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GUVERNUL ROMÂNIEI

Instrumente Structurale 2007-2013

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Mobilitate în România. Conexiuni cu Europa.

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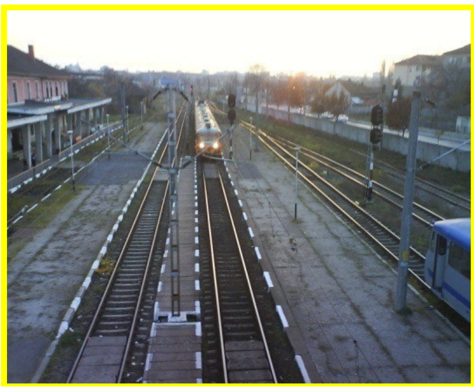
Romania General Transport Master Plan

National Guide for Transport Project Evaluation

VOL 2: Appendix A: Guidance Economic and Financial Cost Benefit Analysis and Risk Analysis



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Vol 2 Appendix A – Guidance Economic and Financial Cost Benefit Analysis and Risk Analysis

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Glossary

Accounting Prices: the opportunity cost of goods, sometimes different from actual market prices and regulated tariffs. They are used in the economic analysis to better reflect the real costs of inputs to society, and the real benefits of the outputs. Often used as a synonym for shadow prices.

Appraisal Guidance: Appraisal Guidance for Transport Projects in Romania

Base Year: Observed conditions or a representation of observed conditions for a pre-defined year.

BCR: Benefit Cost Ratio

CBA: Cost Benefit Analysis

CBA Guidance: Cost Benefit Appraisal Guidance for Transport Projects in Romania (Vol 2 Appendix A of the Appraisal Guidance)

CF: Cohesion Fund

CFR SA: National Railway Company, national infrastructure manager responsible for the public rail infrastructure.

CH_4: Methane gas

CNADNR: National Company of Motorways and National Roads in Romania, national infrastructure manager for motorways and national roads.

CO: Carbon Monoxide

CO_2: Carbon Dioxide

Common Unit of Account: In transport projects, monetary data are available in different units of accounts, the main difference being the inclusion or not in the price of taxes and subsidies.

- Factor cost: this unit of account is net of taxes (VAT or other indirect taxes) and subsidies and as such it is considered to represent the actual value of the production factors used to produce a good;
- Market price: this unit of account represents prevailing market price of a good that is therefore subject to indirect taxation, subsidies or both.

Do Minimum: A realistic view of what is likely to happen on the transport network in the absence of the proposed transport strategy or project.

EC: European Commission

EIRR: Economic Internal Rate of Return

ENPV: Economic Net Present Value

EU: European Union

FIRR: Financial Internal Rate of Return

FNPV: Financial Net Present Value

FTE: Full-time equivalent jobs. A full time job (30 hours a week plus) lasting at least one year.

GDP: Gross Domestic Product

GTMP: General Transport Master Plan

Market Price: The price at which a good or service is actually exchanged for another good or service or for money, in which case it is the price relevant for financial analysis.

MCA: Multi Criteria Analysis

Monte Carlo Simulation: A computerised mathematical technique that accounts for risk in quantitative analysis and decision making.

N_2O: Nitrous Oxide

National road: A state owned road of national importance, which links the capital city with the county capitals, national strategic developments or with neighbouring countries. National roads can be:

- motorways;
- expressways;
- European national roads;
- main national roads; and
- secondary national roads.

Net Present Value: The sum that results when the discounted value of the expected costs of an investment are deducted from the discounted value of the expected revenues.

Nominal Prices: An economic value expressed in fixed nominal money terms (i.e. units of currency) in a given year or series of year. In contrast to real prices, the effects of general price level changes over time are not removed from nominal prices.

NOx: Nitrogen Oxide

PM2.5 / PM10: Fine Particulate Matter

PPP: Public Private Partnership

PVB: Present Value of Benefits

PVC: Present Value of Costs

'Resource' or 'Opportunity' Costs: The value of a resource in its best alternative use. For the financial analysis the opportunity cost of a purchased input is always its market price. In economic analysis the opportunity cost of a purchased input is its marginal social value in its best non-project alternative use for intermediate goods and services, or its value in use (as measured by willingness-to-pay) if it is a final good or service.

SO_2: Sulphur Dioxide

Social Opportunity Costs: Opportunity costs or benefits for the economy as a whole. These may differ from private costs and benefits to the extent that actual prices differ from accounting prices.

Spend Profile: A breakdown of the projected spend of each cost element of a project across the project construction period, usually by year. The profile should include the currency units, price base year, whether the price is market or accounting prices and details of any discounting applied.

Stakeholder: Any individual or group with an interest in the proposal under consideration

VAT: Value Added Tax

VOC: Vehicle Operating Cost

VOT: Value of Time

Overview

Overview	**Economic Analysis**	**Financial Analysis**	**Risk Assessment**
Evaluation framework	Overall approach	Overall approach	Overview
Minimum requirements	Key analysis assumptions	Key analysis issues	Sensitivity analysis
Steps to be performed	Estimation of costs and benefits	Calculation of financial flows	Risk analysis
Treatment of costs and benefits	Assessment of economic impacts	Sources of financing	
		Assessment of financial impacts	

1 Overview

1.1 Cost Benefit Analysis within the Evaluation Framework

1.1.1 This guide forms part of a suite of documents outlining National Guidance for Transport Project Evaluation:

- Vol 1: Appraisal and Prioritisation of Projects for Inclusion in the Master Plan
- Vol 2: Appraisal Guidance for Transport Projects

  Vol 2. Appendix 2A. Guide to Economic and Financial Cost Benefit Analysis and Risk Analysis

  Vol 2: Appendix 2B. Guide for Transport Modelling.

1.1.2 These guidance documents describe the approach that should be taken in undertaking evaluation of transport strategies and projects in Romania. The guidance covers national, regional and inter-urban projects and strategies. Although many of the same principles apply, it is not intended to be used for the appraisal of urban projects.

1.1.3 The *'Appraisal Guidance'* outlines a two stage process (Pre-feasibility and Feasibility) for appraisal of transport interventions. It intends to provide guidance on planning and developing transport proposals, conducting appraisal and indicating post-implementation monitoring and evaluation techniques.

1.1.4 Figure 1 summarises the recommended overall appraisal framework

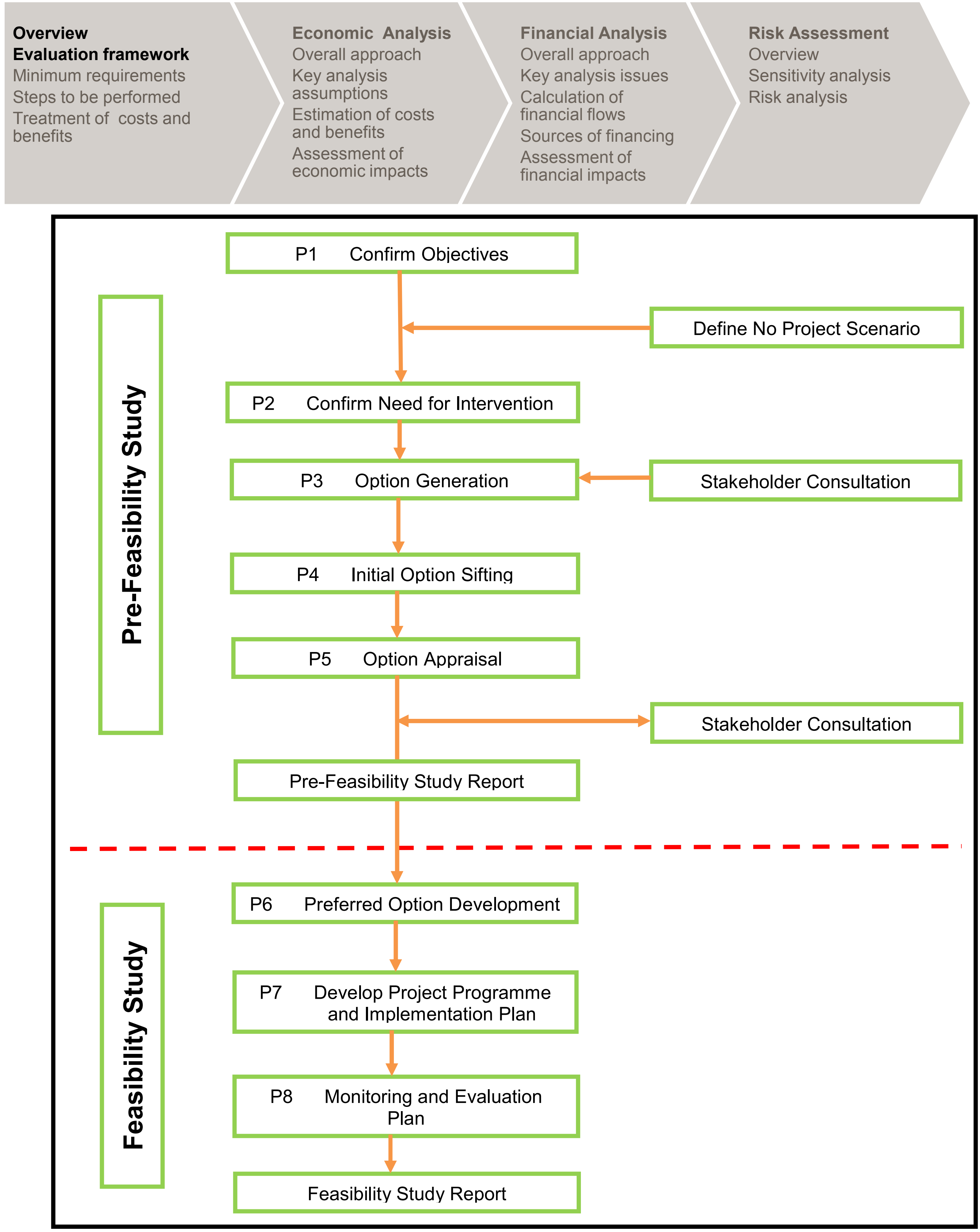


Figure 1 - Structure of the Appraisal Guidance for National Transport Projects

Overview	Economic Analysis	Financial Analysis	Risk Assessment
Evaluation framework	Overall approach	Overall approach	Overview
Minimum requirements	Key analysis assumptions	Key analysis issues	Sensitivity analysis
Steps to be performed	Estimation of costs and benefits	Calculation of financial flows	Risk analysis
Treatment of costs and benefits	Assessment of economic impacts	Sources of financing	
		Assessment of financial impacts	

1.1.5 This document outlines the approach that should be adopted in undertaking the cost benefit analysis element of project evaluation. The guidance has been written to apply to transport projects in Romania. As an EU grant is likely to be a key source of funding for many transport projects, and to simplify the approach to national project appraisal, the guidance has been developed to meet the requirements set out in the EC 'Guide to Cost Benefit Analysis of Investment Projects' published in 2008. Section E on Cost – Benefit Analysis and Section H on Financing Plan of Annex XXI of the Application Form for an EU grant are provided in Appendix C. It is understood that this guidance applies to the funding period 2007-2013 and that updated guidance will be released for the next funding period 2014-2020. The guidance has also been developed to meet the requirements set out in the 'General Guidelines for Cost Benefit Analysis of Projects to be supported by the Structural Instruments', published by the Ministry of Economy and Finance, Authority for Coordination of Structural Instruments. This guidance should, however, also be applied when alternative funding sources are envisaged as it provides a consistent basis for national prioritisation of projects and for assessing whether they offer good value for money. The following documents have been used to produce this guidance:

- Developing Harmonised European Approaches for Transport Costing and Project Assessment (HEATCO), 'HEATCO Deliverable 5. Proposal for Harmonised Guidelines', 2006;
- European Commission (EC), 'Guidance on the Methodology for Carrying out Cost-Benefit Analysis: Working Document 4', 2006;
- Internalisation Measures and Policies for All external Cost of Transport (IMPACT), 'Handbook on estimation of external costs in the transport sector', 2008;
- Ministry of Economy and Finance – Authority for the Coordination of Structural Instruments, 'Cost Benefit Analysis of Transport Projects to be supported by the Cohesion Fund and the European Regional Development Fund in 2007-2013', 2008
- New Energy Externalities Developments for Sustainability (NEEDS), 'NEEDS Deliverable 2.1. Value Transfer Techniques and Expected Uncertainties', 2009;
- Unification of accounts for and marginal costs for Transport Efficiency (UNITE), 'Valuation Conversions for UNITE', 2001.
- UK Department for Transport (UK DfT), 'Web-based Transport Appraisal Guidance (WebTAG)', 2002, 2010.

1.1.6 Modelling outputs are a key input into the cost benefit appraisal of projects. The '*National Transport Modelling Guidance'* outlines the approach that should be adopted in the development and testing of transport projects, and the level of detail that is required for modelling of different projects. The transport modelling work undertaken to support the cost benefit analysis should follow the '*National Transport Modelling Guidance'* to ensure the inputs to the appraisal are consistent with guidance.

1.1.7 A CBA Spreadsheet Tool has been developed as part of the appraisal of General Transport Master Plan (GTMP) projects which will provide a framework to undertake cost benefit analysis of projects in accordance with the requirements outlined in this document.

1.1.8 The National Transport Model has been integrated with the CBA Spreadsheet Tool and has been used for the prioritisation of the GTMP projects. The integrated National Transport Model and CBA spreadsheet Tool will enable project sponsors to assess projects in future which meet the requirements set out in the *'National Transport Modelling Guidance'*.

1.1.9 Following completion of the National Transport model and use of the CBA Spreadsheet Tool on the GTMP project, a user guide to the CBA Spreadsheet Tool will be produced and presented in Appendix B.

1.2 Minimum Requirements for Cost Benefit Analysis

1.2.1 As discussed above the Romanian Appraisal Framework distinguishes between the approaches to be taken when assessing projects at different stages of project development. Within the appraisal framework, cost benefit analysis is required for both strategies and projects; however, the detailed approach that should be undertaken in conducting the cost benefit analysis will vary depending upon the level of project progression.

1.2.2 The appraisal framework outlines the stages of project development where CBA is required :

- Pre-feasibility study
- Feasibility study

1.2.3 Although at both pre-feasibility and feasibility study levels a cost benefit appraisal is required, at later stages of assessment it is expected that project definition will be more precise and correspondingly greater detail should be included in the appraisal. Throughout this document, where the detailed approach to undertaking cost benefit appraisal varies by appraisal stage the requirements, by stage, are clearly set out.

Transport Modelling

1.2.4 The transport model outputs that are required in the cost benefit analysis should be produced from a transport modelling approach that meets the requirements set out in the *'National Transport Modelling Guidance'*. The National Transport Model meets these requirements and is suitable for assessment of projects meeting the following criteria:

- national and regional impacts of changes in population and its distribution;
- national and regional changes in economic activity;
- strategic inter urban highway schemes;
- rail infrastructure and service proposals including major investments such as high speed rail;
- port and maritime infrastructure investment and policy changes;
- aviation projects and service proposals;
- national and regional bus strategy development;
- terminals supporting intermodal transport;
- national policy measures such as:
  - implementation of road tax changes and impact on car ownership;
  - differential pricing for use of rail and road;
  - internalisation of external transport costs; and

- climate change policies.

1.2.5 Further details are given in section 9.2 of the Modelling Guidance.

1.2.6 Projects not meeting these criteria require an alternative modelling approach as described in the '*National Transport Modelling Guidance'*.

Incremental Approach to CBA

1.2.7 The Cost Benefit Analysis is carried out using an 'incremental' approach. Costs and benefits are assessed by considering only the differences between a scenario including the project and an alternative scenario without the project. It is therefore necessary to have transport model results for both a Project scenario and a No Project scenario to calculate the incremental change in benefits. When considering costs it is only necessary to consider elements which are different between the Project and No Project scenarios.

1.2.8 Both the Project and No Project scenarios should include all committed schemes outlined in the forward plans for all modes relevant to the project being assessed. Further guidance on the construction of the No Project scenario is provided in Chapter 4 of the *'Appraisal Guidance'*.

1.3 Steps to be Performed within CBA

1.3.1 As discussed in section 1.1 the CBA structure has been based on the approach recommended by the European Commission. This is to ensure that projects which seek EU funding will have undertaken adequate analysis whilst providing a standardised approach across all projects in Romania needed for effective national project prioritisation.

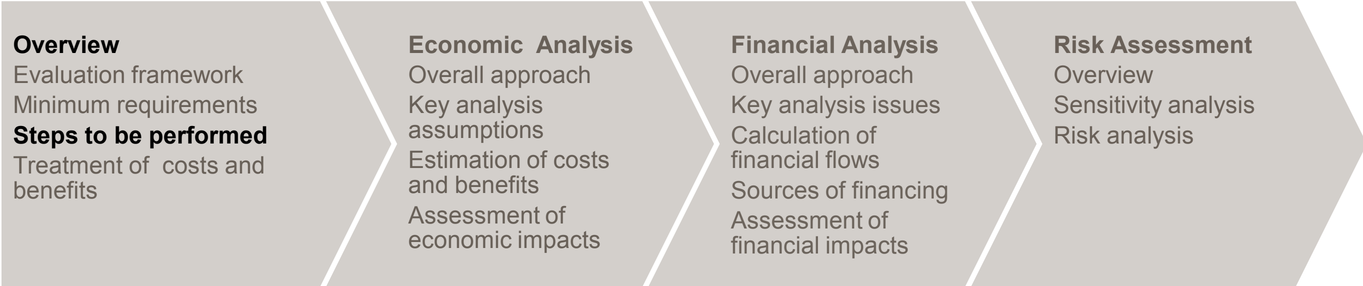
1.3.2 The EU 'Guide to Cost Benefit Analysis of Investment Projects' outlines a six stages structure for project appraisal. These are shown in Figure 2 overleaf.

1. Context analysis and Project objectives
2. Project identification
3. Feasibility and option analysis
4. Financial analysis
5. Economic analysis
6. Risk assessment

1.3.3 Stages 1, 2 and 3 are discussed in the *'Appraisal Guidance'*. The guidance in this document focuses on stages 4, 5 and 6 and meets the requirements set out in the EC document.

1.3.4 In summary the economic analysis shows whether a project is worth funding and the financial analysis shows the financial viability of a project, and - for projects seeking EU grant - demonstrates whether a project needs EU funding. The risk analysis then shows the uncertainty surrounding the outcomes of the economic and financial analysis.

1.3.5 An overview of the financial analysis, economic analysis and risk assessment is given in the following sections. Further detailed descriptions of these stages are outlined in the following chapters.



