Ministry of Finance

Ministry of Transport

National Company „Railway Infrastructure”

„Metropoliten” EAD

National Road Infrastructure Fund

Requirements for preparation of CBA in Transport sector

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Contents

1 Introduction

Subsequent to its monitoring of the process of drafting financing application forms under OP “Transport”, MF initiated a series of meetings with beneficiaries and the Managing Authority to discuss some common problems in application forms drafting. At these meetings the beneficiaries, i.e. “Railroad Infrastructure” NC, “Metropolitan” EAD and the National Road Infrastructure Fund presented their visions for quality improvements of the forms and the relevant financial and economic analyses.

As shown in the discussions with JASPERS, the most important controversial issues concern the absence of regulations (methodologically justified and described in a document) on the scope and contents of the preliminary study of options and the financial and socio-economic analysis. That has given rise to some disagreements regarding the type and contents of the tables used and the accompanying descriptive texts. Another important aspect is the absence of a national agreement or regulation on the adoption of base values for the analyses.

This document is a summary of the agreements reached by the beneficiaries at the meeting concerning the methodology of the analyses and the specific values in terms of their effects monetarisation. Also summarized are the beneficiaries’ insights into the scope and contents of the supportive studies for the application forms.

In addition this second version incorporates inputs from Jaspers’ CBA Guidelines, as discussed with the Bulgarian authorities.

2 Minimal Requirements to Pre-Investment Studies for CBA Purposes

2.0 Scope and Presentation

Chapter 2 of this document deals with the method of presentation and minimal scope of the pre-investment studies for the performance of a cost and benefits analysis and the financing application forms. The beneficiaries should use these requirements as a basis for drafting detailed terms of reference in preparing the pre-investment studies.

It is anticipated that the projects for which financing application forms will be drafted should have pre-investment studies developed well in advance. In that case the results from the studies will be presented in Part C of the application form as follows:

- Item C.1. contains a discussion of the demand analysis. If the pre-investment study does not include such demand analysis, it should be made in accordance with item 2.2. of this document.

- Item C.2. describes the options investigated in the study as technical parameters;

- Item C.3. discusses the choice of an option and the results are presented as proposed in item 2.4 of this document.

If no pre-investment studies are available, same shall be ordered additionally and they should be executed in compliance with items 2.2, 2.3 and 2.4. The minimal contents of a pre-investment study for the purpose of preparing a cost-benefit analysis are presented in Annex 1.

2.1 Demand Analysis

Generally demand analysis should be project specific as much as possible, normally including the following information:

- Historic traffic volumes for the section (e.g. last 5 years), in terms of vehicles, passenger km and tkm and number of trains/train km (passenger and freight trains);

- Forecasted traffic for "Without the project" option (vehicles; pass. km, tkm, number of trains/train km);

- Forecasted traffic for each of the "With project" options, including existing, diverted (from other modes) and generated traffic (vehicles; pass. km, tkm, number of trains);

- Methodology used for demand analysis and main assumptions used (macroeconomic development, demographic changes, growth rates used, train occupancy, etc.);

- Indication about O/D of the traffic (% transit, O/D and local traffic).

It is recommended that, to the extent possible, the demand is determined through a traffic study. The extent and level of elaboration of such traffic study will depend on the particular features (size, complexity, competition with other transport links, etc.) of each project, but for large projects traffic modelling is expected.

Where for some reason a traffic study is not relevant or can not be done (this will need, however, to be well justified), a rather rough estimation of future demand for transport services could be made by means of social and economic projections.

The following formula may be applied for the purpose:

$$T = POP * GPPC^{E},$$

where:

T is the rate of traffic growth;

POP is the rate of growth of the population in the region being studied;

GPPC is the rate of growth of the regional GDP per capita and

E is the traffic elasticity factor versus income growth.

GDP data by planning regions are available from NSI and EUROSTAT[1]. It is advisable to define the rate of GDP growth by capita for the specific planning regions where the project is located. If there are any specialized studies concerning the project region it would be advisable to use them.

Data on the population by planning regions and areas are available from NSI as well as data on the natural growth in the country. [2]. It is advisable to determine the growth rate of the population on the basis of the population data in the region of the project. If there are any specialized studies concerning the project region it would be advisable to use them.

1 GDP data: http://www.nsi.bg/Gdp/Gdp.htm
2 Population data: http://www.nsi.bg/Population/Population.htm

The elasticity rate E is determined on the basis of historical data on traffic growth, GDP per capita and population.

