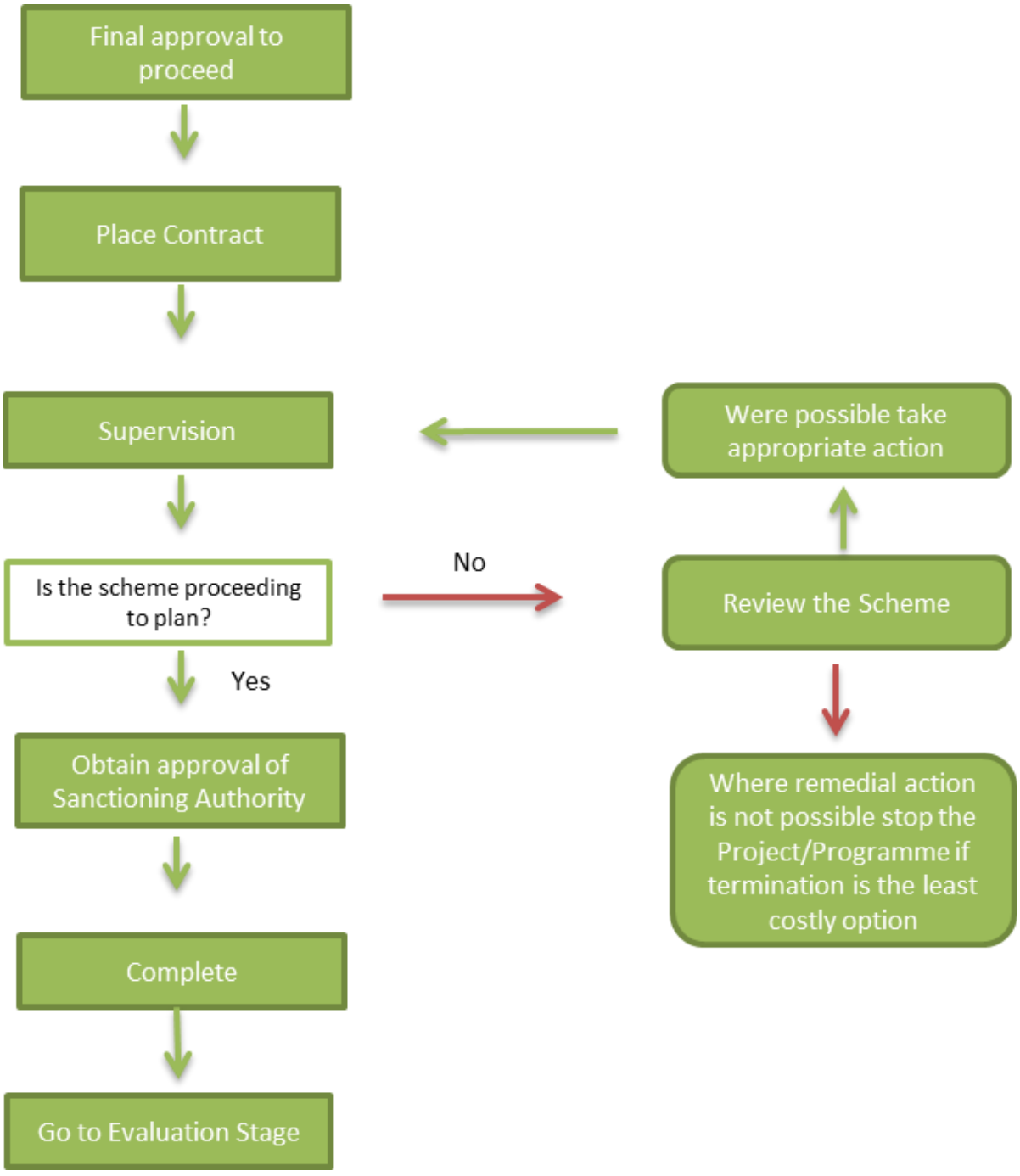
Measuring if outcomes are in-line with expectations: For capital projects, milestones in the contract and in the project plan can be used by the Project Manager and Project Board to ensure that the project is on schedule and within budget. Other performance indicators may have to be developed for changes in the external environment that could influence the project. For programme expenditure performance indicators should be developed at the outset as well as a means of gathering the data to support performance indicator measurement. These performance indicators will then be used as part of the monitoring and management of the Implementation Stage for capital programmes, capital grant schemes and current expenditure programmes. There may be schemes or programmes underway that do not have suitable performance indicators. If this is so then suitable performance indicators should be developed as soon as possible.

Adverse Developments or Changes in Circumstances: Regular management reports should be prepared by the Sponsoring Agency covering all significant developments relating to the project and its costs. If adverse developments occur, including unforeseen cost increases, which call into question the desirability or viability of the project, the Sponsoring Agency should submit a report at the earliest possible moment to the Sanctioning Authority, detailing the necessary measures proposed to rectify the situation.

Where, despite these measures, increased costs above those already approved are likely to arise, the approval of the Sanctioning Authority for the extra expenditure should be obtained before any commitment is made to accept cost increases. Any application for such approval should outline the reasons for the excess, along with a detailed explanation of why it was not possible to take appropriate measures to offset the increased cost. The viability of the proposal, given the changed circumstances, should also be reported on.

If a scheme is continuously not achieving its objective and or targets, there should be a willingness to terminate it before completion. Action of this kind can be justified if the cost escalates above earlier estimates or if the benefits expected are not likely to be realised. An attitude that, once work commences, the scheme must be completed regardless of changed circumstances, is to be avoided. Before making a final decision to terminate, the costs of termination (for example, payments that might have to be paid by way of compensation to contractors etc.) should be ascertained and made known to the appropriate authorities.