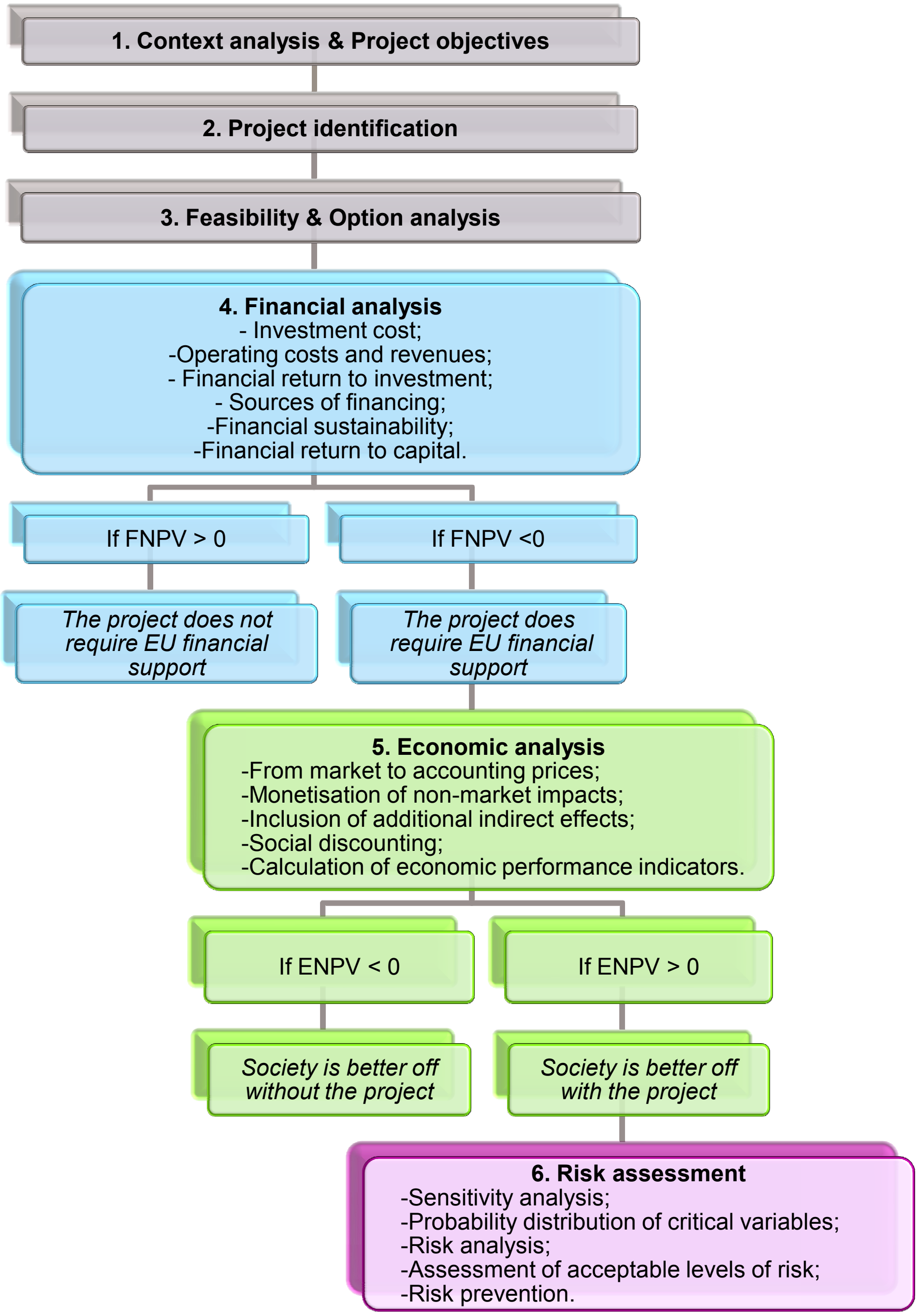


Figure 2 – Structure of Project Appraisal for Investment under EU (Structural, Cohesion, IPA) Funds

Source: 'Guide to Cost Benefit Analysis of Investment Projects' July 2008

Overview
Evaluation framework
Minimum requirements
Steps to be performed
Treatment of costs and benefits

Economic Analysis
Overall approach
Key analysis assumptions
Estimation of costs and benefits
Assessment of economic impacts

Financial Analysis
Overall approach
Key analysis issues
Calculation of financial flows
Sources of financing
Assessment of financial impacts

Risk Assessment
Overview
Sensitivity analysis
Risk analysis

Purpose of Economic Cost Benefit Analysis

1.3.6 The main purpose of the economic analysis is to assess whether the project's benefits exceed its costs and whether it is therefore worthwhile to progress. The analysis is conducted from the view point of the whole of society, not just the project owners. To capture the range of economic impacts the analysis includes both elements with direct monetary value, such as construction and maintenance costs, revenues and vehicle operating cost savings; as well as elements without direct market value such as time savings, accident reduction and environmental impacts.

1.3.7 In order to allow consistent comparison of costs and benefits across a project all impacts should be monetised (i.e. attached a monetary value) and then aggregated to determine the net benefits of the project. From this it can be determined whether the project is desirable and worth implementing. However it is important to recognise that not all project impacts can be monetised and it is therefore important to consider the results of the CBA in conjunction with a wider Multi-Criteria Appraisal (MCA), which also considers these non-monetised impacts. Guidance on MCA is provided in the 'Appraisal Guidance'.

Purpose of Financial Cost Benefit Analysis

1.3.8 The main purpose of the financial analysis is to assess the financial profitability and sustainability of the project from the viewpoint of the project owners. This is done by considering the financial cash flow for the project; this includes both outflows in terms of investment, maintenance and operating costs; and inflows in terms of funding sources and user revenues/charges.

1.3.9 The project appraisal structure uses the financial analysis to determine the financial sustainability of the project. Simplistically this analysis shows whether the project will generate a positive net cash flow over the appraisal period (profitability) and whether the cumulative net cash flow since project inception is not less than zero (sustainability).

1.3.10 The analysis initially considers the project's financial profitability without EU funding to assess whether EU funding is needed. For projects seeking EU funding this is required to demonstrate that the project is eligible for EU funding. It is however important that, even if it is not envisaged that EU funding will be requested, that the financial analysis is still undertaken to demonstrate that the alternative funding sources identified are sufficient.

1.3.11 For a project to be viable the financial analysis needs to demonstrate that the funding sources (including, if relevant an EU grant) and revenue generated by the project are sufficient to offset the project costs, and that the funding and revenue are appropriately profiled across the appraisal period to ensure that in any year the project will not require any additional external bridging funding.

Purpose of Risk Assessment

1.3.12 Project appraisal is a forecasting process and as such has inherent uncertainties. These uncertainties come from both data limitations in the existing situation, and uncertainties as to how aspects, such as demand for travel, costs for infrastructure etc, will change over time. General guidance on the management of project risks is provided in the 'Appraisal Guidance'. In this document, specific guidance is given on the assessment of risk.

1.3.13 The risk assessment considers these uncertainties and their impact on the outcomes of both the economic and financial appraisal. In order to do this sensitivity analysis is undertaken to establish the critical variables. The critical input variables are allocated probability distributions which define the likelihood of the variable value falling within specific ranges. Using probability distributions it is possible to assess, through Monte Carlo simulation, the distribution of uncertainty in the outcomes of the economic and financial appraisal. From these outcome uncertainties the risk analysis can define the likelihood of the project meeting the threshold values for economic and financial performance. There is also a need to establish acceptable values of risk and manage these risks in the analysis.

1.4 Overview of Treatment of Costs/Outflows and Benefits/Inflows

1.4.1 The economic analysis and the financial analysis consider various costs/outflows and benefits/inflows associated with and generated by the project. Whilst the characteristics of inputs are consistent between the economic and financial analysis the treatment of the data can vary. The table below summarises the key inputs to the analysis and whether they are included in the respective analyses.

Table 1 - Summary of Treatment of Analysis Inputs

	Economic Analysis	Financial Analysis
Funding Sources	Does not consider explicitly sources of funding	✓
Investment Costs Maintenance and Operating Costs	✓	✓
Discount Rates	✓ (social discount rate)	✓ (financial discount rate)
Change in User Charges (Fares/Tolls)	Not included (transfer payment)	✓ (as revenue to Operator)
Change in User Travel Time	✓	Not included.
Change in User Vehicle Operating Costs	✓	
Change in User Journey Reliability	Only included if reliability improvements form an important outcome of the project.	
Change in Number of Accidents	✓	
Change in CO_2 Emissions	✓	
Change in Local Air Pollution	✓	
Changes in Noise Levels	✓	
Subsidies/Taxes	Not included (transfer payment)	✓
VAT	Not included (values expressed as factor costs)	✓ (values expressed as market prices)

Economic Cost Benefit Analysis

2 Economic Cost Benefit Analysis

2.1 Overall Approach to Economic Cost Benefit Analysis

2.1.1 The purpose of the economic cost benefit analysis is to determine whether the project has a positive net contribution to total economic welfare. This enables decision makers to prioritise projects and make funding decisions. This is in contrast to the financial analysis which only examines the impact on the owners and operators of the infrastructure. As noted above, certain impacts cannot currently be monetised and these should also be considered by decision makers, through the MCA.

2.1.2 The economic analysis converts the cost and benefits of a project into a common unit of account (Euros) and compares the size of benefits to the size of the costs for individual stakeholder groups (providers, users and wider society).

2.1.3 Many of the impacts of a project are already expressed in monetary terms, for example investment, maintenance and operating costs; however, in the economic analysis market prices should be converted into accounting prices using appropriate conversion factors when they do not reflect social opportunity costs. The glossary provides definitions for key economic terms used in this document.

2.1.4 For project impacts that do not have a direct market value (for example time savings, emissions and local pollution changes) it is necessary to convert the benefits and costs into monetary values using the methods outlined in this document. This allows impacts of varying natures to be combined and compared using a common unit (Euro) as a welfare metric for the items being appraised

2.1.5 There are cases where market price conversions are not available, or very difficult to reliably and accurately define. These include, for example, some environmental impacts such as loss of landscape views, social or health effects and wider economic benefits. Many of these impacts are still important to achieving the project's objective and therefore, whilst not included explicitly in the quantitative economic analysis, need to be evaluated in the wider appraisal framework.

2.1.6 Once project impacts have been monetised and suitably discounted the total benefits can be compared against the total costs. Simplistically for a project to be viable the project benefits should exceed the project costs, and more specifically, the present value of the project economic benefits (PVB) should exceed the present value of the project economic costs (PVC). In practice this is shown by a positive economic net present value (ENPV = PVB-PVC), a benefit to cost ratio (BCR = PVB/PVC) greater than one and an economic internal rate of return (EIRR) greater than the discount rate used.

2.1.7 In summary, economic analysis includes the following steps:

1. Conversion of market to accounting prices
2. Monetisation of non-market impacts
3. Inclusion of additional indirect effects (if relevant)
4. Discounting of estimated costs and benefits
5. Calculation of the key economic performance indicators

2.1.8 The economic analysis should include, where possible to quantify, all the main expected impacts of the project. This should include both the positive impacts that a project has been designed to deliver as well as the negative impacts which may be a consequence of the project. The table below summarises the impacts that are discussed in this guidance document. It is not expected that every project will have significant impacts in every area. It is the responsibility of the appraisal team to select and then demonstrate that an appropriate range of impacts have been assessed. Where these are scoped out as being insignificant, a reasoned justification should be provided.

Table 2 - Possible Social Project Impacts

Impact
Investment costs
Change in maintenance costs
Change in operating costs
Change in user charges/revenue
Change in user travel time
Change in user wait time
Change in user vehicle operating costs
Change in user reliability
Change in soft factors (for example journey comfort, ease of use)
Change in number of accidents
Change in greenhouse gas emissions
Change in levels of local pollution
Change in noise levels experienced

2.2 Key Analysis Assumptions

2.2.1 The sections below describe the approach that should be taken in the economic assessment in relation to key elements of the appraisal.

Appraisal Period

2.2.2 The appraisal period should cover the time over which the project is 'economically useful' and encompass the likely medium and long term impacts of the project. In keeping with recommendations in the European Commission's 'Guide to Cost Benefit Analysis of Investment Projects' 2008, indicative appraisal periods for transportation projects are given in Appendix A1. These appraisal periods represent the time after opening in which benefits (and costs) should be considered. Costs incurred prior to opening, which is likely to include the majority of investment costs, should also be included in the analysis.

2.2.3 If at the end of the appraisal period there are economic benefits, or costs outstanding these can be accounted for in the residual value of the project (see section 2.4.22).

Social Discount Rate

2.2.4 A project typically incurs costs during the early construction phase and provides benefits (and some operating costs) during the subsequent operation phase. In order to compare the benefits and costs incurred in different years on a like-for-like basis it is necessary to 'discount' all costs and benefits to a present value year. The present value cost takes into account that costs and benefits incurred in early years are more 'valuable' than the same sized benefit or cost incurred in a more distant year.

2.2.5 A social discount rate in accordance with the European Commission's 'Guide to Cost Benefit Analysis of Investment Projects' 2008 should be used for all projects; this is given in Appendix A2. Appendix A2 also gives the year to which present value costs should be discounted.

Common Unit of Account – Factor Costs

2.2.6 Economic appraisals may be undertaken in either market prices or factor costs. To avoid inconsistency that could bias the outcome of the appraisal a common unit of account needs to be adopted. Following 'HEATCO Deliverable 5. Proposal for Harmonised Guidelines', we recommend the use of factor costs. Values presented in Appendix A are expressed as factor costs.

Calculating factor cost from market price

The market prices include indirect taxation and the effect of price subsidies, whereas factor costs do not. Market prices can be converted to factor costs by subtracting the average tax/subsidy element, which is usually referred to as the average rate of indirect taxation. If the average rate of indirect taxation is τ, then market prices are converted to factor costs by the following formula:

$$Factor\ Costs = {Market\ Prices}/{(1+\tau)}$$

The steps in the process of adjusting market prices to factor costs are:

1. Consider each element in the cost benefit calculation and establish whether they are at market prices (inclusive of indirect taxation and exclusive of subsidies) or factor costs (exclusive of indirect taxation and inclusive of subsidies)
2. Divide the value of any element that is at market prices by the indirect tax factor as described above.

It should be noted that revenues accruing to firms will be normally recorded at factor costs, whereas revenues paid by consumers will normally be at market prices. Also, if values of time are based on behavioural studies, they are normally rendered in market prices and have to be adjusted downwards to factor costs.

Numerical Example

Suppose that the retail consumer in Romania has to pay 1€ for a bag of sand and that the level of indirect taxes in the Romanian economy, mainly influenced by the VAT rate, is 24%. The factor cost of a bag of sand in Romania is:

$$\text{Factor. Cost}_{\text{sand}} = \frac{\text{Market. Price}_{\text{sand}}}{(1+\tau)} = \frac{1}{(1+24\%)} = 0.81€$$

Currency

2.2.7 The economic assessment should be undertaken in Euros. Appendix A3 provides a standardised exchange rate for conversion of cost estimates from Romanian Lei to Euro and historic exchange rate data. Appendix A3 also provides annual average exchange rates between the Euro and major European currencies which should be used, if necessary for value transfer currency conversions.

Price Base

2.2.8 Costs (investment, maintenance and operating) will typically be estimated in nominal prices. This implies that costs will be priced in the currency of the year in which they occur. On the contrary, benefit parameters are typically quoted in a constant price base. The price base years of benefit parameters recommended in this guidance are indicated in the parameter tables in Appendix A.

2.2.9 An unbiased comparison of costs and benefits requires their respective values to be expressed in comparable units. It is therefore important to ensure that a common price base year is used throughout the analysis. The price base recommended for the analysis is given in Appendix A3.

2.2.10 Ensuring a common price base year may require undertaking the following tasks:

- Converting nominal values to a constant price base year, and
- Converting values from one base year to another.

Converting nominal values to a constant price base year

Nominal values differ from constant values in that they include the effect of inflation. Hence, constant values are calculated by removing inflation from nominal values. This is achieved by using an appropriate price index (PI) and following this formula:

$$\text{Price}_{\text{Base Year}} = \text{Price}_{\text{Data Year}} \times \frac{\text{PI}_{\text{Base Year}}}{\text{PI}_{\text{Data Year}}}$$

Numerical Example

Suppose that the Total Labour Cost (TLC) for a train operating company in 2010 prices in Romania was 130m€ and that the price base year for the analysis is 2008. Using CPI as a price index, the TLC in 2008 prices would be:

$$\text{TLC}_{2008} = \text{TLC}_{2010} \times \frac{\text{CPI}_{2008}}{\text{CPI}_{2010}} = 130 \times \frac{279.1}{312.7} = 116\text{m€}$$

Converting values from one base year to another

Using a different base year needs to address two issues; the rise in prices and the change in the willingness to pay as a result of changes in available income. The use of an appropriate price index (PI) caters for the former, while real GDP per capita acts as a proxy for the latter according to this formula:

$$\text{Value}_{\text{Base Year}} = \text{Value}_{\text{Data Year}} \times \frac{\text{PI}_{\text{Base Year}}}{\text{PI}_{\text{Data Year}}} \times \left(\frac{\text{GDP per capita}_{\text{Base Year}}}{\text{GDP per capita}_{\text{Data Year}}}\right)^{\gamma}$$

Where γ is rate of growth with respect to income. This value varies by parameter. Recommended values are given in Appendix A.

Numerical Example

Suppose that studies have shown that the value of an avoided slight injury (VSI) in Romania in 2002 was 3,830€, that the rate of growth of VSI with respect to income is 1 and that we need to rebase it in 2010 values and prices. Following the above formula, VSI in Romania rebased in 2010 would be:

$$\mathrm{VSI}_{2010} = \mathrm{VSI}_{2002} \times \frac{\mathrm{PI}_{2010}}{\mathrm{PI}_{2002}} \times \left(\frac{\text{GDP per capita}_{2010}}{\text{GDP per capita}_{2002}}\right)^{\gamma} = 3830 \times \frac{126.5}{105.8} \times \left(\frac{3056}{2200}\right)^{1} = 6{,}361€$$

2.2.11 When conducting price base conversions, the use of more specific (sector or sub-sector specific) price indices should be preferred over general ones. Appendix A3 provides major price indices and recommendations on their use.

Value Transfer

2.2.12 A key task when monetising non-monetary benefits is the accurate determination of the social value of a unit change in benefit (for example value of time saving in euro per hour). Primary valuation studies should be conducted before policy applications, to ensure a high degree of certainty. However, when resources are limited, values from a primary study area (or country) could be transferred to Romania. In the EU context, we recommend the use of the adjusted unit transfer method. This method assumes that the general preferences of the population influencing its willingness to pay are the same in the primary study area and Romania, while allowing for income level and cost of living differences.

Value Transfer

Purchasing Power Parities (PPP) is an exchange rate between currencies (hence economies) that forces the purchasing power between the economies to be equal. PPP, when used as a conversion factor, does not suffer from the volatility of the market exchange rates. PPP is based on the comparison of the relative price of a "basket of goods" across countries. For example, assume that the current market exchange rate of the Romanian Leu against the Bulgarian Lev is 0.43. However, if a tonne of cement (of the same quality) is 400 Lei in Romania and 200 Leva in Bulgaria, and cement is the sole component of the “basket of goods” the PPP adjusted exchange rate of the Leu against the Lev would be 0.5.

The PPP factor is used to adjust GDP per capita to allow for income comparison between countries, taking difference in living costs into consideration. GDP per capita at PPP is used in the value transfer method.

Numerical Example

Suppose that studies have shown that the value (social cost) of a tonne of SO_2 emitted in Germany in 2002 was 4,500€. Using GDP per capita at PPP for Romania and Germany the value of a tonne of SO_2 emitted in Romania in 2002 would be:

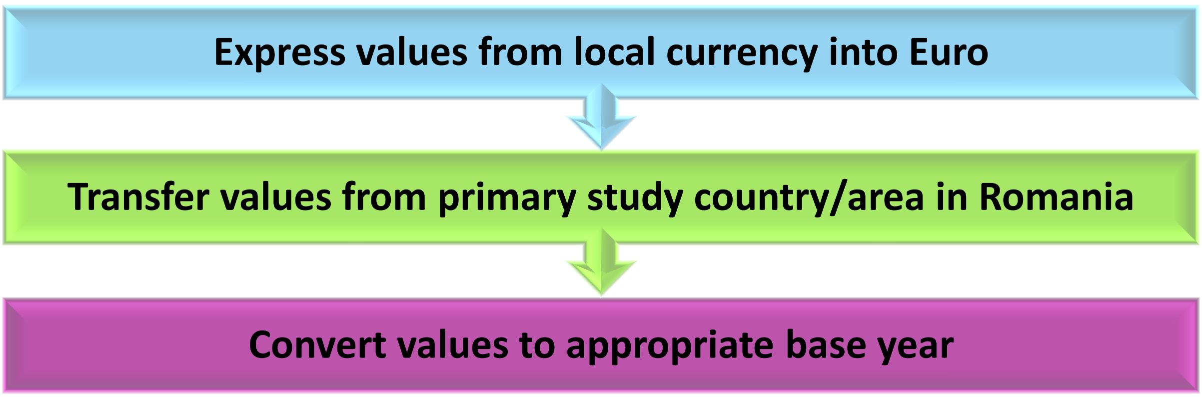
$$SO2_{RO,2002} = SO2_{GER,2002} \times \frac{GDP\ per\ capita, PPP_{RO,2002}}{GDP\ per\ capita, PPP_{GER,2002}} = 4{,}500 \times \frac{2{,}200}{25{,}900} = 382€$$

2.2.13 When undertaking value transfer it is possible that original value data is not provided in Euro. To allow for exchange rate fluctuation, the annual average exchange rate between the data currency and Euro for the year for which the data is available should be used to express values in Euro before proceeding with possible further adjustments required. Appendix A3 provides annual average exchange rates between the Euro and major European currencies.