Road traffic data are available from the Central Roads and Bridges Laboratory at the National Road Infrastructure Fund. Railway traffic data are available from the National Company "Railway Infrastructure".

The demand analysis for the public city transport and subway lines respectively can be carried out by different methods depending on the scope and the available information for the study. In case of availability of transport studies as part of GSDP projecting transported passengers flows, it would be expedient to use them. If there are no such studies as they are very expensive and time-consuming, it is possible to carry out a series of studies to register the current state of things and, through a suitable software, to forecast what number of passengers would use a new subway line. The series of studies includes counting people in public transport as well as stops falling within the scope of the study. "Interview type" surveys including questions on the beginning and end of travel, the respondent' attitude to using the subway line etc. could be used. Such surveys make it possible to obtain partial correspondence matrices to be established in projected or existing public transport or subway networks etc. That approach is not universal and in principle could not be applied equally well to all cases.

Previous specialized studies could also be used to establish demand if they had been completed or updated no less than 5 years prior to the start of the feasibility studies for the specific project.

2.2 Studied Options

2.2.1 *Identification of the Without Project Option*

The Without Project Option (WPO) is the most important option in a CBA using the incremental approach (i.e. comparing the marginal costs of an investment with its marginal benefits) as it forms the reference to which all the investment options in the CBA will be compared. In fact the analysis of the WPO is part of the 'problem definition' step which is essential also for explaining the need and justification of the project.

It must therefore be assessed to the same level of detail as the investment options so that the CBA is a genuine comparison.

Many terms are used in feasibility studies and guidance documents for the scenario to which the investment options are compared. The terms "Do-Nothing Scenario", "Do-Minimum Option", "Reference Case" and "Base Case" are all used but can lead to confusion and can encourage the analyst to compare the investment options with what is considered to be the minimum level of investment, which is not a suitable reference as it is itself an investment option. The authors therefore prefer to adopt the term Without Project Option or WPO which more accurately describes the scenario which is being defined i.e. the level of cost incurred, and the level of performance of the infrastructure predicted, if no investment option is adopted.

The starting point is the condition of the existing road/railway, not just at the time of the analysis but throughout the reference period for which the WPO and investment options will be compared. Some assessment of the existing condition will have been completed in the pre-feasibility stage but possibly not in enough detail to assess the development, over the full period of analysis, of the physical condition of the existing roads/railways, the traffic levels on the relevant part of the network and the costs incurred in keeping it open if the investment does not take place.

To assess what is needed for a full definition of the WPO the effects of the project options need to be considered. If the investment will affect traffic levels on the wider network surrounding the immediate corridor then the future traffic levels on all affected routes need to be predicted for the WPO in order to make a fair comparison.

The operating and maintenance (O&M) costs also need to be assessed in a consistent way between the WPO and project options – using the same unit rates for a particular operation and avoiding comparison of low costs for the WPO (reflecting past expenditure below optimum levels) with full O&M costs for the future investment. This latter error will underestimate the incremental benefits of the investment.

It is also important to ensure that the WPO is realistic and to avoid exaggeration of the deterioration of the condition or congestion on the existing infrastructure by neglecting to include the beneficial effects of unavoidable repairs or other planned investments outside the scope of the current project options (e.g. a key bypass or alternative route already planned)

Table 1. Defining the Without Project Option (WPO)

- **WPO the most important option for use in the incremental approach**
- **Needs a clear assessment of the existing condition and its development over the reference period**
- **Must include forecasts of what happens on all relevant parts of the network which will be affected by the project options**
- **Consistent pricing of O&M costs between WPO and project options**
- **WPO must be realistic and not exaggerate how the existing situation will develop over time**
- **WPO must include the benefits of other planned investments**

2.2.2 *Analysis of Project Options*

The project options are normally studied throughout the following stages:

I. **Pre-feasibility**: reducing a larger number of theoretically possible alternatives to a limited number of worthwhile assessing options.

II. **Feasibility:** assessing in more detail the technical, economical, financial and environmental feasibility of the shortlisted options in view of:

(i) **Selecting the optimal option;**

(ii) **Checking if the selected option is worthwhile financing.**

At the end of the pre-feasibility stage there may be, for very simple projects, a very limited number of options which are technically, legally, environmentally and politically feasible. For a rehabilitation project or a spot improvement one or two investment options, essentially similar but with differences in the standard of improvement, may be all that needs to be analysed in comparison with the Without Project Option.