Table 14: Steps to Implementation and Monitoring



6.2 Post- Implementation

The main requirement during post-implementation is one of review. In addition to the active management and regular analysis of performance indicators there is a need for periodic evaluations of areas of expenditure. This requirement is there because:

- Regular monitoring of performance indicators needs to be supplemented with a more in-depth study to assess efficiency and/or effectiveness;
- An independent review of efficiency, effectiveness and continued relevance is sometimes needed;
- The outcomes of the intervention will not occur for some time and a different approach to measuring effectiveness is required; and
- The scale of the investment/intervention justifies an in-depth evaluation

6.3 Evaluation

Prior to implementation, the proposal's anticipated impacts should be baselined. This may involve collecting the data that is relevant to measuring achievement of objectives before the programme is implemented so that after a period of time the data can be compared against a time when there was no programme or intervention. Comparative data of a similar group that has not been subject to the intervention (counterfactual) may also be needed. This allows evaluators to calculate the additional benefits generated from the intervention and whether the outcomes are in line with the targets and objectives.

For current expenditure programmes over €20 million a pilot should normally be carried out before full implementation. Results of the pilot will inform whether or not the programme should proceed. Data collection should already be in place before the pilot so that structures are there to capture the key variables in order to assess performance.

Evaluation options for projects and programmes

When carrying out a programme evaluation, there are two formal options that are aligned to the PSC. The first is Value for Money Policy Reviews (VFMPRs). A VFM should assess the rationale and objectives of the programme, the relevance of these and whether they were achieved as well as if there are alternative methods of achieving the scheme. More details on how to carry out VFMs are provided in Section C of the Public Spending Code.

The second type of analysis that can be carried out on programme expenditure is a Focused Policy Assessment (FPA) which is referred to in Section C-03 of the PSC. These types of evaluations are less burdensome and are normally carried out on specific issues of policy configuration and delivery or smaller expenditure programmes (i.e. less than €20 million or €5 million annually). FPAs are sharp and narrowly focused assessments designed to answer specific issues of policy configuration. Previous reports that have been carried out focused on preliminary evaluation of complex programmes, discrete expenditure programmes, crosscutting issues, and thematic evaluations. Typically, VFMs and FPAs tend to be applied to current expenditure projects and programmes whereas post project reviews are used to evaluate capital projects. However, there may be merit in subjecting capital programmes to Value for Money evaluation in certain circumstances.

For capital projects, the benefits will not be seen until the project has been completed. All capital projects costing over €20 million must be subjected to a post-project review to see if the predicted benefits of the project were realised. Post-project reviews should be

undertaken once sufficient time has elapsed to allow the project to be properly evaluated with sufficient evidence of the flow of benefits/costs from it. Post-project reviews for capital grant schemes and for current expenditure programmes may also be needed, particularly where evaluations were not undertaken when the schemes were active or if the benefits would not be apparent for some time. Section C-02 of the PSC provides more details on the requirement for post-project reviews.

Mandatory Quality Assurance

One of the Public Spending Code's new requirements is that Departments and Agencies should put in place an internal independent, quality assurance procedure involving an annual report of how the Public Spending Code obligations are met. The procedure is made up of five steps:

- Drawing up inventories of projects and programmes at different stages of the project life cycle;
- Publishing summary information on the responsible party's website of all procurements in excess of €2 million;
- Complete checklists provided in Public Spending Code Section A-04 on a sample of programmes and projects;
- Carry out an in-depth-check on a small number of selected projects or programmes. Over a 3 year period an average of 5% of total value of all projects in the inventory should be assessed each year.
- Complete a short report for submission to Department of Public Expenditure and Reform.

Additional Evaluation/Post-Project Review Requirements

Departments' and Agencies should not restrict themselves to the mandatory evaluation or post-project review requirements. From time to time it may be apparent that while not mandatory, an area of expenditure would benefit from a more in-depth review based on the picture the performance indicators paint or maybe because the performance indicators are not as informative as originally thought.

Communicating lessons learned

As with all parts of the Public Spending Code any significant lessons should be translated into changes in the Sponsoring Agency's/ Sanctioning Authority's practices and communicated within the organisation and to the Sanctioning Authority and DTTaS so that general lessons learned can be applied to this Code or to supplementary information.

Responsibility for Evaluation Review

It is the responsibility of the Sponsoring Agency to carry out the evaluations or post project reviews. Those conducting reviews and evaluations should not be the same people as conducted the appraisal or managed the implementation. Value for Money and Policy Reviews (VFMPRs) have specific requirements regarding Steering Committees and independent chairpersons.

Section 7 TEMPLATES

This section provides templates which should be used by the Sponsoring Agency when reporting to the relevant Agency or Department.

7.1 Financial Appraisal

Financial appraisal focuses on cash flows as opposed to economic flows and in particular considers sustainability and profitability. Some of the general objectives associated with this type of analysis are:

- Identifying and estimating financial cash flows;
- Assessing financial suitability – sustainability occurs if the net flow of cumulated generated cash flow is positive for all years considered;
- Calculating performance indicators (e.g. Net Present Value, Internal Rate of Return); and
- Assessing funding sources for the project.

Table 16 below is a template of how the inflows and outflows of a particular project or programme could be captured. The list of items is not exhaustive but the format should be used when submitting this type of analysis with a business case. Appraisers should discuss Financial Appraisal with SRAD at outset, pending publication of further guidance from DPER in 2016.

Sources of Funding Analysis

A summary of the sources of finance for the preferred option(s) should be outlined in the same format as Table 15 below. The table provides an example of the types of funding that could be included in this analysis. The analysis should focus on funding over the duration of the project and programme. When finalising this analysis it is important that the percentage of public funding for the project is clearly identified.