Conversion and Transfer Sequence

2.2.14 It is possible that both a value transfer and a price base year conversion adjustment are needed to achieve comparability between costs and benefits. In this case, value transfer should take precedence over price base year conversion.

2.2.15 It is important that a uniform method is used when handling values of benefits and costs. The following diagram summarises the sequence of steps that need to be followed. Depending on data availability, steps may be omitted.



Numerical Example

Suppose that studies have shown that the Value of Time during commute in the UK was £5.75 in 2006 values and prices. In order to produce a Value of Time during commute in Romania in 2010 values and prices, the steps below need to be followed:

Step 1

Use the Euro to British Pound average annual exchange rate in 2006 to express the value in Euro.

$$VOT_{UK,€,2006} = VOT_{UK,£,2006} \times \frac{1}{ExchangeRate_{€to£,2006}} = 5.75 \times \frac{1}{0.68173} = 8.43€$$

Step 2

Use GDP per capita in PPP rate for Romania and the UK to transfer value to Romania in 2006 values and prices.

$$VOT_{RO,€,2006} = VOT_{UK,€,2006} \times \frac{GDP\ per\ capita, PPP_{RO,2006}}{GDP\ per\ capita, PPP_{UK,2006}} = 8.43 \times \frac{5800}{27990} = 1.75€$$

Step 3

Use GDP per capita and HICP for Romania in 2006 and 2010 to convert base year to 2010. Assume a rate of growth of VOT during commute with respect to income equal to 0.7

$$VOT_{RO,€,2010} = VOT_{RO,€,2006} \times \frac{HICP_{EU,2010}}{HICP_{EU,2006}} \times \left(\frac{GDP\ per\ capita_{RO,2010}}{GDP\ per\ capita_{RO,2006}}\right)^{\gamma}$$

$$= 1.75 \times \frac{126.5}{115.7} \times \left(\frac{3056}{2868}\right)^{0.7} = 2.00€$$

Growth in Values over Time

2.2.16 Throughout the appraisal period the value of costs and benefits is expected to grow. However, future values should be expressed in real terms (i.e. future inflation should be ignored). This is achieved in two ways:

- Starting from the value of a parameter in the Price Base Year, it is typically assumed that its growth follows that in real GDP per capita. A parameter specific elasticity is applied to allow for differentiated growth. Suggested elasticity values for each parameter are provided in their respective appendices.
- In case of parameters for which there is strong evidence that their future prices will grow in excess of the general inflation, the excess inflation rate represents the growth in real value.

Numerical Example

Suppose that the unit factor cost of fuel is expected to increase at a rate of 5% per annum from the price base year, while general inflation is anticipated to be 2.5% per annum. The excess annual inflation rate for fuel would be:

$$\text{Excess Inflation}_{\text{Fuel}} = \frac{(1 + \text{Inflation}_{\text{Fuel}})}{(1 + \text{Inflation}_{\text{General}})} = \frac{1 + 5\%}{1 + 2.5\%} = 1.024$$

Therefore, future values of fuel for years beyond the Price Base Year should be inflated at 2.4% annually.

2.3 Overview of Estimation of Costs and Benefits

2.3.1 It is necessary to consider the impacts of a project in a consistent manner. Impacts are therefore monetised to allow ease of analysis and combination of impacts across different elements.

2.3.2 Costs typically include:

- Investment costs,
- Maintenance cost,
- Operating costs (for operating new infrastructure/services).

2.3.3 Benefits typically include:

- User charges (as a benefit to the operators and a disbenefit to the users),
- Vehicle operating cost changes for users,
- Time savings for users,
- Variations in external costs:
  - Emissions (greenhouse gas and local pollution),
  - Noise,
  - Accidents,
  - Congestion and scarcity costs.

2.3.4 Costs and benefits can be positive or negative depending upon the nature of the project being assessed.

2.3.5 The table below provides a summary of possible inflows and outflows associated with a transport project that may occur.

Table 3 - Overview of Social Costs and Benefits in Economic Cost Benefit Analysis

Outflows	Inflows
Investment costs Maintenance costs Operating costs	Time savings VOC savings
	Accident savings Greenhouse Emissions savings Local air pollution savings Noise savings

2.4 Investment, Maintenance and Operating Costs and Benefits

2.4.1 Providers include those who construct and own the infrastructure and those who operate services using the infrastructure. For many projects this is not the same body and therefore providers' costs and benefits cannot be considered as a single account. Whilst, in these instances it is necessary to separate out the costs of the different parties in the financial analysis no such separation is required in the economic analysis as this assesses the project from the viewpoint of the impact on the whole of society.

Investment Costs

2.4.2 Project investments costs should include all elements of expenditure required to realise the project, including upfront costs such as planning and design costs. The investment costs should also include any extraordinary maintenance operations expected to be required during the appraisal period.

2.4.3 Costs should initially be specified in market prices. Then converted to accounting prices as discussed later in paragraph 2.4.14

2.4.4 The main elements of the investment cost associated with transportation projects are:

- Planning/design fees: costs related to preparatory studies, designs and tests, acquirement of approval and permits, management of the procurement process, prior to the commencement of the construction period;
- Land purchase/Expropriation Costs: costs of acquiring the land including relevant administrative costs;
- Building and construction – Labour: compensation of skilled and unskilled personnel during the construction period of the project.

- Building and construction – Materials: costs of building materials used in construction period;
- Plant and machinery: costs of acquiring the equipment necessary for the construction of the project;
- Contingencies: unexpected costs relating to the building and construction of the project. The overall eligible contingency budget cannot exceed 10% of the total investment cost of the project (net of contingencies);
- Price adjustment: may be included to allow for expected inflation where cost estimates are quoted in constant prices;
- Technical assistance / Project Management Costs: includes costs for dissemination of technical knowledge and expertise, training of staff, enhancement of administrative capacity and deliverability of projects;
- Publicity: costs focusing on communication strategies and engagement of the public;
- Supervision during construction implementation: costs relating to the management and delivery of the project, including coordination of works, delivery of supplies and quality control;
- Value Added Tax (VAT): is an ineligible cost, unless sufficient explanation is provided.

2.4.5 The cost elements above correspond to the fields required in Table H1 of the EU funding application. For consistency cost estimates in all Cost Benefit appraisals should be disaggregated to these elements (or subsets of these elements). The EU funding application form also currently requires costs of environmental mitigation to be isolated from construction costs.

2.4.6 Depending upon the stage that the cost estimate is undertaken, certain cost elements may be known based on outturn costs. For example, actual land purchase/expropriation costs may be known and elements of planning and design may have been undertaken already.

2.4.7 Actual outturn costs, if known, should always be used in preference to cost estimates. If, at any stage of the appraisal process, detailed project cost estimates are available then these should be used. If however, cost estimates are not available at earlier stages unit rates and typical ratios to total construction cost should be used. These should be based on data from recent tender prices for similar projects.

2.4.8 Table 4 below summarises how each of the cost elements should be considered when cost benefit analysis is undertaken at the pre-feasibility and feasibility study stage. Specific requirements for the general cost estimate are given in Government Decision 28/2008.

2.4.9 Cost estimates expressed in Lei should be discounted to the price base year, following the conversion process in paragraph 2.2.10 and using the appropriate Price Index recommended in Appendix A3. Before being included in the Cost Benefit Analysis, they need to be expressed in Euros. It is acknowledged that the actual exchange rate between Lei and Euros in future years is unknown therefore it is recommended to use the standard exchange rate provided in Appendix A3 as this provides consistency across project appraisals.

2.4.10 It has been recognised internationally that cost estimates in early stages of project development are often lower than the final outturn cost. This should be reflected in the cost estimate by the use of an appropriate contingency factor which reduces as the project progresses and cost estimates become more detailed. For example, in the UK for road projects the recommended contingency (optimism bias) ranges from 44% in early stages of project appraisal to 3% in the final stage of the project appraisal.

2.4.11 For detailed project appraisal the contingency should be linked into the risk register that is discussed in Section 2.4 of the *'Appraisal Guidance'* and the outcomes of the risk analysis. It should be noted, however, that under current EU regulation, a contingency budget for an EU funded project is eligible up to a maximum of 10% of the total investment cost of the project (net of contingencies). Any part of the contingency budget in excess of this threshold is deemed ineligible.

Table 4 - Treatment of Investment Costs

		Project Progression **Start → End**	
		Pre-feasibility Study	**Feasibility Study**
Planning / Design Fees			Assumed x% of total construction cost
Land Purchase / Expropriation		Rate per kilometre, based on recent evidence	Land Expropriation Schedule
Building and Construction	Labour	Total construction cost calculated from unit rates from comparable projects. Labour, Materials and Plant & Machinery calculated from appropriate shares.	% of individual Bill Rates from Bill of Quantities
	Materials		
Plant and Machinery			
Contingencies		Assumed x% of total construction cost	
Price Adjustment		If applicable, assumed to be equal to inflation, when costs are expressed in constant prices.	
Technical Assistance and Project Management		Assumed x% of total construction costs or actual estimates if	

	Project Progression Start → End	
	Pre-feasibility Study	**Feasibility Study**
Publicity	available	
Supervision during Construction Implementation		
Value Added Tax (VAT)	Not included in economic assessment as is a transfer payment	

Note: *If costs are known these should be used at all stages*

2.4.12 Whilst all costs should be included in the investment cost estimates, any costs incurred prior to the beginning of the programming period will not be recognised by EU as eligible expenditure and it should be recognised that the EU grant will not contribute to this element of investment cost. For each cost element an expected spend profile across the construction period should be defined. This will vary by project and depend upon the project opening year and construction period.

2.4.14 The Economic cost benefit analysis considers the costs in accounting prices. These differ to market prices when they do not reflect social opportunity costs. The economic costs of a project are measured in terms of their 'resource' or 'opportunity' costs. This is the benefit that has been forgone (lost) to society by using scarce economic resources in the project rather than for some alternative use. Similarly, the economic benefits of a project are measured in terms of the costs avoided as a result of implementing the project.

2.4.15 The economic cost is derived from the financial cost by removing the impact of indirect taxes and applying conversion factors. Typically factors are 1.0, only differing when market prices are considered not to reflect the true economic costs (see Determination of Conversion Factors box below for further details).

Determination of Conversion Factors

Economic cost is derived from financial cost by applying **Conversion Factors** to ensure that the prices used in the economic analysis reflect the true economic value of the resources used. These factors take account of price distortions caused by imperfections in markets. Project costs should be broken down into the following categories and treated according to the approach outlined in the 'General Guidelines for Cost Benefit Analysis of Projects to be Supported by the Structural Instruments', published by the Ministry of Economy and Finance, Authority for coordination of Structural Instruments and summarised below:

- *Traded Items* – This category comprises all goods and services included in the project cost that can be valued on the basis of world prices. In transportation projects this will include construction materials. In an open economy with international tenders this category will cover most project costs and market prices are assumed to reflect the opportunity cost of the goods or services. **A conversion factor of 1.0 is therefore applied**.

- *Non-Traded Items* – This category comprises all goods and services that have to be procured domestically. In transportation projects this will include domestic construction and some raw materials. The conversion from financial to economic prices is usually done through a **Standard Conversion Factor** (SCF). The SCF is usually calculated based on the average differences between domestic and international prices (i.e. FOB and CIF border prices) due to trade tariffs and barriers. However, given that costs within this category are normally low with regards to total project costs and that roughly 70% of the Romanian trade is internal to the EU and therefore by definition not subject to trade tariffs, **the SCF will be 1.0 unless otherwise justified**.

- *Skilled labour* – This category comprises the labour component of the project cost that is considered scarce and therefore adequately priced in terms of opportunity cost. No specific conversion is required since market prices are assumed to reflect economic prices (**Conversion factor = 1.0**).

- *Non-skilled labour* – This category comprises the labour component of the project cost that is considered in surplus (i.e. in a context of unemployment) and therefore not adequately priced from the economic point of view. The correction to reflect the opportunity cost of labour could be made by multiplying the financial cost of un-skilled workers by the so-called **Shadow Wage Rate Factor** (SWRF), which can be calculated using the following formula:

$$SWRF = (1 - U) \times (1 - T)$$

Where:

U is the regional unemployment rate; and

T is the rate of social security payments and relevant taxes included in the labour costs.

Numerical Example

Suppose that unemployment in a region is 15% and that the unemployment benefit *and relevant taxes is 32% of the minimum wage. The Shadow Wage Rate Factor (SWRF) for that region would then be:*

$$SWRF_{region} = \left(1 - U_{region}\right) \times \left(1 - T_{region}\right) = (1 - 15\%) \times (1 - 32\%) = 0.578$$

- Land Acquisition / Expropriation – This category comprises the land implicitly used in the project, even when no financial cost is included as part of the project cost (for example if the land for the project was already owned by the state). Correction of land costs intends to adjust for the net output that would have been produced on the land if it had not been used by the project. In those cases in which the land has been acquired at market value, the applicable **conversion factor is 1.0** since it is assumed that the market value reflects the present value of the future output. Otherwise, the adjustment to reflect economic costs will have to be calculated on a case by case basis.

In summary:

Cost Type	Conversion Factor
Traded Items	1.0
Non-traded Items	1.0 (unless otherwise justified)
Skilled Labour	1.0
Non-skilled Labour	Calculated according to numerical example above
Land Acquisition / Expropriation	1.0

Operating and Maintenance Costs

2.4.16 Operating and Maintenance Costs include the cost of all routine maintenance and costs of day-to-day operation of services. Any upfront set-up costs for the operator (for example cost of rolling stock for rail projects or back-office set up for toll operators) should be included in the investment cost.

2.4.17 Maintenance costs associated with repairs and renewals of users vehicles must be identified separately from the operating costs of service providers. These operating costs relate to the transport providers, treatment of vehicle operating costs incurred by transport users is discussed in section 2.4.3.

2.4.18 The difference in operating costs and maintenance costs that are incurred for the Project and No Project networks must be accounted for. Operating and maintenance costs must be forecast for the whole of the appraisal period. In forecasting future operating, maintenance and renewal costs, analysts should consider: the impact of increasing usage or patronage; and the potential for cost increases in excess of general cost inflation.

2.4.19 When undertaking detailed project appraisal maintenance costs should be based on a costed maintenance schedule including, if relevant to the project:

- Annual maintenance,
- Distinction between summer/winter maintenance tasks,
- Cleaning,
- Infrastructure renewal at end of life.

2.4.20 When undertaking detailed project appraisal operating costs should be based on a breakdown including consideration of:

- Rolling stock/equipment leases,
- Staff costs,
- Fuel costs,
- Back office costs.
- Any access charges paid to infrastructure manager.

2.4.21 Our recommendation is that these are calculated for each project based on the local infrastructure conditions, the type of stock which is in operation currently and the type proposed to be used in the Project scenario, and the manpower requirements. If it can be demonstrated that no such information is available, then values in Appendix A5 may be used.

Residual Value

2.4.22 The infrastructure that forms the project may have a life greater than the appraisal period. In these instances the residual value of the infrastructure should be included in the analysis. The residual value can be thought of as the outstanding value of the asset at the end of the appraisal period or in terms of the total net present value of benefits generated by the asset after the appraisal period ends.

2.4.23 The residual value of the infrastructure is included in the analysis in the year following the last appraisal year. In the financial analysis, it is included as a negative cost because it is considered as an inflow. In the economic analysis, it is included as a positive benefit to wider society.

2.4.24 There are various accepted methods for calculating the residual value of assets. We recommend the use of the linear method, which assumes that the value of the asset declines by an equal amount each year over its lifetime. The residual value is therefore given by the following formula:

$$Residual\ Value\ = (Remaining\ Asset\ Life\ /\ Total\ Asset\ Life)\ x\ Capital\ Cost$$

Numerical Example

The example below provides the residual value using the linear method for an asset with a capital cost of €1m, constructed in appraisal year 0 and with an expected life of 50 years. The appraisal period is 30 years. A table containing a range of recommended lifetimes for road and rail projects is provided in Appendix A10.

Table 5 - Example of Residual Value using the Linear Method

Appraisal Year	Linear
Year 0	€1,000,000
Year 1	€980,000
Year 5	€900,000
Year 10	€800,000
Year 20	€600,000
Year 30	€400,000

2.5 Treatment of User Costs and Benefits

2.5.1 Some user benefits or disbenefits may already be expressed in monetary terms, for example changes in ticket fares or toll charges. The economic analysis will need, however, to consider some impacts which whilst very important to the economic evaluation of the project, have no direct market value. These could include the value of travel time savings and the value of accident savings. Time savings, specifically, are often the most important element of transport project benefits.

2.5.2 The following sections describe the economic theory behind determining user benefits and the approach that should be taken in assessing and monetising the change in specific user costs and benefits.

Economic Theory

2.5.3 Simplistically benefits can be thought of as the difference between the cost of a journey in the Project scenario and the cost of a journey between the same start and end point in the No Project scenario. This is valid when considering the benefits to users who are already using the project mode to make a trip in the No Project scenario. The situation is however, more complex when considering benefits for users who are either not making a trip, or using another mode in the No Project scenario. A distinction in approach therefore needs to be made between:

- ***Benefits for existing traffic*** (e.g. cost reduction resulting from reduced journey times and vehicle operating costs) – in this case the cost users are prepared to 'pay' for the trip is equal to the cost they were paying for the trip in the do minimum scenario.
- ***Benefits for traffic diverted from other modes*** – in this case the cost users are prepared to 'pay' for the trip is not equal to the cost for the project mode in the No Project scenario as they had not chosen to use the project mode in the do minimum scenario. The cost users are prepared to pay in fact varies according the demand curve.
- ***Benefits for generated traffic*** – similarly to trips that have shifted to the project mode, the cost newly generated users are prepared to 'pay' for the trip is not equal to the cost for the project mode in the do minimum scenario as they too had not chosen to make the trip in the do minimum scenario. Again, the cost users are prepared to pay varies according the demand curve.

2.5.4 To accurately calculate user benefits where there are new or mode shifted users it is necessary to calculate the change in consumer surplus (the variation in the area below the transport demand curve). This represents the difference between what transport users are prepared to 'pay', and what they actually 'pay' for a trip ; although, in this case 'payment' by users should be thought of in terms of generalised cost (including time and vehicle operating cost), rather than a pure monetary cost. The appraisal of economic benefits relies upon the transport system equilibrium being correctly assessed by the transport model. That is, the number of trips, T_0, and system performance (supply) are in balance producing an average trip cost C_0. The figure below illustrates this case.

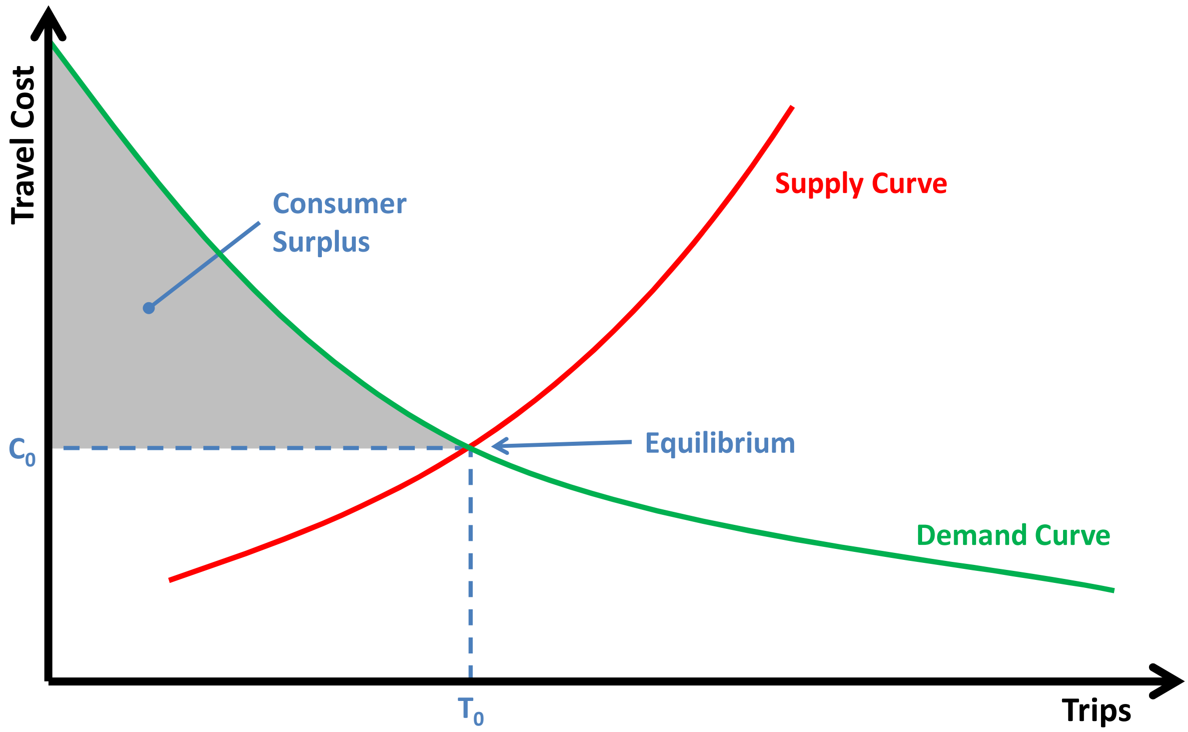


Figure 3 - Supply Demand Equilibrium

2.5.5 At this equilibrium point there are benefits to the consumer over and above the actual trip costs. These are the difference between what the consumer would be willing to pay and what they actually pay and is known as the consumer surplus. The grey, shaded area of the figure above represents the consumer surplus for the system illustrated.