Table 2 Required Outputs from Pre-feasibility Stage

- Project objectives (what is to be achieved not how to do it e.g. remove congestion)
- Short listed investment options (rehabilitation, reconstruction, new alignment etc)
- Project description for each option
- Reference to key planning documents and decisions which must be respected
- Explanation of how the shortlist was arrived at

However for most projects in the other categories it is unlikely that a single investment option will emerge as the only feasible option. A number of levels of upgrade of an existing road/rail will usually be feasible, a number of alternative alignments and a range of capacities for a new road will be available, several alternative ways of phasing the same project can be investigated and, for potential toll roads, a number of tolling regimes can be tested. In the case of applications for EU funds, even though the CBA results in those sections of the form dealing with economic and financial analysis are those of the chosen solution, the way this option was chosen must be explained in the section of the form calling for a summary of the results of the feasibility study. A failure to compare a sufficient number of options and to fully justify the choice of the one proposed for financing can jeopardise the approval of the application.

Table 3. **Example of typical road development options**

- **Without Project** = maintain the existing road
- **Project options =** improvement of existing infrastructure, e.g.:
  1. **Rehabilitation of existing road** possibly including other improvements such as widening, by-passes, safety measures;
  2. **Construction of a new road ,** which could be (on possibly several alternative alignments):
     - An express-way
     - Staged motorway
     - Full motorway

The short listed options should be described and their key parameters such as length, design speed, carriageway width etc outlined.

Clearly the proposed options should be compliant with such documents as: the National Development Plan, a city or town's spatial development plan, the local development plan for a region, or an integrated public transport development plan where the road provides links to other modes. Any pre-existing planning authorisations and decisions must be respected. For EU funded projects the links to the priority axes and intervention areas in the Operational Programme should be highlighted.

It is also necessary to ensure compatibility with the main options analysed within the EIA – ideally all the principle options reviewed in the CBA would also be covered in the EIA so that the environmental and economic merits can be compared. The EIA would normally provide for mitigation and compensatory measures leading to additional cost elements, which will differ between options. These additional capital and operational costs must be incorporated into the CBA for the respective options.

Notes:

Each of the options analysed within the CBA need to be studied in sufficient detail as to arrive at a reasonably accurate estimate of:

1. Investment (Capital) Costs – including construction cost, land purchase, management costs (including consulting services, etc.).

2. Operation & Maintenance (O&M) Costs

3. Demand (traffic) expected (different investment options may result in different time savings which in turn may result in different traffic levels)

4. Timetable for the preparation and construction of the project

5. If applicable the impact on safety (number of accidents).

6. The project beneficiaries should ensure consistent assumptions are used within the preparation of their various projects, in particular regarding unit costs for construction, operation and maintenance, as well as for traffic estimates.

2.3 Options selection

2.3.1 Pre-feasibility

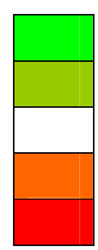
At pre-feasibility stage, the shortlisting of the options could be done through a multi-criteria analysis, including criteria such as:

- □ Objectives: to what extent the options would contribute to the implementation of the specific project and of the programme as a whole.
- □ Demand: to what extent each of the options being discussed would meet the anticipated demand.
- □ Environment: environmental impact of the options – loss of nature, pollution, people exposed to pollution etc.
- □ Economic return (if a preliminary economic analysis exists).
- □ Opportunities: what new opportunities are opened by each option.
- □ Requirements: what time and funds requirements are posed by each option; what other constraints are expected to appear.

Some additional indicators may also be included. In considering the qualitative characteristics it is advisable to also include quantitative indicators wherever possible.

The appraisal of the options under each indicator could be for instance carried out with the help of a five-point scale and presented in colour codes as follows:

- □ Excellent
- □ Good
- □ Neutral
- □ Bad
- □ Very bad



2.3.2 Feasibility

For feasibility stage, it is recommended that the CBA (in particular the economic rate of return) is normally used[3] if not as the sole in any case as one of the main selection criteria.

[3] Except for cases where a particularly special nature of the project makes the CBA inadequate.

3 Basic Parameters for the Analyses

General Assumptions

3.1 Discount Rate for Financial Analysis

In accordance with Working Document № 4 - Guidance on the Methodology for Carrying Out Cost-Benefit Analysis, it is suggested to use *5,0 %.* Any use of a different value should be justified accordingly.