Table 15: Sources of Funding Template

	% Funding	**€ Million**
EU Grants		
EIB Loans		
Loans		
Private Funding		
Own Resources (savings)		
Income from project		
Total Expenditure		
% Public Funding Contribution		

Table 16: Sample Cash Flow Analysis for a Capital Project for a Commercial Body

Items	2015	2016	20XX	Total
Revenue from charges				
Residual value				
Dividends				
Total inflows				
Equity participation				
Subsidies/grants				
Operating costs				
Materials				
Labour				
Other maintenance				
Administrative				
Investment costs				
Plant				
Machinery				
Planning and design				
Decommissioning costs				
PPP payments				
Total outflows				
Indirect taxes (A)				
VRT				
Carbon levy				
Customs and excise				
Direct taxes				
Income tax				
Corporation tax				
Total tax impact				
PPP Payments				
EU Finance passing through the Exchequer				
Fines				
Other flows				
Net cashflow (B)				
Discounted net cashflow				

7.2 Economic Efficiency of the Transport System

A key policy question that arises as a result of transport interventions is how the benefits that arise as a result of public expenditure on infrastructure projects disaggregate to different transport users. There are difficulties in assessing which groups benefits the most or least (i.e. business users benefited by €x). Take a route that has both a road and rail option on which a proposed scheme will increase the number of rail and road users and reduce congestion on the route. Transport models generally produce the net effect of the intervention (i.e. results of individual user behaviour are not available) so it is very difficult to say how many travellers switched modes.

Consequently a method that attributes benefits to particular users is necessary. An approach that relates the breakdown of benefits to the mode of transport where the change in cost has occurred, and not to particular groups of travellers as supported by Sudgen (1999) should be implemented. The formula for assigning benefits to modes as the 'source' of those benefits is the rule of a half formula, applied at the modal level e.g. for mode a:

Change In Total Consumer Surplus a ≈ RoH a = ½ $\sum_i \sum_j \left(T^0_{ija} + T^1_{ija}\right)\left(P^0_{ija} - P^1_{ija}\right)$

Note that the benefits are given by the initial and final perceived costs on the mode. For example, if an intervention on rail creates decongestion benefits on road these benefits are attributed to road users. If demand and supply curves shift (because a scheme affects competing or complementary modes simultaneously) there is no unique attribution of benefits. However, in line with recommendations from Jones (1977) and Sugden (1999), the rule of a half formula as given should be used to attribute benefits by mode. Appendix A of this document and Appendix b of Section 4 provides the full set of formulae required to implement this approach. The following table is a template that is to be used by all agencies when submitting a business case.

Table 17: Economic Efficiency of the Transport System Template

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time						
Vehicle operating costs						
User charges						
During Construction & Maintenance						
NET NON-BUSINESS BENEFITS: COMMUTING		***C***				

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time						
Vehicle operating costs						
User charges						
During Construction & Maintenance						
NET NON-BUSINESS BENEFITS: OTHER		*D*				

Business

User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time								
Vehicle operating costs								
User charges								
During Construction & Maintenance								
Subtotal		***E***						
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal		***F***						
Other business impacts								
Developer contributions		***G***						
NET BUSINESS IMPACT		***(H) = (E) + (F) + (G)***						

TOTAL Present Value of Transport Economic Efficiency Benefits (TEE)		***(I) = (C) + (D) + (H)***

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2011 prices and values

7.3 Cost-Benefit Analysis Summary Table

For certain projects (see Section 3), a Project Appraisal Balance Sheet should be accompanied by a Cost-Benefit Analysis Summary Table. The Cost-Benefit Summary Table should comprise the following elements:

- Net transport user benefits separated by type of user (i.e. Business, Commuting and Other);
- Net transport operator benefits;
- Collision benefits;
- Physical activity benefits;
- Air quality benefits;
- Noise benefits;
- Public finances costs/benefits; and
- Transport budget costs/benefits.

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.

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. However, analysis at factor costs is also permitted, as both methods give consistent results. All costs and benefits should be valued at constant 2011 prices. Parameter values, such as those for journey time, should be those promulgated by the Department of Transport, Tourism and Sport.

Table 18: Sample Cost Benefit Analysis Table

Analysis of Costs and Benefits	
Noise (J)	
Local Air Quality (K)	
Greenhouse Gases (L)	
Physical Activity (M)	
Collision (N)	
Economic Efficiency: Consumer Users (Commuting) (O)	
Economic Efficiency: Consumer Users (Other) (A)	
Economic Efficiency: Business Users and Providers (P)	
Wider Public Finances (Indirect Taxation Revenues) (Q)	
Present Value of Benefits (PVB) ('R)	
Transport Budget (net cash flows) (B)	
Present Value of Costs (see Section E of Public Spending Code) (PVC) (S)	
OVERALL IMPACTS	
Net Present Value (NPV) - NPV=PVB-PVC	
Benefit to Cost Ratio (BCR) - BCR=PVB/PVC	

Source: WebTAG

7.4 Project Appraisal Balance Sheet

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

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		
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
Physical Activity		
Physical Activity	Summary of nature of physical activity impacts including impacts on particular groups of road users	NPV arising from these benefits
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	

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)
Environment		
Cultural, Archaeological and Architectural Heritage	Overall effect on cultural , archaeological and architecture 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	
Accessibility and Social Inclusion		
Vulnerable Groups	Impacts on low income groups, non-car owners, people with a disability	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	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 airports; increased service levels in Gateways

Annex 1 PARAMETER VALUES

Valuing costs and benefits in common price units is a key step in Cost-Benefit Analysis. This Annex sets out the key official parameter values to be used in the appraisal of transport projects and programmes for which the Department of Transport, Tourism and Sport or its agencies are Sanctioning Authorities.

The first section provides central Government parameters and key principles as set out by the Department of Public Expenditure and Reform, in particular through Section E of the Public Spending Code. The second section provides specific values for transport parameters which should be used in conjunction with guidance set out in the main Common Appraisal Framework document.