2.5.6 If a change to the transport system (a project) is introduced which reduces the travel costs, the supply curve shifts down and a new equilibrium is found at a point where the demand is T_1, and the supply cost is C_1. This is illustrated in the figure below.

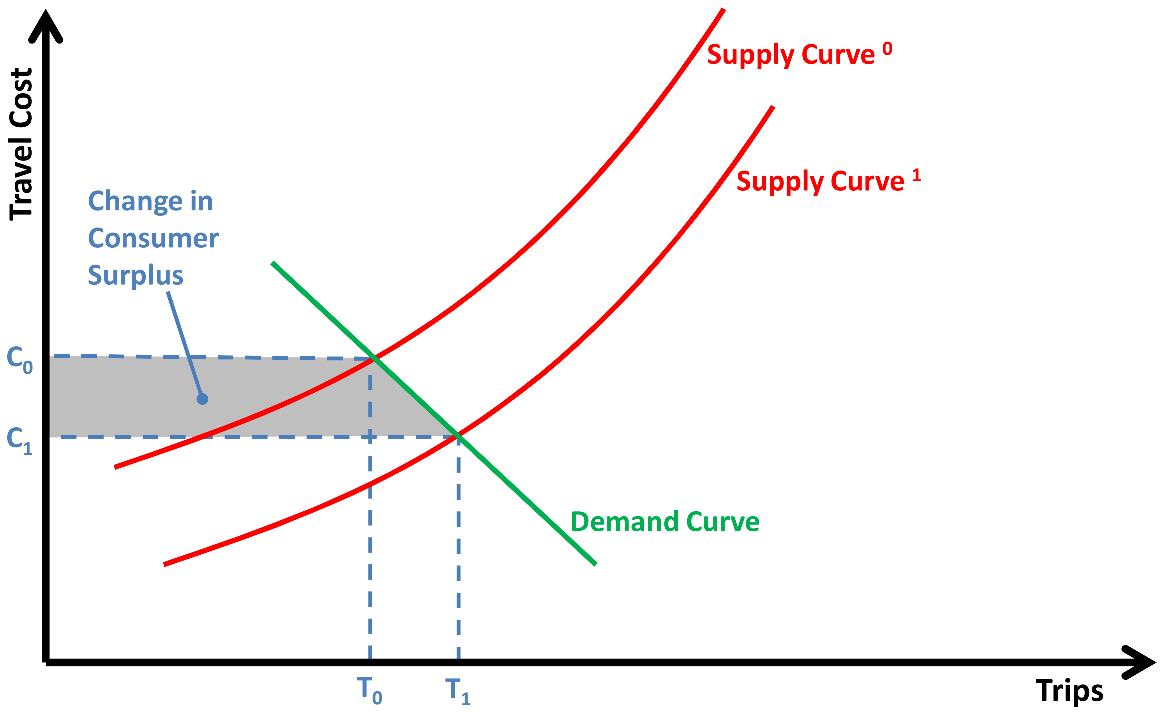


Figure 4 - Change in Consumer Surplus

2.5.7 The benefits to the consumer are defined by the change in consumer surplus, shown by the grey, shaded area of the figure above. Assuming that the demand curve is linear between T1 and T0, the change in consumer surplus is given by:

$$Change\ in\ ConsumerSurplus = \left(\frac{(T_0 + T_1) * (C_0 - C_1)}{2}\right)$$

2.5.8 This calculation must be performed for each origin – destination pair for every, user class, time period and mode separately and summed, this is known as the 'rule of a half'. The assumption that the demand curve is linear is usually only appropriate for relatively small changes in costs. It should be noted that when 'rule of half' is applied to fixed trip situations (that is situations where the number of trips by mode remain the same between the Project and No Project scenarios i.e. the benefits to existing users only) the change in consumer surplus simplifies to a simple change in total cost (T_0*(C_0-C_1)). It is therefore often more efficient to assess benefits for fixed trip situations on a link basis (rather than a matrix basis).

Diverted Trips

2.5.9 Diverted trips are those journeys which have either switched time period, route or transport mode (as opposed to induced trips which are entirely new trips resulting from a change in transport demand or supply.

2.5.10 The approach to calculating the benefits for diverted trips will differ depending on whether a shift in mode occurs.

2.5.11 If a diversion is between time or route, but remaining on the same mode, then benefits are estimated on the basis of the changes in total user costs, and the new and existing links are considered as perfect substitutes.

2.5.12 When the diversion is between different modes, the benefits are estimated on the basis of the change in surplus of the two markets (two modes). The prior generalised cost used for the assessment of benefits should be the one for the mode to which users have switched.

2.5.13 In the case of a totally new infrastructure, the measurement of the benefits depends on the nature of the new mode, its placement in the mode hierarchy and transport network and should be derived from the users' willingness-to-pay.

Travel Time Savings

2.5.14 Travel time savings are one of the most significant elements that are reflected in the cost benefit analysis. For most projects the aggregate time saving is positive, with the change in travel time directly or indirectly generated by the project infrastructure. A monetary value needs to be applied to the travel time saving to calculate the economic benefit of the saving. Generally, a uniform value of travel time saving is applied, distinguishing only by the purpose for which the journey is made (business, commuting and other non-commuting) and mode of travel.

2.5.15 Fixed demand situations may simplify the formula for calculating the change in the consumer surplus. However, for situations where demand varies between scenarios the rule of the half approach should always be used, as it provides the only valid method for calculating the journey time savings. The *'National Transport Modelling Guidance'* provides a description of this approach.

2.5.16 Travel time ***matrices*** for the Project and No Project scenarios must be calculated by journey purpose for each mode for all transport users. The journey time saving must then be calculated from the change in consumer surplus which is given by the '***Rule of half***' method.

2.5.17 It is important to consider changes in person hours (rather than vehicle hours) to ensure consistency ***with values of time,*** which are typically expressed for individuals rather than vehicles. To do this, vehicle occupancy data may be required, which for detailed project appraisal should be based on local surveys. Appendix A4 provides national average occupancy values for use in strategy appraisal.

2.5.18 It is also important to distinguish time savings by trip purpose, as a minimum trip purposes should be split into (business, commuting and other). This is because values of time for business trips are higher than commuting or other non-working time trips. For detailed project appraisal purpose splits should be based on local traffic surveys. Appendix A4 provides national average purpose splits for use in strategy appraisal.

2.5.19 The appropriate value of travel time savings are then applied to the variation in travel times to determine the economic benefit. Appendix A4 contains recommended values of time by mode and trip purpose.

Vehicle Operating Cost Changes

2.5.20 User vehicle operating costs are generated only where a user owns, or leases, the vehicle being used for the journey. In the vast majority of cases this is limited to road trips.

2.5.21 Road user vehicle operating costs are split into two groups: fuel costs and non-fuel costs, the former comprising items such as fuel, oil and tyres, and an element of vehicle maintenance, the latter comprising mileage related depreciation.

2.5.22 The road vehicle operating cost is a function of trip length and speed. Although projects typically show reductions in travel time, road vehicle operating costs can reduce or increase depending upon the nature of the project and the impact the project has on average journey lengths.

2.5.23 Any increase in operating costs which results from use of the project infrastructure by users should be treated as a cost (disbenefit) to travellers and a reduction in charges should be treated as a benefit. Any additional charges resulting from tolls should be considered separately as described in section 2.4.20

2.5.24 Road vehicle operating cost should be calculated from trip characteristics as below:

Vehicle operating cost (fuel element) should be calculated based on:

- Estimate of litres of fuel consumed for each journey based on vehicle type, trip length, and average speed. The following formula can be used to estimate fuel consumption:

$$L = \frac{a}{V} + b + c \times V + d \times V^2$$

Where:
L is fuel consumption (in litres per kilometre);
V is the average speed (in kilometres per hour); and
α, b, c, d are vehicle category specific parameters.

- Estimated mix of fuel types in vehicle fleet.

- Cost per litre of fuel.

Additionally changes over time in fuel price and fuel efficiency should be considered.

Vehicle operating cost (non-fuel element) should be calculated based on vehicle type, trip length and average speed. The following formula can be used to estimate the non-fuel VOC:

$$C = e + \frac{f}{V}$$

Where:
C is the non-fuel cost (in €ct per kilometre);
V is the average speed (in kilometres per hour); and
e, f are vehicle category specific parameters.

2.5.25 The UK WebTAG approach on vehicle operating costs has provided the background for this part of the guidance.

2.5.26 Appendix A5 provides values for the key parameters required in the calculations described above.

2.5.27 Usually users only consider part of the total vehicle operating costs when choosing whether to make a journey, typically this is the fuel element of the vehicle operating cost. The remaining part, the non fuel element of vehicle operating costs, although still a cost to the user as a direct result of the journey, is usually considered as part of the up-front costs of owning a vehicle.

2.5.28 Additionally users making trips for employment purposes (trips on business, not trips to and from work place) are consider vehicle operating cost in factor prices. This means they perceive the raw cost of fuel and non fuel elements and do not consider the indirect tax (which can be claimed back from the exchequer as a business expense). It is therefore necessary to remove indirect taxation from operating cost estimates when considering benefits to business trips.

2.5.29 Fuel and non-fuel vehicle operating cost matrices for the Project and No Project networks must be calculated by journey purpose for each mode for all transport users. Benefits matrices associated with changes in fuel and non-fuel vehicle operating cost should be calculated using the 'Rule of half' method outlined in Section 2.3.3. Any difference in the perception by users of the fuel and non-fuel vehicle operating costs should be ignored.

2.5.30 The '*National Transport Modelling Guidance*' provides a description of this approach.

2.6 Treatment of Externalities

2.6.1 Some of the project impacts will be felt, not directly by the users, managers or operators of the project infrastructure, but by wider society. These impacts can be benefits or disbenefits depending upon the nature of the project. They can include:

- Impacts on local populations (along both the project route and alternative routes from which traffic may divert)
  - Changes in number of accidents
  - Changes in noise levels
  - Changes in local air pollution
- Impacts on wider areas
  - Changes in greenhouse gas emissions
  - Wider Economic Impacts

2.6.2 If the external impacts represent an important outcome of the project then it is necessary to include them in the economic appraisal framework. It is however, important to ensure that if included in the cost benefit appraisal a robust approach has been taken to determining parameters required to monetised the impact.

Accident Reductions

2.6.3 The accident benefit and/or disbenefit associated with the project needs to be calculated, monetised and input into the cost benefit analysis. The monetary value attached to the avoidance of an accident is related to both the direct cost associated with the accident (for example the cost of emergency services and hospital treatment etc.) as well as the indirect economic costs, for example in terms of lost productivity from injury time and a proxy value to estimate the pain, grief and suffering caused by accidents. It should be recognised that a project may generate accident benefits in one geographical area and accident disbenefits in another area.

2.6.4 For projects of all modes the difference in the number of accidents occurring in the Project and No Project networks must be determined. This is done by calculating the total vehicle km by network type (road type, rail type, waterway type) and applying appropriate accident rates (number of accidents per year per vehicle km). Rail accidents are further disaggregated into accident related to total train km, number of level crossings and length of the network. Casualty rates should then be applied to the number of accidents to determine number of casualties by severity. The severity types that should be included are: Fatal; Serious; Slight and non-injury. The total number of accidents and casualties should be calculated for the Project and No Project scenarios to determine the increase or decrease in accidents associated with the project by severity.

2.6.5 When undertaking detailed project appraisal, for all modes local accident data should be used to derive accident rates for use in place of national values for selected links where such data are considered to be reliable. Appendix A6 provides accident rate parameters at a national level suitable for strategy appraisal.

2.6.6 The appropriate monetary values depending on the severity of the accident are then applied to the difference in the number accidents to determine the economic benefit. Appendix A6 contains recommended monetary values for accident avoided by mode and trip purpose.

Noise

2.6.7 If a project changes the volume of traffic on a road or rail line then there may be an impact upon the population living nearby in terms of increased (or decreased) noise.

2.6.8 Noise can be defined as the unwanted sound or sounds of duration, intensity, or other quality that causes physiological or psychological harm to humans. In general, two types of negative impacts of transport noise can be distinguished:

- Costs of annoyance: transport noise imposes undesired social disturbances, which result in social and economic costs like any restrictions on enjoyment of desired leisure activities, discomfort or inconvenience (pain suffering), etc.
- Health costs: transport noise can also cause physical health damages. Hearing damage can be caused by noise levels above 85 dB(A), while lower levels (above 60 dB(A) may result in nervous stress reactions, such as change of heart beat frequency, increase of blood pressure and hormonal changes. increased risk of cardiovascular diseases and reduction in quality of sleep

2.6.9 The scale of the impact will vary depending upon the nature and the location of the project. There are three key factors that determine noise impact

- Time of day – noise disturbance at night will have a greater impact than during the day
- Population density near the noise source – noise changes will only impact on those who can hear it
- Existing noise levels – depending upon traffic volume, speed and vehicle type mix

2.6.10 Additionally there are mode specific factors that should be considered:

- Road – The noise level depends upon the type of vehicle, speed of vehicles, age of the vehicles, proportion of trucks, road surface conditions and gradient.

- Rail – The noise level depends upon the train speed, coach/wagon type, conditions of both track and wheels, type of brake, train length and the presence of noise walls. The most significant impact is from freight train movements at night.
- Air – the biggest impacts occur during landing and takeoff (LTO). Noise levels depend upon the aircraft and engine type.

2.6.11 It is also important to consider the impacts along alternative routes to the direct project corridor, for example a new road or rail line may lead to high volumes of traffic, and thus a noise increase; however if the new infrastructure is in a rural area and has removed traffic from an urban route the net impact may in fact be positive.

2.6.12 The change in vehicle km which result from the project by mode and location (urban, sub-urban and rural) should be calculated and then monetised using unit cost rates. Appendix A7 provides unit costs (euro cent per vehicle km) of the impact of road and rail noise for different network types. Values are differentiated by urban, sub-urban and rural to reflect the different nature of traffic and population density in the regions.

Local Air Pollution

2.6.13 Air pollution costs are caused by the emissions of air pollutants with differing impacts. Pollutants considered should include particulate matter (PM), NOx, SO2 and VOC; and impacts could include health costs, building/material damages, crop losses and costs of damage to the ecosystem (biosphere, soil, water). Health costs (mainly caused by PM, from exhaust emissions or transformation of other pollutants) are by far the most important element.

2.6.14 The scale of the impact will vary depending upon the nature and the location of the project. The main factor that affects the scale of the impact is the population proximity and density near the emission source. Additionally there are mode specific factors that should be considered:

- Road – The most important factor is the emission standards of the vehicle fleet which depends, in part, upon the age of vehicles. Emissions are then related to speed of vehicle, fuel type and driving style.
- Rail – The emission level depends upon the train speed, fuel type, share of electrified services, and the sources and location of electricity generating power plants
- Air – the most significant elements are the aircraft and engine type.
- Waterways (inland and maritime) – the main factors are engine type, vessel type, fuel quality, operation mode, and (for inland waterways) the direction of travel (up/down stream)

2.6.15 It is also important to consider the impacts on populations along alternative routes to the project, for example a new road or rail line may lead to high volumes of traffic, and thus an air pollution increase along the route; however if the new infrastructure is in a rural area and has removed traffic from an urban route the net impact may in fact be positive.

2.6.16 For detailed project appraisal the change in tonnes of air pollutants emitted as a result of the project should be calculated taking into consideration the points raised above. TREMOVE is a policy assessment model commissioned by the European Commission to study the effects of different transport and environment policies on the transport sector for all European countries. This model provides emission rates (tonnes per vehicle km) by vehicle type which can be used, together with vehicle fleet estimates to determine emissions for the Project and No Project scenarios. From these values the change in tonnes of air pollutants emitted can be calculated

2.6.17 These values should then be monetised using unit cost rates. Appendix A8 provides external costs (€ per tonne emitted) for local air pollution emissions for different pollutants, and where relevant different environments (urban metropolitan, urban, and outside built up areas). The cost values are applicable to emissions from road, rail air and inland waterway. Separate values are given for maritime transport.

2.6.18 For strategy appraisal, where local emissions rates may be difficult to calculate, Appendix A8 provides pollution costs per vehicle km for road vehicles, rail, inland waterway vessels and air transport. It should be noted that these values are appropriate for appraisal of national strategies and should only be used for project appraisal in the absence of local emission rate data.

Reliability Costs

2.6.19 Reliability and scarcity costs encompass the impacts of variability in travel times and limited capacity often both resulting from demand exceeding supply.

2.6.20 Reliability is the variation in journey time that users are unable to predict. Hence reliability is associated with random events which can be associated with day-to-day congestion or specific one-off incidents.

2.6.21 The cost associated with unreliable journey times comes from the users' inability to predict the time a journey will take. It is therefore important to make a distinction in each situation between the predictable variations (for example related to varying wait times for a non regular public transport service) from unpredictable variation.

2.6.22 Typically reliability is considered slightly differently between modes. For public transport journeys the presence of timetabled arrival times means that reliability is usually associated with 'lateness' (it should be noted that although 'lateness' leads to a disbenefit for users, 'earliness' is not usually considered a benefit). For public transport trips the important indicators of reliability are therefore average lateness, and variation in lateness (usually given by the standard deviation). For highway trips it is expected that users are aware of the average journey time, and have taken into consideration different travel speeds at different times of day. Reliability is associated with the variation around the average journey time (again, usually given by the standard deviation in journey times).

2.6.23 If a project increases the reliability of transport services (for example improving punctuality for bus or rail services, or, ensuring year round operation of river routes) this may lead to benefits for users

2.6.24 Typically, reliability effects are only relevant for projects in situations with already unreliable journey times. If reliability improvements form an important outcome of the project then they can be included in the economic appraisal framework. It is however, important to ensure that if included in the cost benefit appraisal a robust approach has been taken to determining parameters required to monetise the impact.

2.6.25 To include reliability inputs in the Cost Benefit Analysis, delay savings between the No Project and Project scenarios need to be output from the transport model in minutes and converted to generalised minutes using the value of time parameters in Appendix A4. The *'National Transport Modelling Guidance'* provides advice on the treatment of reliability in Public Transport modelling and the parameter values which should be adopted for weighting delay.

Scarcity Costs

2.6.26 Scarcity arises from demand exceeding limited service supply. Depending upon the mode of transport, type of users, infrastructure characteristics insufficient supply of services can have a range of impacts, including impact of scarcity of travel slots. This is particularly an issue on access regulated infrastructure such as rail lines and airports/airspace.

2.6.27 If capacity improvements form an important outcome of the project then they can be included in the economic appraisal framework. It is however, important to ensure that if included in the cost benefit appraisal a robust approach has been taken to determining parameters required to monetise the impact.