3.2 Discount Rate for Economic Analysis

In accordance with Working Document № 4 - Guidance on the Methodology for Carrying Out Cost-Benefit Analysis, it is suggested to use *5,5 %.* Any use of a different value should be justified accordingly.

3.3 Prices

It is recommended to use fixed (constant) prices - excluding inflation over the entire period of analysis.

3.4 Time Horizon

In accordance with Working Document № 4 - Guidance on the Methodology for Carrying out Cost-Benefit Analysis, it is suggested to use the following time horizons for the different types of infrastructure:

- roads – 30 yeas;
- railway – 30 years;
- subway –30 years.

3.5 Financial to Economic Costs Conversion Coefficients

This requires the elimination of all identifiable fiscal transfer payments from the project cash flow - mainly from the capital expenditure and operating cash flows (revenue and all O&M cost). In the case of transport infrastructure projects, basic transfers include VAT as well as payments involving salaries, pension scheme and other taxes (e.g. fuel tax, etc.).

It is recommended to adjust the value of net financial flows for each year of analysis in two stages. Specification of such calculations is presented in the table below.

Table 4 Stages of adjustment by fiscal effects

Stage	Stages of adjustment by fiscal effects
Stage 1	Elimination of VAT (20%)
Stage 2	See methodology below

The construction value is conventionally divided into components by the following coefficients:

Component	Roads	Railway	Subway
Equipment	8 %	11%	20%
Materials	64 %	61%	54%
Labour	18 %	21%	18%
Other costs (overhead etc.)	10 %	7%	8%

The construction value division coefficients are obtained from the analyses of the unit prices of past construction contracts. To the extent the weight of the individual components may vary depending on the kind of project, proving and using other values is also acceptable.

The costs in the social-economic analysis are converted from financial to economic with the help of standard conversion coefficients (SCC) for the separate components and, more precisely:

- □ Land expropriation SCC = 1,00;
- □ Equipment SCC = 0,95;
- □ Materials SCC = 0,83;
- □ Labour SCC = 0,56;
- □ Other costs (risk, overhead etc..) SCC = 0,83.

3.6 Project Specific Assumptions

The following outputs are required from the traffic analysis <u>distinctly for each project option (alternative)</u>:

- **Traffic volumes** (output of traffic analysis) forecasted distinctly for:
  - Without project scenario;
  - With project scenario, in turn distinctly for:
    - * old traffic (e.g. remaining on old link)

- * diverted traffic (from old link to project link);
- * generated traffic (new traffic generated by the project).

Normally at least three types of vehicles should be considered[4]:

- □ Passenger cars – weighing up to 3.5 tons;
- □ Light/heavy goods vehicles – weighing over 3.5 tons.
- □ Busses (passenger vehicles with more than 7 seats)

Normally, the traffic should be further divided depending on the purpose of the travel (business/non-business) as the unit value of time is substantially different between the two categories. However, in the absence of travel purpose data a 50-50% split between business and non-business could be roughly assumed.

- **Traffic speeds and journey times** for without project scenario and investment options per type of vehicle and road section.

  Very important, the journey times should be determined as travel times actually achievable considering all the relevant operational constraints and not just on the basis of the engineering design speed.

  Whilst this distinction is particularly relevant for railway where journey times are significantly conditioned by other factors such as the trains timetable, the operation regime of the line, the rolling stock available, etc., the point may be relevant for roads as well e.g. if the local traffic regulations may impose different limits than the engineering design speed.

- **Number of passengers/vehicles**

  Road

  The saturation rates may vary depending on the project location and other values can also be used after counts. In the absence of any counts for trucks and busses the rates adopted should be conservative. In the absence of any specific studies of saturation rates in the project area in out-of-city travel the use of the following rates is suggested:

  - □ Motor cars[5] – 2;

[4] This differentiation is compliant with the recommendations in HEATCO 2007.

- □ Heavy trucks – 1;
- □ Buses – 25.

Since the level of motorisation is expected to increase over time, the vehicle occupancy rate for cars may be adjusted over the appraisal period e.g. reducing the average passengers per car linearly over the 30 years of the appraisal period up to the western european average i.e. not exceeding 1.5.

Railway

The railway traffic expressed in number of passengers should normally be determined on the basis of ticket sales per route which reflects the actual rather than theoretical demand for a specific transport service.