CENTRAL PARAMETERS

Table A.1: Overview of Central Government Parameters

Parameter	Rate
Discount Rate[7]	4% for years 1-30
Shadow Price of Public Funds	130%
Shadow Price of Labour	80% - 100%
Shadow Price of Carbon[8]	Non-ETS Emissions - €20/tCO_2

PRESENT VALUES AND DISCOUNT RATE

There is significant evidence to show that people prefer to consume goods and services now, rather than in the future. In general, even after adjusting for inflation, people would prefer to have €1 now, rather than €1 in 60 years' time. As the impacts included in CBA are presented in monetary terms, all monetised costs and benefits arising in the future need to be adjusted to take account of this phenomenon, known as 'social time preference'. The technique used to perform this adjustment is known as 'discounting'. A 'discount rate', which represents the extent to which people prefer current over future consumption, is applied to convert future costs and benefits in to their 'present value', the equivalent value of a cost or benefit in the future occurring today.

The official discount rate of 4 per cent has been set by DPER in Section E of the PSC. This discount rate should be applied in all transport appraisals.

[7] Note: for projects with long time horizons a declining discount rate applies: years 0-30 discounted at 4%, years 31-60 discounted at 3.5%, years 61-100 discounted at 3%, years 101-175 discounted at 2.5%, years 176-275 discounted at 2%, and at 1.5% thereafter

[8] The value above only applies to non-ETS emissions in 2019 and is priced in 2014 euros. Projects which will give rise to emissions over time must apply the relevant values set out in Table A.2. Certain transport investments will require the use of ETS values for the price of Carbon. These annual values can be found in Table 7 of Section E of the Public Spending Code.

SHADOW PRICE OF PUBLIC FUNDS

It is sometimes argued that distortions exist in the market prices for resources used in projects, or for the outputs of projects. The implication is that some other price, usually called a "shadow" price (i.e. a price attributed to a good or factor on the basis that it is more appropriate that its market price) should be used. Taxation gives rise to economic distortions by altering incentives facing economic agents, leading to changes in their behaviour and reduced economic activity. For this reason, the shadow price of public funds is greater than one. Put another way, a €1 private benefit resulting from a €1 grant raised by extra taxation does not imply a neutral result for the economy. The distortionary costs imposed by the additional taxation must be taken into account.

Guidance on the Shadow Price of Public Funds has been published by DPER (Public Spending Code Section E). The value of the shadow price of public funds is set at 130% to take account of the distortionary effects of taxation. Relevant exchequer cash flow should be adjusted by a factor of 1.3 accordingly. This new value updates previous central and sectoral guidance which specified values in the range 125% to 150%.

SHADOW PRICE OF LABOUR

In line with the shadow price concept, one of the central concerns in appraisal is to adjust the distortions in markets to provide a better guide to a more effective allocation of scarce resources. For example, when there is high unemployment, it could be argued that people employed in a project would not otherwise be employed in a productive way, and that the market cost of employing them should be replaced by a lower shadow price.

Guidance on a Shadow Price of Labour has been published by DPER (Public Spending Code Section E). A range of 80-100% has been set for the shadow price of labour. Those involved in the preparation of economic appraisals in the transport sector should use 100% as the shadow price of labour i.e. the market rate of labour. When using a Shadow Price of Labour value of less than 100%, an explanation must be provided with objective evidence and with an emphasis on the sectoral labour market conditions. Sensitivity analysis must be conducted on the upper bound of the scale. This range of acceptable values is consistent with previous centrally-set rules. In addition, the shadow price of labour should be applied to the cost component of economic appraisals and not to the benefits.

SHADOW PRICE OF CARBON

In 2007, the Cabinet Committee on Climate Change and Energy Security established an interdepartmental Working Group - under a Department of Finance chair and reporting to the Senior Officials Group on reflecting the cost of Carbon Emissions in Cost Benefit Analyses. The Group was mandated to prepare a detailed research paper on the appropriate means of treating environmental emissions, in particular carbon dioxide emissions, in future CBAs of major infrastructure projects and to make recommendations on a standardised approach(es) in this regard. In 2008 the Interdepartmental Working Group reported its findings to Cabinet Committee on Climate Change and Energy Security. The outcomes of the work were incorporated into the Department of Finance's then CBA guidelines. In 2012, the Senior Official's Group on Climate Change and the Green Economy approved the Terms of Reference for establishment of a new Interdepartmental Working Group leading to an update of the work previously undertaken. The CO_2 emissions pricing recommendations of

the group were incorporated into both Public Spending Code and Common Appraisal Framework.

In 2018, the Climate Change Unit in the Department of Public Expenditure and Reform undertook a review of the guidance on valuing greenhouse gas emissions in the public spending code. This review concluded that an abatement cost model should be adopted to value greenhouse gas emissions. As per circular 18/2019, the Public Spending Code was updated in light of the main recommendations and findings arising from the 2018 review. These recommendations and findings are summarised as follows;

- The shadow price of carbon for non-ETS emissions is based on the estimated cost to Ireland of removing emissions from the atmosphere i.e. the abatement cost. Economic appraisals are required, where appropriate and relevant, to value emissions from the "basket of seven" greenhouse gases which can be converted into CO_2e (carbon dioxide equivalent) using GWP (Global Warming Potential) conversion rates. Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Sulphur Hexafluoride (SF6), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Nitrogen Trifluoride (NF3) should all be converted into CO_2e using the latest available and Intergovernmental Panel on Climate Change adopted conversion factors for GWP[9] where such emissions are considered relevant, significant and practicable for inclusion.
- Table A.2 outlines the values for the price of CO_2e emissions in the non – Emissions Trading Sector (non-ETS) that should be applied in appraisals for each year out to 2050.

Table A.2: Shadow Price of Carbon 2019-2050 per tonne of CO_2 emissions (Non-ETS)[10]

Year	Price per tonne of CO_2 emissions (Non-ETS, €2014)
2019	€20
2020	€32
2021	€39
2022	€46
2023	€52
2024	€59
2025	€66
2026	€73

[9] The Group recommends the 100-year Direct Global Warming Potential (GWP) values from IPCC AR4 as the best measure currently available to convert other gases into CO2e. See Annex 1 of report for the latest Direct Global Warming Potentials from IPCC 4th Review (AR4). The latest available and IPCC-adopted conversion factors for the GWP should always be used. These were revised as part of the IPCC's 5th Review (AR5).