Soft Factors

2.6.28 Soft Factors include characteristics of a journey that make the experience more pleasant, whilst not actually reducing direct travel times or costs. These factors can include:

- Changes in crowding and driver stress
- Provision of travel Information
- Increases in in-vehicle comfort
- Improvements in interchange facilities
- Increases in ease of use of transport systems and services (for example through ticketing changes)

2.6.29 If a project increases the 'pleasantness' of a transport journey this will be a benefit to users.

2.6.30 If soft factor improvements form an important outcome of the project then they should be included in the economic appraisal framework. It is however, important to ensure that if included in the cost benefit appraisal a robust approach has been taken to determining parameters required to monetise the impact.

Greenhouse Gas Emissions

2.6.31 Climate change or global warming impacts of transport are mainly caused by emissions of the greenhouse gases carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). In the case of aviation other aircraft emissions (water vapour, sulphate, soot aerosols and nitrous oxides) at high altitude have an impact on global warming. These emissions have a range of impacts which may include sea level changes, agricultural impacts, water supply impacts, health impacts, ecosystem and biodiversity impacts and climate/weather impacts.

2.6.32 Road related emissions should be estimated from the change in fuel consumption in the Project and No Project scenarios, as estimated within the NTM using the Rule of Half. Non-road related emissions should be estimated from vehicle km in the Project and No Project scenarios using emission factors (in g/km) for each of the greenhouse gases. The TREMOVE model is a policy assessment model commissioned by the European Commission to study the effects of different transport and environment policies on the transport sector for all European countries. This model provides emission factors (tonnes per vehicle km) by vehicle type which can be used, together with vehicle fleet estimates to determine emissions for the Project and No Project scenarios. Changes in emissions for the opening year and over the whole appraisal period should be recorded and quantified in terms of kg of each emission type.

2.6.33 Greenhouse gas emissions are considered a global impact and therefore the value of the change in emissions volume is independent of the location at which the change occurs.

2.6.34 Calculating the monetary costs of changes in emissions should be done in terms of the change in the equivalent tonnes of greenhouse gases released as a result of implementing a project. This is done by adding the various greenhouse gas emissions to a total CO_2 equivalent greenhouse gas emission using Global Warming Potentials (recommended values given in Appendix A9)

2.6.35 Climate change costs have a high level of complexity due to the fact that they are long-term and global and because risk patterns are very difficult to anticipate. As a result there are difficulties in valuing the damage caused. Appendix A9 contains recommended values for the external costs of climate change.

2.6.36 For strategy appraisal, where local emissions rates may be difficult to calculate, Appendix A9 provides greenhouse gas emission costs per vehicle km for road vehicles, rail, inland waterway vessels and air transport.

Wider Economic Impacts

2.6.37 A transport project may have an impact on the economic structure of a region. The impact may be positive or negative depending upon the nature of the project and are influenced by the presence of market distortions and relative local competitiveness.

2.6.38 The EC *'Guide to Cost Benefit Analysis of Investment Projects'* identifies that it is 'necessary to proceed with great caution when assigning these kinds of benefits to the project and, in any case, they should be excluded from the calculation of profitability indicators.' The guidance goes on to suggest that 'if there are no major distortions in the transport-using sectors, i.e. markets are reasonably competitive, the use of transport costs and benefits (costs and time savings, externalities, etc.) could be considered an acceptable approximation of the final economic impact of the transport projects.'

2.6.39 It is therefore recommended that wider economic impacts are not included in the economic assessment and that any expected impacts are reflected in the wider appraisal framework and are not monetised.

2.6.40 The current EU grant application form requires the calculation of full-time equivalent (FTE) jobs created during construction and operation. This calculation is therefore required if EU grant has been identified as a likely funding source.

2.7 Assessment of Economic Impacts

2.7.1 Following collation and monetisation of the various project impacts for each of the stakeholder groups, the next stage of the economic analysis is the calculation of indicators of the economic return on the capital invested.

2.7.2 The outcome from the economic analysis is an indication whether the project will generate a positive net benefit over the appraisal period to the whole of society (project viability) and the scale of benefits generated relative to costs incurred (used for project ranking). These are discussed in detail below.

Key Performance Indicators

2.7.3 Economic return on investment is given by the following indicators:

- Present Value of Benefits (PVB) – the value of the discounted stream of total social benefits during the appraisal period (n years)

  $$\mathrm{PVB} = \sum_{t=0}^{n} \alpha_t B_t = \frac{B_0}{(1+i)^0} + \frac{B_1}{(1+i)^1} + \cdots + \frac{B_n}{(1+i)^n}$$

  where B_t is the total social benefit in year t and α_t is the social discount factor for year t based on a social discount rate of i%

- Present Value of Costs (PVC) – the value of the discounted stream of total social costs incurred during the appraisal period (n years)

  $$\mathrm{PVC} = \sum_{t=0}^{n} \alpha_t C_t = \frac{C_0}{(1+i)^0} + \frac{C_1}{(1+i)^1} + \cdots + \frac{C_n}{(1+i)^n}$$

  where C_t is the total social cost in year t and α_t is the social discount factor for year t based on a social discount rate of i%

- Economic Net Present value (ENPV) – the difference between the discounted total social benefits (PVB) and costs (PVC). ENPV is expressed in monetary units (Euros) and gives the absolute size of the project net benefits. Values of ENPV typically scale with size of project investment. ENPV is the most reliable social CBA indicator.

  $$\mathrm{ENPV} = \mathrm{PVB} - \mathrm{PVC} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots. + \frac{S_n}{(1+i)^n}$$

  where S_t is the net benefit in year t and α_t is the social discount factor for year t based on a social discount rate of i%

- Benefit to Cost Ratio (BCR) – the ratio between the discounted total social benefit and costs. This gives the relative size of the project net benefits but is independent of project size

$$\mathrm{BCR} = \frac{\mathrm{PVB}}{\mathrm{PVC}}$$

- Economic Internal Rate of Return (EIRR) – the discount rate that needs to be applied so that the discounted value of the total stream of net social benefits is equal to the initial capital investment (also discounted, if spread over more than one year). The EIRR is calculated by setting the ENPV equal to zero. EIRR is unit-less (a percentage) and like the BCR this gives the relative size of the project net benefits. It is independent of project size and gives an indication of the scale of benefits relative to the investment cost. Values of EIRR therefore typically do not scale with size of project investment.

$$ENPV = 0 \Rightarrow \sum_{t=0}^{n} \left(\frac{S_t}{(1+EIRR)^t} \right) = 0$$

Calculating the Economic Internal Rate of Return

The most convenient way to calculate the EIRR is by using a spreadsheet like Microsoft Excel.

Numerical Example

Suppose that the investment for a project is 1,000,000€ and the appraisal period is 5 years, during which the net social benefits are 300,000€ annually. After inputting the data in an Excel spreadsheet as shown in the picture below, we use the IRR function by indicating the cells that include the net social benefits. Excel returns the Internal Rate of Return equal to 15.238%.

	A	B	C	D	E	F	G	H	I
1									
2		Year	0	1	2	3	4	5	
3		Net Benefits	-€ 1,000,000	€ 300,000	€ 300,000	€ 300,000	€ 300,000	€ 300,000	
4									
5		EIRR	=IRR(C3:H3)	15.238%					
6									

The same function can be used to calculate the Financial Internal Rate of Return. In this case however, the cells D3 to H3 should represent the net financial benefits to the owner/operator of the project.

Project Viability

2.7.4 The purpose of the economic assessment is to determine whether a project is worth proceeding with. The key economic performance indicators measure this. The following criteria identify viable projects:

- If ENPV>0 – project is socially beneficial. That is the economic benefits are greater than the economic costs. The greater the ENPV the larger the net benefits of the project are.
- If BCR>1.0 and EIRR>social discount rate – project generates more economic benefits that it costs to implement

2.7.5 Typically, but not always, projects with an Economic Internal Rate of Return (EIRR) lower than the social discount rate are rejected. The EC guidance provides an indication of the EIRR for a sample of investment projects sponsored by the European Union in the previous programming period (2000-2006):

	EIRR (%)	
	Average	**Standard Deviation**
Roads and Highways	15.53%	9.58%
Railways and underground	11.62%	8.21%
Ports, airports	26.84%	28.99%

2.7.6 As an example the table over leaf shows the structure of the Economic Analysis Summary Table for a rail project. Other transport projects will have a similar structure, however for some projects not all impacts will be relevant and therefore not all impacts need to be included in the summary table.

Project Ranking

2.7.7 When ranking projects BCR or EIRR are typically used in preference to ENPV. This is because whilst ENPV measures the total size of net benefits, BCR and EIRR measure the size of net benefits relative to the project costs which adjusts for project size and allows projects of different costs to be compared.

2.7.8 It is also important, however, to consider the ability of the proposed project to address the problems it is intended to solve. It is often the case that low cost options have high BCRs and EIRRs, while making little contribution to solving the identified problems

Table 6 - Example Economic Analysis Summary Table

Cost	Unit Value (where applicable)	Total Value (in m€$_{2010}$, discounted, factor prices)	% of total costs
Investment		A	$\frac{A}{PVC} \times 100$
Maintenance		B	$\frac{B}{PVC} \times 100$
Operation[a]		C	$\frac{C}{PVC} \times 100$
Benefit	**Unit Value (where applicable)**	**Total Value (in m€$_{2010}$, discounted, factor prices)**	**% of total benefits**
Time Savings		D	$\frac{D}{PVB} \times 100$
VOC[b]		E	$\frac{E}{PVB} \times 100$
Accidents		F	$\frac{F}{PVB} \times 100$
Air Pollution		G	$\frac{G}{PVB} \times 100$
Climate Change		H	$\frac{H}{PVB} \times 100$
Noise		I	$\frac{I}{PVB} \times 100$
Total Costs (PVC)		$A+B+C$	
Total Benefits (PVB)		$D+E+F+G+H+I$	
Social Discount Rate		$Y\ \%$	
Economic Net Present Value		$PVB - PVC$	
EIRR		$Z\ \%$	
Benefit/Cost Ratio		PVB/PVC	

[a] refers to 2.4.15, [b] refers to 2.5.20

Financial Cost Benefit Analysis

3 Financial Cost Benefit Analysis

3.1 Overall Approach to Financial Analysis

3.1.1 The main purpose of the financial analysis is to assess the financial profitability and sustainability of the project from the viewpoint of the project owners/operators. Simplistically this analysis shows whether the project will generate a positive net cash flow over the appraisal period (profitability) and whether the cumulative net cash flow since project inception is not less than zero (sustainability).

3.1.2 This is done by considering the financial cash flow for the project; which includes both outflows in terms of investment, maintenance and operating costs; and inflows in terms of funding sources and user revenues/charges. These inflows and outflows should not be confused with accounting cash flows. The cash flows included in the financial analysis do not include depreciation, reserves and other accounting items which do not correspond to actual flows.

3.1.3 The analysis should adopt an incremental approach and consider the differences between scenarios including and excluding the project. This means that it is not necessary to calculate the cash flow associated with elements which remain unchanged between scenarios including and excluding the project.

3.1.4 Typically the analysis is conducted from the viewpoint of the infrastructure manager, who is often a government body. This is appropriate where the project infrastructure is both constructed and operated by the same party. It may be necessary, however, to separate analysis for different groups and then consolidate into a final analysis as inflows for one group are often outflows for another. This is the case, for example, when considering a new rail line if the infrastructure is developed by one group and services are operated by a different group. In this case the financial viability of the project from the point of view of both parties is important to show sustainability for all stakeholders.

3.1.5 As an EU grant is likely to be a key source of funding for many transport projects the guidance has been developed to meet the requirements set out in the EC *'Guide to Cost Benefit Analysis of Investment Projects'* published in 2008. This guidance should, however, also be applied when alternative funding sources are envisaged as it provides a consistent basis for national prioritisation of projects. It is therefore necessary to undertake a financial analysis for all projects, however if EU funding is not envisaged it is not necessary to calculate the EU grant as part of funding source assessment.

3.1.6 For projects where EU grant is identified as a likely financing source the analysis initially considers the projects financial profitability without EU funding (financial return on investment) to assess whether EU funding is needed, and then from the national perspective (financial return on capital). The analysis is carried out by considering the inter-linked accounts shown in Figure 5.

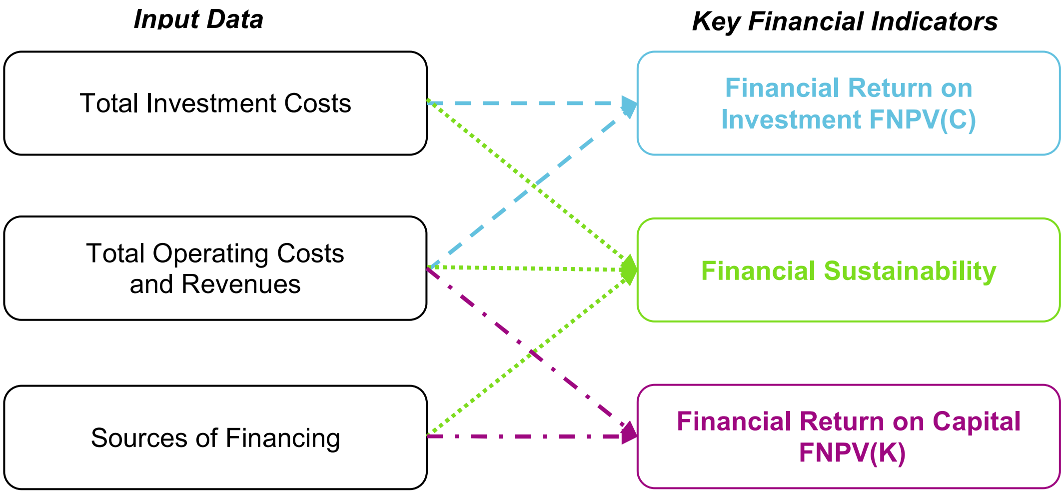


Figure 5 - Structure of Financial Analysis

Source: 'Guide to Cost Benefit Analysis of Investment Projects' July 2008, EC

3.1.7 Financial analysis includes the following steps, each of which is discussed in detail in sections 3.3 to 3.8:

1. Provide estimates of the Total Investment Costs, including initial investment and possible non-routine maintenance and replacement costs during the project's life;
2. Provide estimates of Total Operating Costs and Revenues, consisting of all foreseeable regularly reoccurring costs;
3. Calculate key Financial Return on Investment indicators for the project (FNPV(C) and FRR(C));
4. Identify Sources of Funding and, if appropriate, consider the EU grant using the funding gap calculation method;
5. Determine the Financial Sustainability and profitability of the project;
6. Appraise the Financial Return on Capital from the perspective of the national contribution to the project (FNPV(K) and FRR(K)).

3.2 Key Analysis Assumptions

3.2.1 The sections below describe the approach that should be taken in the financial assessment in relation to key elements of the appraisal.

Currency and Exchange Rate

3.2.2 The financial assessment should be undertaken in Euros. Appendix A3 provides a standardised exchange rate for conversion of cost estimates from Romanian Lei to Euro.

Appraisal Period

3.2.3 The appraisal period for financial analysis is the same as that used for economic analysis. See section 2.2 and Appendix A1.

Financial Discount Rate

3.2.4 The aggregation of cash flows occurring in different years requires the adoption of an appropriate discount rate. This allows calculation of the present value of future cash flows.

3.2.5 The benchmark financial discount rate presented in Appendix A2 should be used for all projects. The year to which future prices should be discounted (in effect the year for which the present value is calculated) is also given in Appendix A2.

Price Base

3.2.6 The financial analysis requires a consistent price base across all cash flow lines. The price base year that should be adopted is given in Appendix A3. This is the same price base as used in the economic analysis. Section 2.2 provides details of how data in different price base should be re-based to appraisal price base.

Units of Account

3.2.7 The financial analysis is conducted in market prices (as opposed to the economic analysis which is conducted in factor costs). Market prices include VAT and indirect taxes and are used because they represent the prices paid by the provider groups. One exception to this is revenue paid by users to operators for use of a service (for example bus fares for a public transport project). These revenues are included in the analysis excluding VAT as this element of the user charge is passed directly on to the government and does not represent a real cash inflow to the operator.

Infrastructure Manager/Operator

3.2.8 In the case of vertically separated infrastructure manager and operator(s), separate accounts for each body should be kept to facilitate financial analysis from their specific perspectives.

Analysis Perspective

3.2.9 The financial analysis is conducted from two perspectives focusing on:

- the project's return considering the total cost of the investment (FNPV(C) and FRR(C));

- the project's return for national beneficiaries considering all sources of finance apart from a possible EU grant (FNPV(K) and FRR(K)).

3.3 Total Investment Cost

3.3.1 Total investments costs should include all elements of expenditure required to realise the project, split into:

- Fixed assets cost, such as land purchase, building and construction, plant machinery;
- Start-up costs, such as preparatory studies, consulting services, planning/design, supervision during construction.

3.3.2 The total investment cost estimate used in the financial analysis should be consistent with assumptions used in the economic analysis. Section 2.4 outlines the approach that should be adopted in estimating investment costs and the required disaggregation into cost elements for all transportation projects. It is important that investment costs are appropriately split as this information is required in Table H1 of the application form for EU grant.

3.3.3 The total investment cost estimate used in the financial analysis should include VAT.

3.3.4 The financial analysis includes the residual value of the project infrastructure as a negative investment cost after the end of the appraisal period. Section 2.4 outlines the approach that should be adopted in estimating residual value.

Infrastructure Manager/Operator Investment Costs

3.3.5 In the case of vertically separated infrastructure manager and operator(s), it is likely that the infrastructure manager meets the majority of the total investment costs.

3.4 Total Operating Costs and Revenues

Costs

3.4.1 Operating costs of a project include the costs associated with day-to-day operation and routine maintenance as well as the costs of planned work.

3.4.2 The operating costs estimate used in the financial analysis should be consistent with assumptions used in the economic analysis. Section 2.4 outlines the approach that should be adopted in estimating operating and maintenance costs.

Revenues

3.4.3 The main source of revenues is the charges and fares paid by users for travel. These may include ticket fares for public transport modes and rail freight charges as well as toll charges for highway modes. However, not all projects will generate revenue (for example a non-tolled highway).

3.4.4 It is important that the impact of user charges on travel demand has been accurately reflected in the transport modelling. As outlined in the *'National Transport Modelling Guidance'* revenue estimates must be consistent with charge and demand (i.e. elasticity of demand with respect to charge level must have been considered).

3.4.5 VAT, or other indirect taxes, are excluded from the cash flow as these elements of the fare charged to the user are usually passed on to the government and do not constitute a real revenue of the project. However, they are included in transport modelling as they may affect users' travel choices.

3.4.6 The revenue estimate used in the financial analysis should be consistent with assumptions adopted in the economic analysis. Section 2.3.2.3 outlines the approach that should be adopted in estimating revenues.

Infrastructure Manager/Operator Operating Costs and Revenues

3.4.7 In the case of vertically separated infrastructure manager and operator(s), it is likely that the infrastructure manager charges the operator(s) a fee to allow access to the infrastructure. The access charge is cost for the operator and revenue for the infrastructure manager.

3.4.8 Effectively the access charge is a transfer payment between the infrastructure manager and the operator(s) and should not be considered when conducting the financial analysis for the project. However, it should be considered when conducting financial analysis from the perspective of either the infrastructure manager or the operator(s) as it affects their relative financial profitability and sustainability.

3.5 Financial Return on Investment

3.5.1 Following collation of the total investment costs and total operating costs and revenue, the next stage of financial analysis is the calculation of indicators of the financial return on the capital invested and the financial sustainability of the project finances.

Key Performance Indicators

3.5.2 Financial return on investment is given by the following indicators:

- ***Financial net present value of the project (FNPV)***

  FNPV is defined as the sum which results when the expected investment and operating costs of the project (suitably discounted to a present year value) are deducted from the discounted value of the expected revenue. In effect, financial net present value is the excess of revenue over investment and operating costs across the appraisal period.

$$FNPV = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots. + \frac{S_n}{(1+i)^n}$$

  Where S_t is the net cash flow in year t and a_t is the financial discount factor for year t based on a discount rate of *i%*

  FNPV is expressed in monetary units (Euros) and gives an indication of the absolute scale of benefits. Values of FNPV therefore typically scale with size of project investment.