Alternatively, if for some reason specific data are not available for the actual rail route studied, average occupancy rates per train can be used, as determined by the Bulgarian authorities:

- □ For diesel trains – 123 people;
- □ For carriage trains (EMUs? to be checked by BG Railway authorities – 106 people.

- **Accident ratios** (for without the project scenario and investment options).
- **Capital and O&M cost estimates** (see chapter 4 below).

[5] Source: Trifonov, I, Anastasov, T. , 2007. Measurement automobile for solution of road dynamic tasks. Report to a jubilee conference on the occasion of the anniversary of UACG.

4 Investment Expenditures Costing

4.1 Investment (Capital) Costs

In so far as the findings of the financial and economic analyses are sensitive to investment expenditures costing (construction costs being their major part), it is necessary to pay special attention to construction works costing.

Where only a concept project is available it is suggested that the costing be carried out in accordance with the following aggregate indicators:

- □ Net price of the structure down to road bed (road, railway etc.);
- □ Price of earthwork (calculated separately for ditches, embankments and some specific cases, i.e. ditches dug in rock);
- □ Price of fortifications (support walls etc.);
- □ Price of big facilities (underpasses, overhead crossings, viaducts, bridges, tunnels);
- □ Price of small facilities (drain pipes);
- □ Price of a railway electrification system;
- □ Price of signalization, telecommunications and lighting;
- □ Price of green layout;
- □ Other specific (and expensive) construction activities;
- □ Other price components.

Where a technical or working project is available, costing of works by amounts of aggregated quantitative accounts is obligatory.

In order to perform the costing it is necessary to set unit prices for the separate components of the construction value (through aggregate or unit prices).

To estimate the prices, it is recommended that a pool of recently completed contracts (which are final prices i.e. including overruns) and recently completed tenders is used for reference.

The pool of recently completed contracts is particularly useful in order to estimate the average overruns between the tender/initial contract price and the final price of the construction.

The pool of recently competed tenders is important as it reflects the updated market status. This is particularly important as significant changes may have occurred in the prices of base materials and labour and the old prices may not be suitable any more. It is not recommended to use prices dating back to more than 2 years (counting from the base date which in this case could be the date of signing the construction contract) and not by any means use prices older than 4 years. According to a survey by Industry Watch at the end of 2006 the prices of construction works rise by about 5.4 % annually. The analysis should include some reserves for such a price increase at the presumed start of the construction activities.

The reference prices from recent tenders should be the prices of the winning tenders – i.e. actually contracted prices.

If dayworks are envisaged to be included in the construction contract, it is suggested that the direct construction value be increased by 1-2%.

4.2 Amount of Contingency Costs

The previous experience of the beneficiaries with projects implemented under EU pre-accession instruments provides grounds to adopt the following recommended values for contingencies as a per cent of the construction works value:

- Low-risk projects (i.e. road rehabilitation) – 10 to 15 %;
- Medium and high-risk projects (i.e. new roads construction, new railway construction, subway construction) – 15 to 20 %.

In certain cases it is admissible to increase the amount of contingencies – where the project carries high risks and there are specific requirements in this regard, i.e. envisaging project updating at a certain stage depending on the conditions found in the course of construction.

Where costing concerns a concept project it is suggested that the percentage of contingencies normally applied could be raised by 5%.

One should be aware of the difference between the amount of contingencies under the construction contract and the amount of contingencies relative to the total investment value of the project (separate budget line in the application form). Contingencies relative to the investment value include the amount of contingencies under the construction contract and, according to the application form footnote 16 and Working Document no. 4 <u>are only eligible within a limit of 10 per cent of the total investment value</u>.

It should be also mentioned that according to WD 4 contingencies may be included as eligible costs only if supported by detailed risk analysis, but in any case they will not be included in the funding gap calculation.

Distinction should be made as well between contingencies[6] and price adjustment[7], the later covering the inflation over the implementation period (where the appraisal is carried out in constant prices).

It practically means that:

- The eligible cost of table H.2.1[8] may include contingency, price adjustment and the eligible VAT (carrying forward the cell C12 of table H.1), whilst
- The total investment cost of table E.1.2 shall exclude VAT, contingency and price adjustment (carrying forward the out of table H.1 the difference between cells A10 and cells A5+A6).

4.3 Maintenance and Operating Costs

Roads

The maintenance and operating costs include the annual expenditures for routine maintenance of the road section and the costs of regular repairs and road fortification.