[10] Non-ETS values are based on UCC/ESRI modelling done for the National Mitigation Plan and are priced in €2014/tCO2. ETS values are based on EU Commission values for the 2016 Reference Scenario and are priced in €2013/tCO2.

2027	€80
2028	€86
2029	€93
2030	€100
2031	€105
2032	€110
2033	€116
2034	€122
2035	€128
2036	€134
2037	€141
2038	€148
2039	€155
2040	€163
2041	€171
2042	€180
2043	€189
2044	€198
2045	€208
2046	€218
2047	€229
2048	€241
2049	€253
2050	€265

- Specific transport-related appraisals may require the use of the shadow price for CO_2 emissions in the Emissions Trading Sector. Please refer to the annual values presented in Table 7 in Section E of the Public Spending Code.
- Economic appraisals are required to monetise the value of emissions of other specified non-GHG emissions (NOX, SO2, PM and noise) where such emissions are

considered relevant, significant and practicable for inclusion. For monetising the other specified non-GHG emissions in economic appraisals (Particulate Matter with a diameter of less than 2.5 micrometers (PM2.5), Nitrogen Oxide (NOx), Non-Methane Volatile Organic Compounds (NMVOCs) and Sulphur Oxide (SOx)) values, based on EU reference values, are outlined in Table A.3. PM2.5 values are disaggregated by rural, suburban and urban exposure, to reflect the increased damage costs in more densely populated areas where human exposure is higher.

Table A.3: Valuations for the estimated damage costs of non-greenhouse gas pollutants (€2010 per tonne)[11]

Estimated damage costs per tonne (€2010)					
PM 2.5			NOx	NMVOCs	SOx
Rural	**Suburban**	**Urban**			
16,512	47,420	194,660	5,688	1,398	6,959

Care should be taken to avoid double counting of emissions in any analysis undertaken. CO_2e emissions from materials directly attributable to the construction phase of a project which are purchased from organisations/facilities/installations operating within the EU ETS should not be included in the quantification of emissions for a project scenario as this would be double counting. Similarly, direct CO_2e emissions from sources within the State's jurisdiction, including those from direct construction and operation should be included in economic appraisals bearing in mind not to double count (see previous point). In certain instances consideration may need to be given by project managers to indirect emissions. For example, any rebound effects that the project may give rise to.

The shadow price is used to account for the external costs associated with CO_2e emissions. If this is partially or fully internalised in the product or input purchase price through the carbon tax then the price needs to be adjusted to reflect this and avoid double counting. This readjustment should be performed by deducting the current level of the carbon tax (€20 a tonne) where it is included in costs.CO2e emissions from materials directly attributable to the construction phase of a project which are purchased from organisations/facilities/installations operating within the EU ETS should not be included in the quantification of emissions for a project scenario as this would be double counting.

BASE YEAR AND CONSTANT PRICES

With all project appraisals, it is necessary to set a baseline year as a single historic point in time by reference to which all economic values are stated or converted back/forward to. This is because values in project appraisal are taken net of inflation, i.e. by reference to the price levels in a particular year. Inflation is the general increase in prices and incomes over time which reduces what a given amount of money can buy. When applying monetary values to impacts over a long appraisal period in CBA, it is very important to remove the effects of inflation. Failing to remove the effects of inflation would distort the results by

[11] The damage costs for the non-GHG emissions are valued in 2010 euros.

placing too much weight on future impacts, where values would be higher simply because of inflation.

As such, values assessed should be in constant prices, so that the effects of inflation are removed and the base year used should be 2011, in line with official guidance.

Note that choice of a fixed year for setting reference price levels does not mean that other technical elements - such as engine technology, fuel, vehicle or modal mix, or tax levels - must also be set to the same year. These should be set by reference to the best information on the latest position (for the current year), or the most likely future position (for future years). The related economic values would then be converted back to the baseline year price levels.

When economic values are to be adjusted to a different year by reference to price inflation alone, then the Consumer Price Index or an appropriate sub-index should be used. Where prices levels can also be expected to vary over time by reference to output or income levels, then nominal GNP per capita is generally the favoured index, except in particular circumstances where GNP per person employed is more appropriate (in particular, see Section 5.2.1 on Value of Time).

APPRAISAL PERIOD

Infrastructure projects often have impacts over a long time period. Such projects often have significant up-front costs that must be compared against benefits that accrue over a longer period. In order to do so, CBA typically forecasts future costs and benefits over a long time horizon and discounts them to present value (PV) for comparison. In Ireland, the official transport-specific evaluation period of 30 years is applied. This time period should normally be used where the life of the asset is 30 years or more. For large projects with long preparation time horizons, the 30 year time period should begin from the year in which benefits accrue, with the appraisal also including the years when costs commence. A large capital project with a four year construction period should be appraised over a 34 year period (4+30). Appraisers should consult with the Economic, Financial and Evaluation Unit of the Department of Transport, Tourism and Sport on this if uncertain.

Some projects, for example, fleet renewal, may involve assets that have a limited life; have special circumstances, such as franchises; or be addressing a transport problem with a short time horizon, so that a shorter appraisal period is more appropriate. With regard to short-lived assets less than 30 years, the project should be evaluated over the life of the asset.

GROWTH RATES

Forecasts of macroeconomic growth are often required for project evaluation purposes. A number of sources are available for different time periods.

The Department of Finance publishes short-term macro-economic projections regarding variables such as economic growth (generally covering the immediate three year period). These growth projections should be used for appraisal purposes for the time period for which they are available. These can be sourced from the annual Stability Programme Updates.

The Economic and Social Research Institute also publishes macro projections for time horizons that can be used for periods beyond the scope of official Department of Finance estimates.

For projections relating to longer term time horizons (e.g. beyond the horizon of official statistics), those carrying out appraisals can contact the Department of Public Expenditure and Reform Central Economic Evaluation Unit for assistance.