- ***Financial internal rate of return (FIRR)***

  FIRR is defined as the discount rate that produces a zero FNPV. The FIRR measure the capacity of the project revenues to generate a return on the investment cost.

$$FNPV = \sum (\frac{S_t}{(1+FIRR)^t} = 0$$

  FIRR is unit-less (a percentage) and gives an indication of the scale of benefits relative to the investment cost. Values of FIRR therefore typically do not scale with size of project investment.

3.5.3 The outcome from the financial analysis is an indication whether the project will generate a positive net cash flow over the appraisal period (profitability) and whether the cumulative net cash flow since project inception is not less than zero (sustainability). These are discussed in detail below.

Profitability Analysis

3.5.4 The profitability analysis is considered from the whole project view point and uses the FNPV/C, FIRR/C performance indicators that are independent of the size of any EU grant.

3.5.5 There are two elements to this assessment:

1. ***Is a project profitable in its own right?***

   If the Financial Net Present value (FNPV/C) is greater than zero then the project is financially profitable. When FNPV is greater than zero the Financial Internal Rate of Return (FIRR/C) will also be greater than the discount rate. Simplistically for projects that meet these criteria the return from project revenues is equivalent to a rate greater than the discount rate and the project can be thought of as sufficiently profitable.

   Projects that meet these criteria (FNPV/C ≥ 0, FIRR/C ≥ Discount Rate) usually do not require EU financial support and currently usually will not be eligible for an EU grant.

   If a projects fails these criteria (FNPV/C < 0, FIRR/C < Discount Rate) then the project is not profitable and therefore requires financial support and may be eligible for an EU grant.

2. **Which project (from a range of options) provides the greatest profitability?**

   Typically Financial Internal Rate of Return (FIRR/C) is used to judge the future performance of an investment in comparison to other projects, or against a benchmark required rate of return.

   The EC guidance provides an indication of the FIRR/C for a sample of investment projects sponsored by the European Union in the previous programming period (2000-2006):

	FIRR/C (%)	
	Average	**Standard Deviation**
Roads and Highways	-0.75%	5.13%
Railways and underground	0.33%	3.73%
Ports, airports	1.79%	6.21%

3.5.6 As an example the table below shows the structure of the Financial Analysis Summary Table for a rail project. Other transport projects will all have similar structure, however for some projects not all cash flows will be relevant and therefore not all cash flows need to be included in the summary table.

Table 8 - Example Financial Analysis Summary Table – Return on Total Investment

Indicator	**Total (m€$_{2010}$, Market prices, discounted)**				
	To Rail Manager	To Rail Operator Total	To Rail Operator Freight	To Rail Operator Passenger	Consolidated
Total Investment Cost excluding EU Grant	*A*				*A*
Residual Asset Value	*B*				*B*
Operating Costs		*C+D*	*C*	*D*	*C+D*
Track Access Charges		*E+F*	*E*	*F*	
Total Outflows	***A+B***	***C+D+E+F***	***C+E***	***D+F***	***A+B+C+D***
Track Access Charges	*E+F*				
Revenues		*G+H*	*G*	*H*	*G+H*
Total Inflows	***E+F***	***G+H***	***G***	***H***	***G+H***
Net Cash Flows	(E+F)-(A+B)	(G+H)-(C+D+E+F)	G-(C+E)	H-(D+F)	(G+H)-(A+B+C+D)
Net Cash Flows (discounted)	I	J+K	J	K	I+J+K
Financial NPV of Investments (FNPV/C)	**I**	**J+K**	**J**	**K**	**I+J+K**
Financial IRR of Investments (FRR/C)	**x%**	**x%**	**-**	**-**	**x%**

3.6 Sources of Financing

3.6.1 For EU co-financed projects the main sources of financing are:

- Community assistance (the EU grant);
- National public contribution (grants or capital subsidies at central, regional and local government level);
- National private capital (i.e. private equity under a PPP);
- Other resources (e.g. EIB loans, loans from other lenders).

Determination of EU Grant (Funding Gap Calculation) 2007-2013

3.6.2 The methodology for calculation of and eligibility for EU co-funding are outlined in Annex I of the EC *'Guide to Cost Benefit Analysis of Investment Projects'* published in 2008. This guidance applies to application made for the current (2007-2013) funding period. It is likely that updated guidance will be issued for the next funding period (2014-2020) which should be followed for future projects. Current guidance is summarised below.

3.6.3 A project will be eligible for EU support only if the FNPV is negative or the FIRR is less than the discount rate for the project as a whole.

3.6.4 The EU contribution is generally determined by multiplying the project's eligible expenditure (EC) by the co-financing rate of the relevant operational programme's priority axis (Max CRpa). The eligible expenditure is the part of the investment cost that may be eligible for EU co-financing.

3.6.5 In order to modulate the contribution from the Funds, the maximum eligible expenditure (MaxEE) is identified by Article 55(2) Regulation 1083/2006 as the amount 'that shall not exceed the current value of the investment cost less the current value of the net revenue from the investment over a specific reference period'. Such identification of the eligible expenditure aims at ensuring enough financial resources for project implementation, avoiding, at the same time, the granting of an undue advantage to the recipient of the aid (over-financing)

3.6.6 For revenue generating projects the methodology used to determine the EU grant is the funding gap approach. According to the funding-gap approach, three steps have to be followed in order to determine the EU grant:

- Calculation of the funding-gap rate (R), which is the share of the discounted cost of the initial investment not covered by the discounted net revenue of the project
- Identification of the 'the amount to which the co-financing rate for the priority axis applies', the 'decision amount' (DA) is defined as the eligible cost (EC) multiplied by the funding-gap rate (R)

- Identification of the maximum EU grant, that is equal to the decision amount (DA) multiplied by the maximum co-funding rate (Max CRpa) fixed for the priority axis in the Commission's decision adopting the operational programme. It gives the amount of financial resources provided by the EU.

3.6.7 The figure below, extracted from EC document *'Working Paper No4, Guidance on the Methodology for Carrying out Cost-Benefit Analysis'* sets out the necessary calculations for the programming period 2007-2013.

STEPS TO DETERMINING THE EU GRANT

2007-2013 PROGRAMMING PERIOD

Step 1. Find the Funding Gap Rate (R):

$$R = MAX\ EE/DIC$$

where

Max EE is the *maximum eligible expenditure* = $DIC - DNR$ (Art. 55.2)
DIC is the *discounted investment cost*
DNR is the *discounted net revenue* = discounted revenues - discounted operating costs + discounted residual value

Step 2. Find the Decision Amount (DA), i.e. "the amount to which the co-financing rate for the priority axis applies" (Art. 41.2):

$$DA = EC * R$$

where

EC is the *eligible cost.*

Step 3. Find the (maximum) EU Grant:

$$EU\ Grant = DA * Max\ CRpa$$

where

Max CRpa is the *maximum co-funding rate* fixed for the priority axis in the Commission's decision adopting the operational programme (Art. 53.6)

Figure 6 - Steps to Determining the EU Grant (2007-2013)

Completing the Financial Plan of an EU Grant Application Form for Infrastructure Investment

3.6.8 The financial plan of an EU Grant Application Form for Infrastructure Investment (2007-2013) consists of four main tables; namely Table H.1 (Cost breakdown), Table H.2.1 (Union contribution calculation), Table H.2.2 (Sources of co-financing) and Table H.3 (Annual financing plan of Union contribution). A blank application form is provided in Appendix C.

3.6.9 The CBA Spreadsheet tool in Appendix B incorporates features that automatically complete the main tables according to instructions provided below for the project considered.

Table H.1

3.6.10 Total annual investment expenditure by cost type (in nominal prices) should be added to form column (A).

3.6.11 Total ineligible costs form column (B). Costs are not deemed eligible if they occurred prior to the beginning of the ongoing multiannual funding period and if the contingency budget does not meet the requirements of section 2.4.11. The current EU multiannual funding period is provided in appendix A1.

3.6.12 Eligible costs – column (C) are calculated by deducting ineligible costs from total investment expenditure.

Table H.2.1

3.6.13 Eligible costs are extracted from Table H.1.

3.6.14 Funding gap rate is calculated according to the following formula:

$$Funding\ Gap\ Rate = \frac{[Total\ Investment\ Cost - (Total\ Revenue - Operating\ Costs)]}{Total\ Investment\ Cost}$$

Where

Decision amount equals Eligible costs multiplied by Funding gap rate.

Co-financing rate is decided by the EU.

Union contribution equals Decision amount multiplied by Co-financing rate.

Table H.2.2

3.6.15 Table H.2.2 provides information on national sources of capital (public and private) needed to meet the Total Investment Cost, given Union assistance/contribution extracted from Table H.2.1.

Table H.3

3.6.16 Annual financing plan of Union contribution equals Total annual investment expenditure (in nominal prices) multiplied by Co-financing rate.

3.6.17 Values in the tables H.1 and H.3 are expressed in nominal prices. Therefore values used in the financial analysis should be adjusted to allow for inflation using an appropriate price index. Appendix A3 provides major price indices and recommendations on their use.

3.7 Financial Sustainability

3.7.1 A project is financially secure if it does not incur the risk of running out of cash in the future. This is not only influenced by whether total revenue outweighs total costs across the appraisal period (shown in the profitability analysis) but also the timings of cash inflows and outflows.

3.7.2 The sustainability analysis considers the cash inflow and cash outflow in each year of the appraisal period. The difference between these flows gives the annual surplus or deficit accumulated each year. By calculating the cumulative deficit/surplus each year a project can show whether the cumulative net cash flow is always in surplus. This analysis should be undertaken for the project as a whole, as well as for each provider group.

3.7.3 For a project to be considered financially sustainable the cumulative net cash flow for all provider groups (infrastructure manager and operator) should be greater than zero in all years.

3.7.4 As part of the analysis it is important to accurately reflect the profile of funding from all sources, including EU grant, in order to demonstrate financial sustainability in both the construction and operation phases.

3.7.5 As an example the table below shows the structure of the Financial Sustainability analysis for a rail project scheduled for opening in 2020 with constant expected operating costs and revenues. Other transport projects will have different stakeholder accounts to be considered.

Table 9 - Example Financial Sustainability Analysis

Time		Rail Manager				Rail Operator				Overall			
				Net Cash Flow				Net Cash Flow				Net Cash Flow	
Year	Period (t)	Total Inflow	Total Outflow	Annual	Cumulative	Total Inflow	Total Outflow	Annual	Cumulative	Total Inflow	Total Outflow	Annual	Cumulative
2015	1	a_{it}	a_{ot}	0	0	0	0	0	0	a_{it}	a_{ot}	0	0
2016	2	a_{it}	a_{ot}	0	0	0	0	0	0	a_{it}	a_{ot}	0	0
2017	3	a_{it}	a_{ot}	0	0	0	0	0	0	a_{it}	a_{ot}	0	0
2018	4	a_{it}	a_{ot}	0	0	0	0	0	0	a_{it}	a_{ot}	0	0
2019	5	a_{it}	a_{ot}	0	0	0	0	0	0	a_{it}	a_{ot}	0	0
2020	6	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2021	7	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2022	8	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2023	9	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2024	10	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2025	11	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2026	12	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2027	13	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2028	14	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2029	15	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2030	16	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2031	17	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2032	18	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2033	19	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2034	20	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2035	21	b_t	c_t	$c_t - b_t$	$\sum_{t=1}^{T}(c_t - b_t)$	d_t	e_t	$d_t - e_t$	$\sum_{t=1}^{T}(d_t + e_t)$	$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	$\sum_{t=1}^{T}[(c_t + e_t) - (b_t + d_t)]$
2036	22	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2037	23	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2038	24	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2039	25	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2040	26	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2041	27	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2042	28	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2043	29	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2044	30	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2045	31	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2046	32	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2047	33	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2048	34	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
2049	35	b_t	c_t	$c_t - b_t$		d_t	e_t	$d_t - e_t$		$b_t + d_t$	$c_t + e_t$	$(c_t + e_t) - (b_t + d_t)$	
No of years in which cumulative net cash flow is below zero					0	No of years in which cumulative net cash flow is below zero			0	No of years in which cumulative net cash flow is below zero			0

3.8 Financial Return on Capital

3.8.1 The appraisal of the financial return on capital should be undertaken when a project is being co-funded by the EU. It determines the effect of the EU grant on the financial return of the capital invested by national entities, either public or private.

3.8.2 The key financial indicators outlined in section 3.5 (FNPV and FIRR) need to be calculated for the project from the perspective of the national capital (K) committed to the project, rather than the total investment cost (C). This is achieved by considering all sources of financing except for the EU contribution.

3.8.3 The values of the key indicators with respect to the national capital (K) will be higher than those with respect to the total investment cost (C), as a result of the need to commit less capital due to the provision of the EU grant.

Risk Analysis

Overview
Evaluation framework
Minimum requirements
Steps to be performed
Treatment of costs and benefits

Economic Analysis
Overall approach
Key analysis assumptions
Estimation of costs and benefits
Assessment of economic impacts

Financial Analysis
Overall approach
Key analysis issues
Calculation of financial flows
Sources of financing
Assessment of financial impacts

Risk Assessment Overview
Sensitivity analysis
Risk analysis

4 Risk Assessment

4.1 Overview

4.1.1 Project appraisal is a forecasting process and as such has inherent uncertainties. These uncertainties come from both data limitations in the existing situation, and uncertainties as to how aspects, such as demand for travel, costs for infrastructure etc, will change over time. These uncertainties in the inputs to the appraisal process lead to uncertainty in the output from the economic and financial appraisal.

4.1.2 The risk assessment considers these uncertainties and their impact on the outcomes of both the economic and financial appraisal through the following stages:

- ***Sensitivity analysis*** – A series of tests to establish which input variables have a significant impact on economic and financial appraisal outcomes (determination of critical variables); and how much these variables are permitted to vary before the project becomes non-viable in economic terms (switching values).
- **Scenario analysis** – A process used to examine the impact of alternative future developments on the economic and financial appraisal outcomes; a combination of sensitivity analyses usually testing extreme cases (negative/pessimistic, positive/optimistic scenario) that are, consequently, unlikely to represent a realistic future alternative.
- ***Risk analysis*** – Definition of probability distributions for critical variables followed by Monte Carlo simulation to assess the resultant distribution of uncertainty in the outcomes of the economic and financial appraisal which arises from the uncertainty in values of critical variables. From these outcome uncertainties the risk analysis can define the likelihood of the project meeting the threshold values for economic and financial performance.
- ***Assessment of acceptable levels of risk*** – Establishment of acceptable values of risk; and
- ***Risk prevention*** – Management of these risks in the project.

4.1.3 The outcome of the risk analysis should also inform the contingency values adopted in the financial and economic analysis.

4.1.4 This document provides guidance for undertaking sensitivity analysis and Risk analysis. Assessment of acceptable levels of risk and risk prevention are covered in the '*Appraisal Guidance*' document.

4.2 Sensitivity Analysis

4.2.1 The sensitivity analysis considers the impact of changes in input variable value on output value of key performance indicators. The analysis has the following stages:

- Identification of critical values
- Calculation of switching values
- Scenario analysis

4.2.2 It should be noted that sensitivity and scenario analysis is not a substitute for risk analysis; and rather that it is an interim stage of the risk assessment.

Identification of Critical Variables

4.2.3 Typically the economic and financial analysis will have been undertaken assuming the most likely values for all of the input variables. This represents a 'Base Case' scenario. A series of sensitivity tests should be undertaken in which variables are altered from the 'base case' assumptions by +/- 1%. In each test only one variable should be changed, all other variables should take 'base case' values.

4.2.4 Typical variables tested include:

- Investment and maintenance costs
- Change in volume of traffic/passengers receiving benefits – in effect this tests changes in the size of benefits generated by project
- Socio-Economic growth – Population and GDP growth forecasts
- Monetary values assigned to non-market goods (e.g. value of time, emissions).

4.2.5 It is important to ensure that the variables tested are deterministically independent. This is to ensure double counting does not occur. For example total investment cost and land cost are related (as a total investment cost includes the cost of land). If these variables were both identified as critical and allocated probability distributions in the risk analysis, the uncertainty in land cost would be included twice.

4.2.6 For each test the key economic and financial performance indicators are recorded, together with the % change from the 'base case'.

4.2.7 The elasticity between the change in variable value and the change in performance indicator should be calculated for each variable. A Threshold elasticity should be adopted to determine which input variables are critical. The choice of the critical variables will vary according to the specific project and the threshold value must be accurately established on a case-by-case basis.

4.2.8 In general a variable can be deemed critical if a 1% variation in the value leads to a greater than 1% change in any of the key economic and financial performance indicators. The Risk analysis should consider all critical variables identified.

Switching Values

4.2.9 The switching values give an indication of how much each input assumption can change before the project becomes non-viable in economic terms. Specifically, the switching value for a variable is defined as the percentage change permitted before the ENPV or FNPV fall to zero. It should be determined for each critical variable tested in the sensitivity analysis.

Scenario Analysis

4.2.10 Whilst the standard sensitivity tests consider changes in each variable separately, scenario analysis considers the combined impact of a set of values for the critical variables.

4.2.11 Typically pessimistic (low case) and optimistic (high case) scenarios are considered. Values for critical variables under each scenario should be set to represent expected values under different future scenarios such as differing approaches to the balance between growth and environmental protection. Economic and financial key performance indicators should be calculated for each scenario.

4.3 Risk Analysis

4.3.1 The risk analysis considers the critical variables identified in the sensitivity analysis and assesses how uncertainty in the values of these variables leads to uncertainty in the values of the key performance indicators. The analysis has the following stages:

- Definition of probability distributions for critical variables – these distributions define the likelihood of the critical variable values falling within specific ranges
- Monte Carlo Simulation

Probability Distributions for Critical Variables

4.3.2 Whilst providing an indication of the impact of changes in input variable value, the sensitivity and scenario tests discussed above do not consider the likelihood that the input variable will have a specific value. In order to include this aspect Critical values should be assigned probability distributions. These distributions define the likelihood of the critical variable values falling within specific ranges.

4.3.3 The shape and spread of the probability distributions assigned to variables can be derived from a range of sources, including outturn data from previous similar projects and consultation of experts. In the absence of contrary data triangular distributions should be adopted with ranges appropriate for the specific project.

4.3.4 Figure 7 provides an example of normal and triangular probability distribution functions. Both distributions have a mean value of 1.0, but the differing shapes of the functions mean that the range and likelihood of specific values occurring is different.