The maintenance costs presented below have been calculated by Bulgarian and Dutch experts within the framework of the "Partnership for Roads" Programme for the period of 2005-2007 as an attempt at their definition in terms of road maintenance on a base level.

Activity			Motorway	I class	II class	III class
			A35, A32.5, A29.5, A29, Г20	Г12, Г10.5	Г9, Г8	Г6
Routine	Routine maintenance	BGN/km	18 500	1 700	1 400	750
		€/km	9 487	872	718	385
	Winter maintenance	BGN/km	31 500	2 900	2 400	1 250
		€/km	16 154	1 487	1 231	641
	Total routine and winter	*BGN/km*	*50 000*	*4 600*	*3 800*	*2 000*
		€/km	*25 641*	*2 359*	*1 949*	*1 026*
Periodical	Rehabilitation	BGN/km	400 000	125 000	100 000	60 000
		€/km	205 128	64 103	51 282	30 769
	Structural	BGN/km	1 700 000	600 000	500 000	300 000
		€/km	871 795	307 692	256 410	153 846

[6] Line 5 of the Cost breakdown table H.1 of the Annex XXI Application Form
[7] Line 6 of the Cost breakdown table H.1 of the Annex XXI Application Form
[8] Annex XXI Application Form

In accordance with the common practices in Bulgaria it should be assumed in the analyses that rehabilitation should take place in 7-year periods and fortification – a single time in the time horizon in the 14th year since site commissioning. In case of absence of any data for the last rehabilitation year, it should be assumed that the first rehabilitation would take place in the base year.

Similarly to investments costs, the operating costs are divided into three groups: equipment, materials and labour costs for their subsequent conversion to economic.

Railway Infrastructure

The maintenance and operating costs cover both the routine (annual) maintenance as well as the costs of the regular rehabilitation/replacement works[9] necessary over the appraisal period for all elements of railway infrastructure – rail road and facilities, power network and engineering, signalization and telecommunications as well as the train traffic management costs. In compliance with the legal framework annual maintenance activities and current repairs are also included as a total value. Analytical historical data are provided by NC "Railway Infrastructure" from the cost budgeting system by railway network sections.

4.4 Expropriation Costs

The expropriation costs are determined by independent licensed evaluators or licensed business performance evaluation companies in compliance with the Business Evaluation Standards (BES)

For urbanized territories the evaluation is made in compliance with BES for realties or whole enterprises if their liquidation is made necessary in the course of expropriation procedures.

The evaluation of farm lands is performed in compliance with the regulations on the Terms and Conditions of Setting Current Market Prices for Farm lands adopted with DCM № 118 dated 26.05.1998, promulgated SG, issue 64 dated 5 June 1998, amended SG, issue 63 dated 13 July 1999, amended SG, issue 98 dated 1 December 2000, amended SG, issue 41 dated 24 April 2001, amended SG, issue 44 dated 8 may 2001, amended SG, issue 96 dated 11 October 2002, amended SG, issue 31 dated 4 April 2003, amended issue 59 dated 19 July 2005, amended SG, issue 75 dated 12 September 2006, amended SG, issue 78 dated 26 September 2006, amended SG, issue .62 dated 31 July 2007.

[9] Irrespective whether for national accounting purposes such works are classified as investment.

Evaluation for expropriation of farm lands with perennial plantations is also carried out in compliance with Regulations on Base Prices of Perennial Plantations adopted with DCM № 151 dated 30.07.1991, promulgated SG issue 65 dated 9 August 1991, amended SG, issue.84 dated 11 October 1991, amended SG. issue 107 dated 28 December 2000, amended SG, issue 81 dated 12 September 2003.

For expropriation of forests and land from the Forestry Fund evaluations are made in compliance with Regulations 32 issued by the Ministry of Agriculture and Forests, dated 26.06.2001, promulgated SG, issue 57/2001.

4.5 Project Management Costs

Project management costs are acceptable. For reference should be used National Council of Ministers' Decree No 194/2007 for Management of the Implementation of Infrastructure Projects financed with EU Funds. 4.6 Project Residual Value

The residual value of the assets subject to the investment project is determined in compliance with the provisions of the Bulgarian legislation (Accountancy Act, Corporate Taxation Act etc.) and the depreciation policies of the beneficiaries.