Table A.4: Economic Growth Rate Forecasts

	% Change								
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**20-25** **25-30**	**2030+**
Real GDP	4.8	4.0	3.8	3.2	3.2	3.0	3.0	2.2 2.0	2.0
Real GNP	5.2	3.9	3.5	2.7	2.6	2.5	2.5	2.2 2.3	2.3

Source: 2014 – 2020 Department of Finance Spring Statement; 2020 – 2030 ESRI Medium Term Review (2013)

POPULATION

Section E of the Public Spending Code determines that the CSO M1F2 scenario should be used as the relevant set of population assumptions as projections for appraisal purposes. The net migration assumption, M1, assumes that net migration will be positive in 2016 and rise to plus 30,000 by 2021 and the fertility assumption assumes that the total fertility rate will decrease to 1.8 by 2026 and to remain constant thereafter.

For transport project appraisal, the CSO M2F2 scenario is desirable as it provides a regional breakdown. The population forecasts under this scenario are given in Table 5 and should be applied for now.

Table A.5: Population Forecasts

	Thousands							
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
M2F2	4574.9	4686.5	4875.1	5042.1	5187.4	5337.4	5491.0	5635.2

Source: CSO Population and Labour Force Projections (2013)

Sensitivity Analysis

Sensitivity analysis is an important component in appraisal in order to understand the impact of assumptions on the cost-benefit analysis results. Population projections are crucial to demand analysis/ forecasts for most projects and should therefore be one of the elements that should be varied as part of sensitivity analysis.

A 'no growth' scenario should be among the demand assumptions tested during sensitivity analysis. The most recent Census results could be one way that 'no growth' is tested. Where local areas may be at risk from de-population or reduction – a 'no growth' scenario may be too optimistic and assumptions about population decline should also be tested for these areas. Other drivers of local demand should also be tested as part of general sensitivity analysis. This will vary by project and economic sector.

TRANSPORT PARAMETERS

VALUE OF TIME

Transportation projects frequently involve time savings as a benefit. Time savings generally account for a significant share of the benefits of major transport projects. There are different types of time savings i.e. work time and leisure time.

These values are to be applied when calculating the value of time per person for use in the economic appraisal of transport projects in Ireland. The value of travel time varies according to journey purpose. Different values are provided for in-work/business journeys, for leisure journeys and for commuting journeys.

It is recommended that growth in GNP per person employed is used to predict the growth in the value of time for in-work trips, since this will be the ratio which affects the earnings of the average 'in-work' trip-maker.

Table A.6: In-Work Value of Travel Time in Factor Costs and Market Prices, 2011

In-Work Value of Time €/hour Factor cost	In-work Value of Time €/hour Market Prices
€29.02	€34.33

Table A.7: Leisure Travel Time Values in Factor Costs and Market Prices, 2011

Leisure Value of Time €/hour Factor Costs	Leisure Value of Time €/hour Market Prices
€10.78	€12.75
Average hourly earnings for travellers are calculated at €26.95 for 2011	

Table A.8: Commuting Travel Time Values in Factor Costs and Market Prices, 2011

Commuting Value of Time €/hour Factor Costs	Commuting Value of Time €/hour Market Prices
€11.86	€14.03

Table A.9: Forecasted Growth in GNP per Person Employed

Period	% Growth
2010 - 2014	1.4
2015 – 2019	3.6
2020 - 2024	2.2
2025 – 2030+	2.3

VEHICLE OPERATING COSTS

Use of the transport system gives rise to operating costs for the user. These costs include both fuel and non-fuel operating costs. Non-fuel costs comprise costs relating to oil, tyres, maintenance and depreciation.

Fuel Costs

Fuel consumption is estimated by taking a weighted average of the most recent Irish road vehicle fleet and applying fuel consumption factors by both vehicle and road type. These data, when multiplied by the fuel prices given in Table A.10, provide the basis for calculating vehicle operating fuel costs.

Table A.10: Fuel Consumption Parameters in Litres per 100 Km, 2013

	Parameters		
Vehicle Type	Urban (litres/km)	Rural (litres/km)	Motorway (litres/km)
Petrol Car	8.361	6.438	6.803
Diesel Car	6.559	5.251	5.552
Petrol LGV	13.131	8.103	7.737
Diesel LGV	9.662	6.809	8.068
OGV	20.268	14.239	15.003
Buses	41.268	24.827	21.883
M & M/Cs	5.710	4.050	4.674

Table A.11: Fuel Prices in Cents per Litre, 2011

Fuel	Parameters	
	Market Prices	Factor Costs
Petrol	149.2	63.0
Diesel	142.9	70.0

Non-Fuel Costs

Non-fuel costs comprise costs relating to oil, tyres, maintenance, and depreciation. The cost functions set out below are based on those used in the UK transport appraisal guidance WebTAG and adjusted to Irish values.

Table A.12: Non Fuel Costs, 2011

Vehicle Category		Parameter Values	
		a1 p / km	b1 p / hr
Car	Work Petrol	6.265	171.493
	Work Diesel	6.265	171.493
	Work Electric	1.460	171.493
	Non-Work Petrol	5.507	0
	Non-Work Diesel	5.507	0
	Non-Work Electric	1.657	0
LGV	Work	9.099	70.308
	Non-Work	10.327	0.000
	Average	9.099	52.298
OGV1	Work	10.020	393.702
OGV2	Work	19.491	758.888
PSV	Work	45.458	1036.494

Future Profile of Vehicle Operating Costs

For future fuel costs, fuel efficiency changes are taken into account through forecasting the evolution of the Irish vehicle fleet and applying fuel consumption factors by vehicle and road type. These values are set out in Table A.13 and should be used in predicting the

improvement in fuel efficiency for the calculation of future vehicle operating costs. For the period after 2030, values are assumed to hold constant.