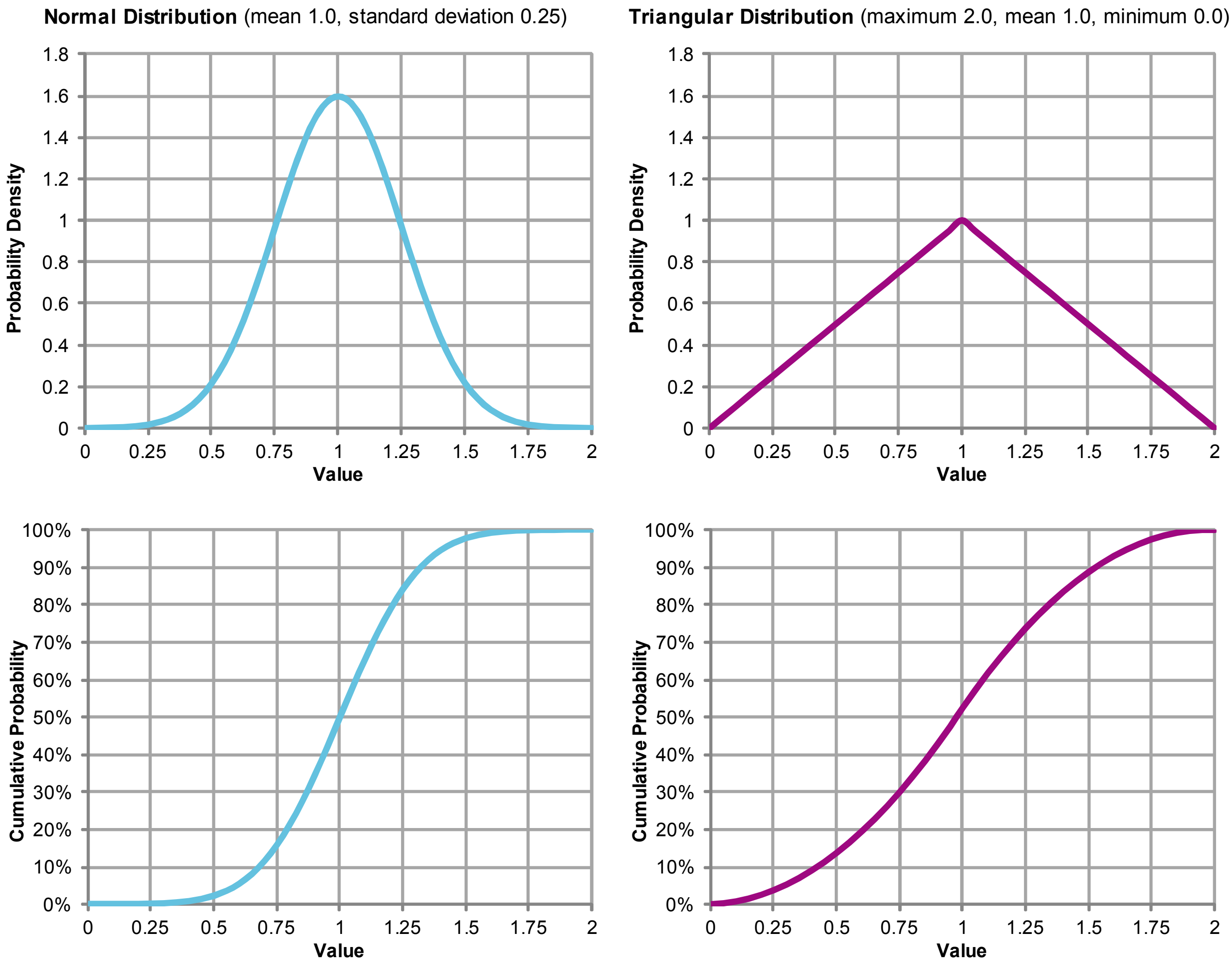


Figure 7 - Example Probability Distributions

Monte Carlo Simulation

4.3.5 The Monte Carlo method combines a number of input variables (and the uncertainty in the values of these variables) to determine the uncertainty in the financial and economic analysis outcomes.

4.3.6 The method uses an iterative approach that builds up the distribution of an output variable from successive runs of the analysis process (typically a spreadsheet programme). For each run the value of each critical input variable is randomly selected from the range of values in the probability distribution allocated to the variables. Critically, the analysis takes account of whether the uncertainty in input variables is correlated, for example a situation in which economic growth in one year is lower than expected is likely to experience lower trip growth as well.

4.3.7 The key performance indicators are then calculated from the set of critical variable values and stored. After a large number of iterations, analysis of the set of output variable values gives the probability distribution of each of the key performance indicators.

4.3.8 The resulting distributions for each key performance indicator (FRR/C, ERR FNPV(C) ENPV) should be reported in terms of estimated mean, standard deviation and cumulative probability. The cumulative probability distribution provides a tool for project risk assessment as it gives the % probability that a key performance indicSator is below a threshold values (for example percentage chance ENPV is below zero)

Appendices

Appendix A – Parameter Values

This appendix contains the recommended parameters for undertaking transport project cost benefit appraisal. The parameter values represent the current best estimates, however through the work undertaken appraising projects for the RGTMP it is likely that following further analysis parameter values may be revised.

A1. Appraisal Period

Indicative appraisal periods for transportation projects:

Roads **25-30 years**

Railways **30 years**

Ports and Airports **25 years**

For Strategy appraisal, where multi-modal projects are being compared a common 30 year appraisal period should be adopted.

Current EU Multiannual Funding Period: **2007-2013**

A2. Discount Rate

Social Discount Rate **5.0%**

Financial Discount Rate **5.5%**

Present Values should be discounted to **2010**

A3. Price Base

Economic and Financial analysis should be undertaken in EURO.

A standard exchange rate of **€1 = 4.2099 RON** should be used to convert values from Romanian Lei.

***Source**: 2010 average value, National Bank of Romania*

Monetary values should be reported in **2010** prices

Average Annual EUR to RON/ROL exchange rate

Year	1 Euro = Romanian Lei
2013	4.3821
2012	4.4560
2011	4.2379
2010	4.2099
2009	4.2373
2008	3.6827
2007	3.3373
2006	3.5245
2005	3.6234

***Source**: National Bank of Romania*

***Note**: 2013 exchange rate is the average exchange rate of January and February 2013*

Price Index

We recommend the use of the Construction Price Index for Costs and the Harmonised Index of Consumer Prices for benefits and externalities.

Consumer Price Index: Romania

Year	Consumer Price Index (2000=100)			
	Total	Food	Non-Food Goods	Services
2011	330.8	282.2	366.2	373.4
2010	312.7	266.2	345.0	357.5
2009	294.7	260.1	314.2	341.2
2008	279.1	251.9	295.8	313.1
2007	258.8	230.7	278.1	288.4
2006	246.9	222.0	264.9	270.5
2005	231.7	213.8	244.2	250.0
2004	212.5	201.5	219.5	226.2
2003	189.9	184.1	193.9	197.1
2002	164.8	160.5	167.0	171.6
2001	134.5	135.7	133.1	135.4
2000	100.0	100.0	100.0	100.0

***Source**: INS Yearly Consumer Price Index*

Construction Price Index: Romania

Year	Construction Price Index (2000=100)		
	Total	Labour	Materials
2011	483.7	604.6	488.2
2010	442.9	588.2	427.2
2009	434.6	584.6	417.7
2008	428.1	562.2	401.0
2007	368.3	460.4	344.0
2006	334.3	360.5	328.6
2005	301.0	302.1	300.6
2004	263.3	266.1	262.5
2003	210.4	220.9	207.0
2002	171.0	177.5	168.9
2001	140.0	139.5	140.2
2000	100.0	100.0	100.0

***Source**: Eurostat (sts_copi_a), rebase*

	Harmonised Indices of Consumer Prices (2000=100)													
	EU27	AT	BE	BG	CZ	CY	DE	DK	EE	EL	ES	FI	FR	HU
1996	83.6	95.7	94.0	:	79.7	89.2	95.9	92.4	78.5	86.3	91.2	93.5	95.8	61.1
1997	89.7	96.8	95.4	74.5	86.1	92.1	97.4	94.2	85.8	91.0	92.9	94.6	97.0	72.4
1998	93.9	97.6	96.3	88.4	94.5	94.3	97.9	95.4	93.3	95.2	94.5	95.9	97.7	82.7
1999	96.7	98.1	97.4	90.7	96.1	95.4	98.6	97.4	96.2	97.2	96.6	97.1	98.2	90.9
2000	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2001	103.2	102.3	102.4	107.4	104.5	102.0	101.8	102.3	105.6	103.7	102.8	102.7	101.8	109.1
2002	105.8	104.0	104.0	113.6	106.1	104.8	103.2	104.8	109.4	107.7	106.5	104.7	103.8	114.8
2003	108.1	105.4	105.6	116.3	106.0	109.0	104.3	106.9	110.9	111.4	109.8	106.1	106.0	120.2
2004	110.5	107.4	107.6	123.4	108.6	111.0	106.2	107.8	114.3	114.8	113.2	106.2	108.5	128.3
2005	113.1	109.7	110.3	130.9	110.4	113.3	108.2	109.6	119.0	118.8	117.0	107.1	110.5	132.8
2006	115.7	111.6	112.9	140.6	112.7	115.9	110.2	111.6	124.3	122.7	121.2	108.4	112.7	138.1
2007	118.4	114.0	114.9	151.2	116.0	118.4	112.7	113.5	132.7	126.4	124.6	110.1	114.5	149.1
2008	122.7	117.7	120.1	169.3	123.3	123.5	115.8	117.7	146.7	131.7	129.8	114.5	118.1	158.1
2009	123.9	118.2	120.1	173.5	124.1	123.8	116.0	118.9	147.0	133.5	129.4	116.3	118.2	164.5
2010	126.5	120.2	122.9	178.7	125.5	126.9	117.3	121.5	151.1	139.8	132.1	118.3	120.3	172.2
2011	130.4	124.4	127.1	184.8	128.3	131.4	120.2	124.8	158.8	144.2	136.1	122.2	123.0	179.0

Source*: Eurostat (prc_hicp_aind), rebased*

Note: *EU27=European Union (27), AT=Austria, BE=Belgium, BG=Bulgaria, CY=Cyprus, CZ=Czech Republic, DE=Germany, DK=Denmark, EE=Estonia, EL=Greece, ES=Spain, FI=Finland, FR=France, HU=Hungary*

Harmonised Indices of Consumer Prices: EU Members (continued)

Year	Harmonised Indices of Consumer Prices (2000=100)													
	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
1996	89.6	92.3	83.9	93.2	84.7	88.1	92.4	65.9	91.4	11.6	95.5	74.0	71.4	94.6
1997	90.8	94.0	92.5	94.5	91.5	91.5	94.1	75.9	93.1	29.6	97.2	80.2	75.6	96.3
1998	92.7	95.9	97.5	95.4	95.4	94.9	95.8	84.8	95.2	47.1	98.2	86.5	80.7	97.9
1999	95.0	97.5	98.9	96.3	97.4	97.1	97.7	90.8	97.3	68.6	98.7	91.8	89.1	99.1
2000	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2001	103.9	102.4	101.5	102.4	102.5	102.5	105.1	105.3	104.4	134.5	102.7	108.6	107.2	101.2
2002	108.9	105.1	101.9	104.5	104.5	105.2	109.2	107.3	108.2	164.8	104.7	116.7	110.9	102.5
2003	113.3	108.0	100.8	107.2	107.6	107.2	111.6	108.1	111.8	189.9	107.1	123.3	120.3	103.9
2004	115.9	110.4	102.0	110.6	114.3	110.1	113.2	112.0	114.6	212.5	108.2	127.8	129.2	105.3
2005	118.3	112.9	104.7	114.8	122.1	112.9	114.9	114.4	117.0	231.7	109.1	131.0	132.9	107.4
2006	121.5	115.3	108.6	118.2	130.2	115.8	116.8	115.9	120.6	247.0	110.7	134.3	138.5	109.9
2007	125.0	117.7	115.0	121.3	143.3	116.6	118.6	118.9	123.5	259.2	112.6	139.3	141.1	112.5
2008	128.9	121.9	127.7	126.3	165.2	122.1	121.2	123.9	126.8	279.7	116.3	147.0	146.7	116.5
2009	126.7	122.8	133.0	126.3	170.5	124.4	122.4	128.8	125.6	295.3	118.6	148.3	148.0	119.0
2010	124.7	124.8	134.6	129.8	168.4	126.9	123.5	132.3	127.4	313.3	120.9	151.4	149.1	123.0
2011	126.2	128.4	140.2	134.7	175.6	130.1	126.6	137.4	131.9	331.5	122.5	154.6	155.2	128.5

***Source**: Eurostat (prc_hicp_aind), rebased*

***Note:** IE=Ireland, IT=Italy, LT=Lithuania, LU=Luxembourg, LV=Latvia, MT=Malta, NL=Netherlands, PL=Poland, PT=Portugal, RO=Romania, SE=Sweden, SI=Slovenia, SK=Slovakia, UK=United Kingdom*

Euro to Major European Currencies Average Annual Exchange Rates

Year	1 Euro =										
	Bulgarian lev	Czech koruna	Danish krone	Hungarian forint	Latvian lats	Lithuanian litas	Norwegian krone	Polish zloty	Swedish krona	Swiss franc	UK pound sterling
1999	:	36.884	7.4355	252.77	0.6256	4.2641	8.3104	4.2274	8.5625	1.6003	0.65874
2000	:	35.599	7.4538	260.04	0.5592	3.6952	8.1129	4.0082	8.8313	1.5579	0.60948
2001	1.9482	34.068	7.4521	256.59	0.5601	3.5823	8.0484	3.6721	9.3012	1.5105	0.62187
2002	1.9492	30.804	7.4305	242.96	0.581	3.4594	7.5086	3.8574	9.1528	1.467	0.62883
2003	1.949	31.846	7.4307	253.62	0.6407	3.4527	8.0033	4.3996	9.08	1.5212	0.69199
2004	1.9533	31.891	7.4399	251.66	0.6652	3.4529	8.3697	4.5268	9.0206	1.5438	0.67866
2005	1.9558	29.782	7.4518	248.05	0.6962	3.4528	8.0092	4.023	9.3885	1.5483	0.6838
2006	1.9558	28.342	7.4591	264.26	0.6962	3.4528	8.0472	3.8959	9.0404	1.5729	0.68173
2007	1.9558	27.766	7.4506	251.35	0.7001	3.4528	8.0165	3.7837	9.4415	1.6427	0.68434
2008	1.9558	24.946	7.456	251.51	0.7027	3.4528	8.2237	3.5121	10.87	1.5874	0.79628
2009	1.9558	26.435	7.4462	280.33	0.7057	3.4528	8.7278	4.3276	10.252	1.51	0.89094
2010	1.9558	25.284	7.4473	275.48	0.7087	3.4528	8.0043	3.9947	8.9655	1.3803	0.85784
2011	1.9558	24.59	7.4506	279.37	0.7063	3.4528	7.7934	4.1206	8.912	1.2326	0.86788

Source*: European Central Bank*

A4. Value of Time

Value of Time (€ per passenger hour / per tonne hour, factor costs) Romania in 2010 prices & values

	Mode	Journey Purpose	Trip Length	Occupant	Value in €/Hour
Passengers	Car/LGV	*Business*	*All*	*Driver*	10.16
				Passenger	10.16
		Commuting	*Short Distance*	*Driver*	3.62
				Passenger	3.62
			Long Distance	*Driver*	4.65
				Passenger	4.65
		Other Non-Working Time	*Short Distance*	*Driver*	3.03
				Passenger	3.03
			Long Distance	*Driver*	3.90
				Passenger	3.90
	Rail	*Business*	*All*	*Passenger*	10.16
		Commuting	*Short Distance*	*Passenger*	3.62
			Long Distance		4.65
		Other Non-Working Time	*Short Distance*	*Passenger*	3.03
			Long Distance		3.90
	Bus	*Business*	*All*	*Passenger*	8.15
		Commuting	*Short Distance*	*Passenger*	2.60
			Long Distance		3.34
		Other Non-Working Time	*Short Distance*	*Passenger*	2.18
			Long Distance		2.80
	Air	*Business*	*All*	*Passenger*	13.99
		Commuting	*Short Distance*	*Passenger*	5.40
			Long Distance		6.93
		Other Non-Working Time	*Short Distance*	*Passenger*	4.65
			Long Distance		5.81
Freight	Road	*Business*	*All*	-	1.27
	Rail				0.52
	Air				1.27
	Water				0.52

***Source**: EU-25 values from HEATCO Deliverable 5 (Tables 4.6 – 4.8), rebased for Romania in 2010 values and prices*

Value of Time Growth Factor (Annual)

Annual growth in value of time will be 70% of the growth in GDP per head.

Vehicle Occupancy (average people per vehicle)

Vehicle Type	Purpose	Occupancy
Car	Business	1.439
	Commuting	1.548
	Other (Private)	1.791
	Other (Vacation)	1.703
LGV	All	1
HGV	All	1

***Source**: AECOM data survey (2012)*

Trip Purpose Share

Trip Mode	Trip Purpose			
	Business	Commuting	Other (Private)	Other (Vacation)
Motorbike	13%	33%	44%	11%
Car	13%	33%	44%	11%
Bus	6%	21%	71%	2%
Rail	4%	20%	74%	2%
Air	36%	0%	25%	39%

***Source**: AECOM data survey (2012)*

A5. Vehicle Operating Costs incurred by users

Fuel Consumption Formulae Parameters Values (see section 2.5.24 for formula)

Vehicle Category	Fuel Parameters			
	a	b	c	d
Petrol				
Car	0.964022581	0.04144803	-4.54163E-05	2.01346E-06
LGV	1.556463336	0.06425332	-0.00074448	1.00552E-06
Diesel				
Car	0.437094041	0.058616489	-0.00052488	4.12709E-06
LGV	1.045268333	0.057901415	-0.000432895	8.02520E-06
OGV1	1.477368474	0.245615208	-0.003572413	3.06380E-05
OGV2	3.390702946	0.394379054	-0.004642285	3.59224E-05
PSV	4.115603124	0.306464813	-0.00420643	3.65263E-05

***Source**: WebTAG, Unit 3.5.6, (Table 10)*

Fuel Costs (€ per litre, market prices & factor costs) Romania 2010 prices & values

Fuel	Market Prices	Factor Costs			
	Cost with Indirect Taxation (A)	Resource Cost (B)	Duty (C)	VAT $(D) = (A) - \frac{(A)}{(1 + VAT\ Rate)}$	Total Factor Cost $(E) = (B) + (C)$
Petrol	1.063433	0.522038	0.335569	0.205826	0.857607
Diesel	1.032038	0.551462	0.280827	0.199749	0.832289

***Source**: EC Weekly Oil Bulletin, averaged across 2010*

Fuel Costs Price Growth

Year	Annual Growth Rate			
	Petrol		Diesel	
	Resource	Duty/VAT	Resource	Duty/VAT
2010 – 2030	2.040%	as CPI	2.372%	as CPI
2031 +	0.195%	0.195%	0.195%	0.195%

***Source**: WebTAG, Unit 3.5.6, Resource growth (2010-2030) calculated based on values on WebTAG, Unit 3.5.6, Table 11a*

Non-Fuel Vehicle Operating Cost

Non Fuel Resource VOCs (€ct/km, factor costs) Romania in 2010 values & prices (see section 2.5.24 for formula)

Vehicle Category	Non-fuel Parameters	
	e	f
Car (Business)	1.772	48.521
Car (Other)	1.373	:
LGV (Business)	2.574	16.815
LGV (Other)	2.574	:
OGV1	2.396	94.160
OGV2	4.662	181.499
PSV	10.872	247.893

***Source**: WebTAG, Unit 3.5.6, (Table 15), rebased for Romania in 2010 values and prices*

Non-Fuel Costs Price Growth

Year	Annual Growth Rate
2010 – 2030	0%
2031 +	0%

***Source**: WebTAG, Unit 3.5.6*

VOCs Growth Rates: Fuel Consumption Rate Change (annually in period indicated)

Period	Car - Petrol	Car - Diesel	Bus	LGV - Petrol	LGV - Diesel	HGV
2015	-2.09%	-1.71%	0.00%	-0.66%	-2.07%	0.00%
2020	-3.72%	-2.22%	0.00%	-1.38%	-2.34%	0.00%
2025	-3.63%	-2.62%	0.00%	-3.07%	-2.19%	0.00%
2030	-2.10%	-2.10%	0.00%	-2.95%	-1.30%	0.00%
2035	-0.74%	0.96%	0.00%	-0.86%	0.57%	0.00%

***Source**: WebTAG, Unit 3.5.6*

A6. Accidents

Average Accident Rates Romania in between 2007 and 2011

Network Type	Accident Rate PIA	unit
Road		
A Road	0.0168	accidents per mvehicle km
DN Rural	0.0576	
DN Urban	0.5784	
DJ Rural	0.1605	
DJ Urban	1.7042	
Local	2.4533	
Rail		
Traffic related	0.1336	accidents per mtrain km
Level Crossing related	0.0148	accidents per level crossing
Network related	0.0175	accidents per rail network km
Waterways		
Entire Network	12.9621	accidents per mship km
Air		
Entire Network	0.0000	accidents per mplane km

***Note**: Waterways data in 2011*

***Note:** Road reduction factor set to 1, as insufficient data available to allow calculation of long-term accident rate trends.*

Average Number of Casualties per Accident Romania between 2007 and 2011

Network Type	**Number of Casualties per Accident**		
	Fatal	Serious	Minor
Road			
A Road	0.4400	0.8945	0.6618
DN Rural	0.3972	0.8809	0.4985
DN Urban	0.4077	0.8849	0.4804
DJ Rural	0.2869	0.8656	0.3527
DJ Urban	0.2847	0.8722	0.3478
Local	0.1616	0.9133	0.2052
Rail			
Traffic related	0.0780	0.2537	0.0000
Level Crossing related	0.3917	0.5355	0.0000
Network related	0.4865	0.5010	0.0000
Waterways			
Entire Network	0.0727	0.2182	0.0000
Air			
Entire Network	0.0000	0.0000	0.0000

Note: *Road reduction factor set to 1, as insufficient data available to allow calculation of long-term accident rate trends.*

Accident Reduction (β) Factors

β factors provide annual reduction in accident and casualty rates

$$Accident\ Rate\ in\ year\ t = Accident\ Rate\ in\ year\ b \times \beta^{(y-b)}$$

Network Type	Annual Accident Rate Reduction Factor (β factor)
Road	
A Road	1.0000
DN Rural	1.0000
DN Urban	1.0000
DJ Rural	1.0000
DJ Urban	1.0000
Local	1.0000
Rail	
Traffic related	1.0000
Level Crossing related	1.0000
Network related	1.0000
Waterways	
Entire Network	1.0000
Air	
Entire Network	1.0000

***Source**: CESTRIN (for road), EUROSTAT (for rail), RORIS and EUROSTAT (for waterways), EUROSTAT (for air)*

***Note**: Road data do not include accident with minor injuries only.*

***Note**: Waterways reduction factor set to 1, as data available for 2011 only.*

***Note**: Air reduction factor set to 1, as initial accident rate is 0.*

$$Casualties\ per\ Accident\ in\ year\ t = Casualties\ per\ Accident\ in\ year\ b \times \beta^{(y-b)}$$

Network Type	**Annual Casualties per Accident Reduction Factor (β factor)**		
	Fatal	Serious	Minor
Road			
A Road	1.0000	1.0000	1.0000
DN Rural	1.0000	1.0000	1.0000
DN Urban	1.0000	1.0000	1.0000
DJ Rural	1.0000	1.0000	1.0000
DJ Urban	1.0000	1.0000	1.0000
Local	1.0000	1.0000	1.0000
Rail			
Traffic related	1.0000	1.0000	1.0000
Level Crossing related	1.0000	1.0000	1.0000
Network related	1.0000	1.0000	1.0000
Waterways			
Entire Network	1.0000	1.0000	1.0000
Air			
Entire Network	1.0000	1.0000	1.0000

***Source**: CESTRIN (for road), EUROSTAT (for rail), RORIS and EUROSTAT (for waterways), EUROSTAT (for air)*

***Note**: Rail traffic related casualties seem not to follow a consistent pattern, so reduction factor set to one.*

Value of Casualties avoided (€ per casualty avoided, factor costs) Romania in 2010 values & prices

Cost per Casualty	
Fatality	635,972
Serious injury	87,963
Minor injury	7,114

Source: *Germany values from HEATCO Deliverable 5 (Table 5.2), rebased for Romania in 2010 values and prices*

Value of Accidents Growth Factor

Annual growth in value of accident cost will be 100% of the growth in GDP per head.

A7. Noise

Noise Costs (€ct/vkm, factor costs) Romania in 2010 values & prices

Vehicle type	Time of day	Network type		
		Urban	Suburban	Rural
Car	Day	0.35	0.05	0.005
	Night	0.63	0.10	0.01
Motorcycle	Day	0.70	0.11	0.01
	Night	1.27	0.20	0.02
Bus	Day	1.74	0.27	0.03
	Night	3.17	0.50	0.06
LGV	Day	1.74	0.27	0.03
	Night	3.17	0.50	0.06
HGV	Day	3.20	0.50	0.06
	Night	5.83	0.91	0.10
Passenger Train	Day	10.78	9.40	1.17
	Night	35.56	15.68	1.96
Freight Train	Day	19.12	18.26	2.28
	Night	78.00	30.87	3.85

Source: *EU-15 values from Handbook of Estimation of External Costs in the Transport Sector, 2008 as part of the IMPACT study (Table 22), rebased for Romania in 2010 values and prices*

Value of Noise Costs Factor (Annual)

Annual growth in value of noise costs will be 100% of the growth in GDP per head.

A8. Local Air Quality

Local Pollution Costs (€/tonne emitted, factor costs) Romania in 2010 prices & values

Emission Type		Road, Rail, Inland Waterway and Air			Maritime
		Urban Metropolitan	Urban	Rural	
SO_2		3,994			3,994
NO_x		4,393			998
VOC		799			599
$PM_{2.5}$ (exhaust)		58,309	18,771	14,977	11,183
PM_{10}	non-exhaust at source	23,364	7,588	5,991	:
	electric generation	6,590	5,192	:	:

***Source**: Romania values from Handbook of Estimation of External Costs in the Transport Sector, 2008 as part of the IMPACT study (Tables 13-14), rebased in 2010 values and prices*

***Note**: Urban metropolitan: cities with more than 0.5 million inhabitants*

***Note:** Urban smaller and midsized cities with up to 0.5 million inhabitants*

***Note:** Maritime Values taken for Mediterranean Sea*

Value of Local Air Quality Costs Factor (Annual)

Annual growth in value of local air quality costs will be 100% of the growth in GDP per head.

Local Air Pollution Costs (factor costs) Romania in 2010 prices & values

Vehicle Type			Local Air Pollution Cost				Unit
			Metropolitan	Other Urban	Non Urban		
					Interurban	Motorway	
Passenger							
Road	Car		0.99	0.82	0.41	0.04	€ct/vkm
	Bus		4.08	3.29	2.24	0.21	€ct/vkm
Rail	Electric	Train	0.00		0.00		€ct/ trainkm
	Diesel	Train	76.65		62.39		
Air	<500km		0.67				€ct/ pkm
	500 – 1000km		0.44				
	1000 – 1500km		0.31				
	1500 – 2000km		0.29				
	>2000km		0.30				
Freight							
Road	LGV		1.62	1.08	0.68	0.08	€ct/vkm
	HGV		7.18	4.90	3.41	0.32	€ct/vkm
Rail	Electric	Train			0.00		€ct/ trainkm
	Diesel	Train			211.90		
Inland Waterway	Inland Ship		214.27				€ct/ shipkm

Source: *TREMOVE 2010 Emission Data for Romania, Cost data from Local Pollution Costs table above.*

Note: *90% of the non-urban motorway network is assumed to be outside habitable areas.*

A9. Greenhouse Gas Emissions

Global Warming Potentials

Greenhouse Gas	Tonnes of equivalent CO_2 for one tonne of greenhouse gas emitted
CH_4	23
N_2O	296

Source*: Handbook of Estimation of External Costs in the Transport Sector, 2008 as part of the IMPACT study (Internalisation Measures and Policies for All external Cost of Transport)*

CO_2 Equivalent Emission Cost Forecasts per 1000kg (factor costs) EU-27 in 2010 prices & values

Year of Emission	Price € per 1000kg CO_2 emitted		
	Low	Medium	High
2010	20.56	33.41	80.95
2020	25.70	41.12	104.08
2030	33.41	51.40	132.35
2040	46.26	70.67	168.33
2050	65.53	106.65	213.30

***Source**: Handbook of Estimation of External Costs in the Transport Sector, 2008 as part of the IMPACT study (Internalisation Measures and Policies for All external Cost of Transport), rebased in 2010 values and prices*

Greenhouse Gas Emissions Rates (kgr CO2/litre consumed)

Year	Petrol	Diesel
2010	2.2317	2.5339
2011	2.2128	2.5387
2012	2.2013	2.5255
2013	2.1898	2.5123
2014	2.1670	2.4981
2015	2.1441	2.4840
2016	2.1213	2.4699
2017	2.0985	2.4558
2018	2.0757	2.4416
2019	2.0528	2.4275
2020+	2.0300	2.4134

***Source**: WebTAG, Unit 3.3.5, (Table 1)*

Greenhouse Gas Emissions Costs (factor costs) Romania in 2010 prices & values

<table>
<tr><th colspan="3" rowspan="3">Vehicle Type</th><th colspan="4">Greenhouse Gas Emissions Costs</th><th rowspan="3">Unit</th></tr>
<tr><th rowspan="2">Metropolitan</th><th rowspan="2">Other Urban</th><th colspan="2">Non Urban</th></tr>
<tr><th>Interurban</th><th>Motorway</th></tr>
<tr><td colspan="8">Passenger</td></tr>
<tr><td rowspan="2">Road</td><td colspan="2">Car</td><td>0.71</td><td>0.72</td><td>0.49</td><td>0.49</td><td>€ct/vkm</td></tr>
<tr><td colspan="2">Bus</td><td>1.86</td><td>1.86</td><td>1.42</td><td>1.37</td><td>€ct/vkm</td></tr>
<tr><td rowspan="2">Rail</td><td>Electric</td><td>Train</td><td>23.91</td><td></td><td colspan="2">15.57</td><td rowspan="2">€ct/ trainkm</td></tr>
<tr><td>Diesel</td><td>Train</td><td>13.23</td><td></td><td colspan="2">17.92</td></tr>
<tr><td rowspan="5">Air</td><td colspan="2"><500km</td><td colspan="4">0.71</td><td rowspan="5">€ct/ pkm</td></tr>
<tr><td colspan="2">500 – 1000km</td><td colspan="4">0.53</td></tr>
<tr><td colspan="2">1000 – 1500km</td><td colspan="4">0.40</td></tr>
<tr><td colspan="2">1500 – 2000km</td><td colspan="4">0.38</td></tr>
<tr><td colspan="2">>2000km</td><td colspan="4">0.40</td></tr>
<tr><td colspan="8">Freight</td></tr>
<tr><td rowspan="2">Road</td><td colspan="2">LGV</td><td>0.87</td><td>0.87</td><td>0.60</td><td>0.72</td><td>€ct/vkm</td></tr>
<tr><td colspan="2">HGV</td><td>2.17</td><td>2.18</td><td>1.69</td><td>1.61</td><td>€ct/vkm</td></tr>
<tr><td rowspan="2">Rail</td><td>Electric</td><td>Train</td><td></td><td></td><td colspan="2">36.62</td><td rowspan="2">€ct/ trainkm</td></tr>
<tr><td>Diesel</td><td>Train</td><td></td><td></td><td colspan="2">61.45</td></tr>
<tr><td>Inland Waterway</td><td colspan="2">Inland Ship</td><td colspan="4">68.43</td><td>€ct/ shipkm</td></tr>
</table>

***Source**: TREMOVE 2010 Emission Data for Romania, Cost data from Global Warming Potentials & Medium CO_2 Equivalent Emission Cost Forecasts tables above.*

A10. Road and Rail Asset Lifetimes

Lifetimes in Years by Mode and Group of Components (Road and Rail)

Mode	Group of Components	Min	Main	Max
General	Bridges	50	75	100
	Tunnels	50	75	100
	Land	Infinite	Infinite	Infinite
Road	Base Course	30	45	60
	Wearing Course	10	20	30
	Environmental Installations	10	20	30
	Drainage	50	75	100
	Retaining Walls	50	75	100
Rail	Substructures	40	60	80
	Tracks	20	30	40
	Tech. Equip.	10	20	30
	Power Supply	20	30	40
	Environmental Installations	10	30	50

Source: HEATCO Deliverable 5

Appendix B – CBA Spreadsheet Tool User Manual

The CBA Tool Manual will be issued to accompany the final version of the CBA Tool

Appendix C – EU Grant Application Form for Infrastructure Investment

This appendix contains Section E on Cost – Benefit Analysis and Section H on Financing Plan of Annex XXI on Major Project Request for Confirmation of Assistance under Articles 39 to 41 of Regulation (EC) No 1083/2006 for Infrastructure Investment of Commission Regulation (EC) No 1828/2006 on Setting out rules for the implementation of Council Regulation (EC) No 1083/2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and of Regulation (EC) No 1080/2006 of the European Parliament and of the Council on the European Regional Development Fund

E. COST-BENEFIT ANALYSIS

This section should be based on the Guidelines on the methodology for carrying out the cost-benefit-analysis of major projects. In addition to the summary elements to be provided, the full cost-benefit analysis document shall be provided in support of this application as Annex II.

E.1. Financial analysis

The key elements from the financial analysis of the CBA should be summarised below.

E.1.1. Short description of methodology and specific assumptions made

TEXT BOX

E.1.2. Main elements and parameters used in the CBA for financial analysis

	Main elements and parameters		Value Not discounted	Value Discounted (Net Present Value)
1	Reference period (years)			
2	Financial discount rate (%)[1]			
3	Total investment cost excluding contingencies (in euro, not discounted)[2]			
4	Total investment cost (in euro, discounted)			
5	Residual value (in euro, not discounted)			
6	Residual value (in euro, discounted)			
7	Revenues (in euro, discounted)			
8	Operating costs (in euro, discounted)			
Funding gap calculation[3]				

1 Specify if the rate is real or nominal. If the financial analysis is conducted in constant prices, a financial discount rate expressed in real terms shall be used. If the analysis is conducted in current prices, a discount rate in nominal terms shall be used.

2 Investment cost should here exclude contingencies in accordance with working document number 4.

9	Net revenue = revenues – operating costs + residual value (in euro, discounted) = (7) – (8) + (6)		
10	Investment cost – net revenue (in euro, discounted) = (4) – (9) (Article 55(2))		
11	Funding gap rate (%) = (10) / (4)		

Where VAT is recoverable, the costs and revenues should be based on figures excluding VAT.

E.1.3. Main results of the financial analysis

		Without Union assistance (FRR/C) A		With Union assistance (FRR/K) B[4]	
1. Financial rate of return	(%)		FRR/C		FRR/K
2. Net present value	(euro)		FNPV/C		FNPV/K

E.1.4. Revenues generated over its lifetime

If the project is expected to generate revenues through tariffs or charges borne by users, please give details of charges (types and level of charges, principle or Union legislation on the basis of which the charges have been established).

(a) Do the charges cover the operational costs and depreciation of the project?

TEXT BOX

(b) Do the charges differ between the various users of the infrastructure?

TEXT BOX

(c) Are the charges proportional

i) To the use of the project/real consumption?

TEXT BOX

ii) To the pollution generated by users?

TEXT BOX

If no tariffs or charges are proposed, how will operating and maintenance costs be covered?

TEXT BOX

E.2. Socio-economic analysis

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3 This does not apply: 1) for projects subject to the rules on State aids in the meaning of Article 107 of the Treaty (see point G.1), pursuant to Article 55(6) of Regulation (EC) No 1083/2006 and 2) if operating costs are higher than revenues the project is not considered as revenue generating in the sense of Article 55 of Regulation (EC) No 1083/2006, in which case, ignore items 9 and 10 and set funding gap to 100%.

4 For the calculation of the project profitability without ("/C") and with ("/K") Union assistance, refer to the guidance provided by the Commission in line with Article 40 of Regulation (EC) No 1083/2006.

E.2.1. Provide a short description of methodology (key assumptions made in valuing costs and benefits) and the main findings of the socio-economic analysis:

TEXT BOX

E.2.2. Give details of main economic costs and benefits identified in the analysis together with values assigned to them:

Benefit	Unit value (where applicable)	Total value (in euro, discounted)	% of total benefits
…	…	…	…
Cost	**Unit value (where applicable)**	**Total value (in euro, discounted)**	**% of total costs**
…	…	…	…

E.2.3. Main indicators of the economic analysis

Main parameters and indicators	Values
1. Social discount rate (%)	
2. Economic rate of return (%)	
3. Economic net present value (in euro)	
4. Benefit-cost ratio	

E.2.4. Employment effects of project

Provide an indication of the number of jobs to be created (expressed in terms of full-time equivalents (FTE)).

Number of jobs directly created:	No (FTE) (A)	Average duration of these jobs (months)[5] (B)
1. During implementation phase		
2. During operational phase		

[NB: indirect jobs created or lost are not sought for public infrastructure investments.]

E.2.5. Identify the main non-quantifiable / non valuable benefits and costs:

TEXT BOX

E.3. Risk and sensitivity analysis

E.3.1. Short description of methodology and summary results

TEXT BOX

5 In case of permanent jobs, instead of duration in months, type "permanent".

E.3.2. Sensitivity analysis

State the percentage change applied to the variables tested:

Present the estimated effect on results of financial and economic performance indexes.

Variable tested	Financial Rate of Return variation	Financial Net Present Value variation	Economic Rate of Return variation	Economic Net Present Value variation

Which variables were identified as critical variables? State which criterion is applied.

TEXT BOX

Which are the switching values of the critical variables?

TEXT BOX

E.3.3. Risk analysis

Describe the probability distribution estimate of the project's financial and economic performance indexes. Provide relevant statistical information (expected values, standard deviation).

TEXT BOX

H. FINANCING PLAN

The decision amount and other financial information in this section must be coherent with the basis (total or public cost) for the co-financing rate of the priority axis. Where private expenditure is not eligible for financing under the priority axis it shall be excluded from the eligible costs; where private expenditure is eligible it may be included.

H.1. Cost breakdown

	Euro	**TOTAL PROJECT COSTS (A)**	**INELIGIBLE COSTS[1] (B)**	**ELIGIBLE COSTS (C)=(A)-(B)**
1	Planning/design fees			
2	Land purchase			
3	Building and construction			
4	Plant and machinery			
5	Contingencies[2]			
6	Price adjustment (if applicable)[3]			
7	Technical assistance			
8	Publicity			
9	Supervision during construction implementation			
10	**Sub-TOTAL**			
11	(VAT[4])			
12	**TOTAL**	(5)		

(1) Ineligible costs comprise (i) expenditure outside the eligibility period, (ii) expenditure ineligible under national rules (Article 56(4) of Regulation (EC) No 1083/2006), (iii) other expenditure not presented for co-financing. NB: The starting date for eligibility of expenditure is the date of receipt of the draft operational programme by the Commission or 1 January 2007, whichever is the earlier.

(2) Contingencies should not exceed 10% of total investment cost net of contingencies. These contingencies may be included in the total eligible costs used to calculate the planned contribution of the funds – Section H2.

(3) A price adjustment may be included, where relevant, to cover expected inflation where the eligible cost values are in constant prices.

(4) Where VAT is considered as eligible, give reasons.

(5) Total cost must include all costs incurred for the project, from planning to supervision and must include VAT even if VAT is considered non eligible

H.2. Total planned resources and planned contribution from the Funds

The funding gap rate was already presented under Section E.1.2. This should be applied to the eligible cost to calculate the "amount to which the co-financing rate for the priority axis applies" (Article 41(2) of Council Regulation (EC) No 1083/2006). This is then multiplied by the co-financing rate of the priority axis to determine the Union contribution.

H.2.1. Union contribution calculation

		Value
1.	Eligible cost (in euro, not discounted) (Section H.1.12(C))	
2.	Funding gap rate (%), if applicable = (E.1.2.11)	
3.	Decision amount, i.e. the "amount to which the co-financing rate for the priority axis or priority axes[6] applies" (Article 41(2)) = (1)*(2). If H.2.1.2 not applicable, the decision amount must respect the maximum public contribution according to state aid rules	
3.1	In case of major project co-financed by more than one Operational Programme, indicate the share of the Decision amount corresponding to each Operational Programme	
4.	Co-financing rate of the priority axis or priority axes[19] (%)	
5.	Union contribution (in euro) = (3)*(4)	

6 In case of major project co-financed by more than one Operational Programme.

H.2.2. Sources of co-financing

In the light of the results of the financing gap calculation (where relevant) the total investment costs of the project shall be met from the following sources:

Source of total investment costs (€)					**Of which (for Information)**
Total investment cost [H.1.12.(A)]	Union assistance [H.2.1.5]	National public (or equivalent)	National private	Other sources (specify)	EIB/EIF loans:
(a)= (b)+(c)+(d)+(e)	(b)	(c)	(d)	(e)	(f)

H.2.3. Expenditure already certified

Have expenditure for this major project been already certified?

Yes ☐ No ☐

If yes, state the amount: ………. EUR.

If yes and in case of major project co-financed by more than one Operational Programme, under which Operational Programmes have the expenditure been certified?

Title of the related Operational Programme(s):

CCI number:

Amount concerned in the Operational Programme: …….. EUR

H.3. Annual financing plan of Union contribution

The Union contribution (H.2.1.5) shall be presented below in terms of the share of annual programme commitment. In case of major project co-financed by more than one Operational Programme, the annual financing plan shall be presented separately for each Operational Programme.

(in Euro)	2007	2008	2009	2010	2011	2012	2013
[CF/ ERDF - specify]							