Table A.13: Forecast Fuel Consumption Parameters in Litres per 100 Km

Vehicle Type	2020			2025			2030		
	Urban	Rural	Motorway	U	R	M	U	R	M
Petrol Car	6.447	5.278	5.824	5.775	4.606	5.152	5.546	4.377	4.923
Diesel Car	5.435	4.127	4.403	5.077	3.769	4.045	4.921	3.613	3.889
Diesel LGV	6.462	5.197	6.642	6.269	4.994	6.441	6.195	4.915	6.363
OGV	18.430	14.772	19.200	18.406	14.732	19.119	18.409	14.730	19.110
Buses	34.707	24.154	27.077	34.710	24.102	27.045	34.758	24.122	27.073

For non-fuel costs, it is recommended to use the general Irish CPI for converting non-fuel-related vehicle costs between different price base years.

EMISSIONS

Vehicle emission factors are estimated from the default values contained within the COPERT 4 road transport emissions model and weighted to the Irish vehicle fleet. Tables A.14 to A.16 provide emission factors for the main road transport pollutants by each different combination of vehicle and road type. These data, when multiplied by the cost of emission values given in Table A.17, provide the basis for calculating vehicle emission costs.

Table A.14: CO_2 Emission Factors in Grams per Km, 2013

Vehicle Category	Parameters		
	Urban (grams/km)	Rural (grams/km)	Motorway (grams/km)
Petrol Car	192.294	148.068	156.460
Diesel Car	181.084	144.964	153.271
Petrol LGV	301.992	186.350	177.926
Diesel LGV	266.749	187.984	222.725
OGV	559.542	393.093	414.196
Buses	1139.322	685.417	604.150
M & M/Cs	131.318	93.136	107.483

Table A.15: NO_X Emission Factors in Grams per Km, 2013

Vehicle Category	Parameters		
	Urban (grams/km)	Rural (grams/km)	Motorway (grams/km)
Petrol Car	0.097	0.078	0.092
Diesel Car	0.677	0.500	0.593
Petrol LGV	0.052	0.041	0.045
Diesel LGV	1.051	0.737	0.861
OGV	4.405	2.103	1.542
Buses	9.210	3.813	2.821
M & M/Cs	0.143	0.194	0.303

Table A.16: PM Emission Factors in Grams per Km, 2013

Vehicle Category	Parameters		
	Urban (grams/km)	Rural (grams/km)	Motorway (grams/km)
Petrol Car	0.00176	0.00119	0.00119
Diesel Car	0.03511	0.02553	0.03305
Petrol LGV	0.00111	0.00156	0.00207
Diesel LGV	0.05200	0.03927	0.06146
OGV	0.03755	0.02311	0.02106
Buses	0.08104	0.04186	0.03566
M & M/Cs	0.01767	0.01767	0.01767

Costs of Emissions

The emission values associated with different pollutants is given in Table A.17 (see also tables A.2 and A.3). These can be used to monetise the cost of road transport emissions.

Table A.17: Values for Greenhouse and Non-Greenhouse Gas Emissions

Emissions Type		Emission Value (€ per tonne)
CO_2[12]		€20
NO_X		€5,688
VOC		€1,398
$PM_{2.5}$	**Urban**	€194,660
	Suburban	€47,420
	Rural	€16,512

Future Emission Values

For future emission costs, technological improvements are taken into account through forecasting the evolution of the Irish vehicle fleet towards meeting EU pollutant emission standards and using the COPERT 4 emission factors disaggregated by vehicle and road type. The values given in Tables A.18 to 20 should be used in forecasting the changes in vehicle emissions. For the period after 2030, values are assumed to hold constant.

Table A.18: Forecast CO_2 Emission Factors in Grams per Km

	2020			2025			2030		
Vehicle Type	**U**	**R**	**M**	**U**	**R**	**M**	**U**	**R**	**M**
Petrol Car	148.271	121.377	133.940	132.821	105.927	118.490	127.549	100.654	113.218
Diesel Car	150.053	113.937	121.545	140.173	104.057	111.666	135.864	99.748	107.356
Diesel LGV	178.410	143.489	183.371	173.080	137.870	177.812	171.027	135.698	175.666
OGV	508.806	407.814	530.078	508.159	406.726	527.828	508.240	406.674	527.575
Buses	958.188	666.828	747.532	958.270	665.390	746.636	959.579	665.958	747.411

[12] CO_2 values are for Non-ETS emissions and are priced in 2014 euros. All other emission values in table A.17 are in 2010 euros.

Table A.19: Forecast NO_X Emission Factors in Grams per Km

	2020			2025			2030		
Vehicle Type	**U**	**R**	**M**	**U**	**R**	**M**	**U**	**R**	**M**
Petrol Car	0.055	0.036	0.024	0.040	0.025	0.015	0.038	0.024	0.014
Diesel Car	0.526	0.381	0.440	0.353	0.256	0.285	0.251	0.181	0.200
Diesel LGV	0.710	0.568	0.684	0.406	0.352	0.438	0.273	0.245	0.308
OGV	3.344	1.614	1.214	1.391	0.568	0.355	0.667	0.224	0.105
Buses	7.805	3.149	2.275	3.719	1.346	0.881	1.589	0.511	0.270

Table A.20: Forecast PM Emission Factors in Grams per Km

	2020			2025			2030		
Vehicle Type	**U**	**R**	**M**	**U**	**R**	**M**	**U**	**R**	**M**
Petrol Car	0.00149	0.00101	0.00101	0.00190	0.00100	0.00100	0.00199	0.00100	0.00100
Diesel Car	0.01032	0.00780	0.00845	0.00374	0.00244	0.00251	0.00214	0.00112	0.00113
Diesel LGV	0.01824	0.01134	0.02071	0.00522	0.00305	0.00491	0.00246	0.00130	0.00156
OGV	0.03797	0.02199	0.01936	0.01246	0.00694	0.00625	0.00551	0.00262	0.00242
Buses	0.08913	0.04499	0.03728	0.03294	0.01625	0.01398	0.01458	0.00650	0.00565

Noise and Vibration

It is not proposed to estimate noise impacts at the preliminary appraisal stage of projects), 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. Much research is needed to arrive at definitive values for noise impacts. However, based on two surveys, a value of €30 per DB(A) per person per year is proposed (2011 prices). 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. It is recommended that Lden50 be used as the threshold for appraisal. This means that only incremental noise impacts above this value should be assessed.

Transport Infrastructure Ireland 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 Lden60.

COLLISIONS

The severity of collisions varies from damage to vehicles to fatal collisions. Most collisions have elements of police costs, damage to property and insurance and administration costs. Where there are casualties as a result of a collision there are costs associated with lost output, human costs and medical and ambulance costs.

Table A.21: Average Value of Prevention of Road Collisions by Severity and Element of Cost, € (2011 Prices & 2011 Values)

Collision Severity	Casualty related costs			Collision related costs			
	Lost output	Human costs	Medical & Ambulance	Police cost	Damage to property	Insurance & admin	Total
Fatal	701,881	1,338,656	1,205	21,521	13,952	375	2,077,589
Serious	27,041	186,012	16,382	2,519	6,225	233	238,412
Slight	2,858	13,617	1,212	653	3,713	142	22,053
Damage only	-	-	-	42	2,346	67	2,456

Table A.22: Collision Costs by Type of Collision, 2011

Accident Type	Value (€000)
Fatal	2310.5
Serious Injury	331.4
Slight Injury	31.1
Damage only	2.5

Table A.23: Vehicle Occupancy Rates by Flow Group and Time Modes

		Weekday				Weekend			
Vehicle Type	**Purpose**	**1**	**2**	**3**	**4**	**6**	**7**	**8**	**9**
Car	Work	1.24	1.25	1.26	1.26	1.33	1.34	1.38	1.38
	Commuting	1.21	1.22	1.23	1.23	1.2	1.23	1.22	1.22
	Other non-work	1.64	1.65	1.66	1.68	1.7	1.83	1.85	1.85
LGV	Work	1.36	1.32	1.37	1.38	1.42	1.42	1.42	1.42
	Commuting	1.4	1.41	1.4	1.4	1.95	1.95	1.95	1.95
	Other non-work	1.47	1.45	1.49	1.48	2.05	2.05	2.05	2.05
OGV1	Work	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
	Commuting	1.25	1.28	1.24	1.24	1.25	1.25	1.25	1.25
	Other non-work	1.29	1.33	1.26	1.27	1.29	1.29	1.29	1.29
OGV2	Work	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
	Commuting	1.11	1.14	1.11	1.08	1.11	1.11	1.11	1.11
	Other non-work	1.13	1.12	1.11	1.16	1.13	1.13	1.13	1.13
PSV	Work	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
	Commuting	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Other non-work	9.35	9.35	9.35	9.35	9.35	9.35	9.35	9.35

N.B. See Flow Group Description below

Flow Group	Description	
1	**Weekday**	Overnight off peak
2		Adjacent to peak
3		Peak Hour am
4		Peak Hour pm
6	**Weekend**	Overnight off peak
7		Off peak
8		Adjacent to peak
9		Peak Hour

Future Collision Values

Collision values are dependent on income, therefore the change in accident values over the evaluation time horizon should follow the growth in real GNP per person employed – the same updating mechanism, as set out in the value of time approach.

ACTIVE TRAVEL

The below values should be applied when calculating the benefits of investments in active travel. The total active travel benefit or cost is arrived at by combining the benefits associated with reductions in relative risk and reductions in absenteeism. To ensure consistency in appraisal of transport projects these values are presented in 2011 prices. Appraisers should cross-reference the section on the Value of Time which refers to the perceived value of time for active travel.

The calculated reductions in relative risk of death and the number of new walkers and cyclists are used to calculate a figure for the potential number of lives saved based on average mortality rates. An average mortality rate of 0.0019 is used, the mean proportion of the population aged 15-64 who die each year. The number of potentially prevented deaths is then multiplied by the value of a prevented fatality used in accident analysis (see collision values) to give a monetary benefit.

It is also assumed that the benefit of using active modes accrues over a five year period, after which new cyclists or pedestrians achieve the full health benefit of their activities.

Real growth in GNP per person employed should be used to adjust the benefits of reduced absenteeism from increased amounts of active travel between one year and another.

Valuing Reductions in Relative Risk

Table A.24: Reduction in Relative Risk for Cyclists and Walkers in Ireland

	Cyclists		Walkers	
	Return	**Single**	**Return**	**Single**
Average Active time per workday (mins)	44	22	36	18
Proportion of individuals	0.9	0.1	0.9	0.1
Average active time per workday (mins)	41.8		38	
Reduction in relative risk	0.21		0.11	

Valuing Absenteeism Impacts

Increasing physical activity increases productivity in the economy by reducing short-term sick leave. The median absenteeism rate for short terms sick leave is 4.6 days and 5.8 days for the private and public sector, respectively.

The number of employees in public sector employment is about 21% of total employment in Ireland, based on CSO employment tables. Calculating average sick leave taken in Ireland by

weighting the relative proportions of private and public sector employment gives an overall estimate of 4.9 days per year.

A cycling or walking intervention of 30 minutes per day reduces absenteeism in a reduction in short-term sick leave by between 6% and 32% per annum (WHO 2003). The lower bound of 6% is to be applied in appraisals to estimate the reduction in absenteeism per employee per year.

Thus, a conservative estimate of the expected reduction in absenteeism as a result of an intervention delivers activity levels of 30 minutes per day is about 0.3 days per employee per year (= 4.9 * 0.06). As in the case of mortality, the research in this area is scarce but it is assumed that the full benefits accrue to all new users.

The monetary value of the total benefit is then the product of the total hours per year saved and value of work time per hour (€34.33). The values should then be calculated, with graduated benefits to 2015, and full benefits from 2016 on, including real growth in the value of work time per hour in line with forecast GNP per person employed, then summed and discounted to give a total benefit in 2011 present values.