Depending on the depreciation rates set or adopted in accordance with the depreciation policy the asset value is determined by the end of the projection period as the value between the initial investment value as of the date of site commissioning and the depreciation accrued up to that point of time. Where assets can be recovered in more than one single time over the period of projection, they are incorporated with their total investment value.

If there is no obligation to account for depreciation deductions the residual value is determined as a percentage of asset life. The transport infrastructure and its facilities (tunnels, bridges, overhead crossings, underpasses, viaducts etc.) have an average set life of 50 years; consequently in a projection of 30 years a 30% residual asset value could be allowed. Nevertheless, depending on the actual features of the project in question, the life cycle and consequent residual value could vary significantly.

4.6 Biodiversity Preservation Measures Costing

If the evaluation is made before receiving the EIE decision prescribing environmental protection measures, the assumed value of the measures should be between 2 and 6% of the construction works value.

Should the evaluation be performed after obtaining an EIE decision, it is advisable to cost the measures (in compliance with item 4.1) and to calculate what percentage of the construction value they represent.

If the evaluation is performed after selecting a contractor and the measures are included in the scope of construction works, the value of the quantitative estimate as part of the contract should be used.

In all cases it is necessary to clarify the mechanism for implementation of the measures for protection of the environment – whether they are included in the contract for construction or will be added in addition or implemented under a separate contract.

5 Economic Impacts: Costs and Benefits

5.1 Definitions and elements of approach

The economic analysis aims at comparing the impact of the project to the overall society in terms of both costs and benefits. In order to do so, the impacts need to be expressed in monetary terms, which in particular for external impacts (e.g. impact on safety, on environment, etc.), requires the use of certain methodological conventions accepted at EU scale - and this chapter aims at providing guidance in this respect.

Normally the impact of transport projects is analysed at the following levels:

Table 5 Impacts on various levels/groups

Net Impacts (Costs or Benefits) to:	ROAD	RAIL	SUBWAY
A. Infrastructure Managers (Government)			
	Capital costs	Capital costs	Capital costs
	Maintenance & Operation Costs	Maintenance & Operation Costs	Maintenance & Operation Costs
B. Users			
	Time (VoT)	Time (VoT)	Time (VoT)
	Vehicle Operating Costs (VoC)		…
C. Providers (operators)			
		Vehicle Operating Costs (VoC)	Vehicle Operating Costs (VoC)
D. Wider society (externalities):			
Safety			
	Accidents costs savings	Accidents costs savings	Accidents costs savings
Environment			
	Air pollution	Air pollution	Air pollution
	Climate Change	Climate Change	Climate Change

Notes:

1. The table structures the main types of impacts expected in typical road and railway infrastructure projects. For other modes, given the heterogeneous nature of possible projects, even if the table cannot capture the variety of possible situations, the same conceptual framework should apply in appraisal.
2. Charges, tolls, fares and related revenues should be left outside the economic analysis (but they should be treated in the traffic and financial analyses!) because at consolidated system level their effect is typically neutral[10].
3. On a case-by-case basis, depending on the particular features of the project in question, other impacts (e.g. external effects associated with the noise and congestion which are relevant for urban projects) could be included in the appraisal. However, where such impacts are included in analysis, the detailed way they are monetised (including unit economic values used) must be presented transparently. If clear and precise assumptions are not available, such additional impacts should not be included in the economic analysis.
4. As the analysis is done incrementally (difference between 'with project' and 'without project' scenario, the negative changes (e.g. additional capital or O&M or environment costs) are economic costs whilst the positive changes (e.g. savings in O&M or savings of travel time or savings in accident costs) are economic benefits of the project.

5.3 Impacts of Infrastructure Managers

These are essentially the incremental capital (investment) and O&M costs of the project. Guidance on the estimation of these costs has been given under chapter 4 of this document.

On top of that, the economic analysis requires application of fiscal corrections as to convert the market into economic prices – see chapter 3.5 above.

5.4 Transport Users Benefits

The first part of the analysis should aim at estimating the transport **users'** benefits. In doing so the following approach is recommended[11]:

'The calculation of transport user benefits is based on the conventional *consumer surplus theory*.

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[10] E.g. Railway ticket revenues would be benefits for the operators but costs for users – net effect 0. Railway track access charging would be benefit for the infrastructure manager but cost for operators – net effect 0.

[11] Source: UK DfT – Transport Analysis Guidance (with certain simplifications and adjustments): http://www.webtag.org.uk/webdocuments/3_Expert/5_Economy_Objective/3.5.3.htm

The transport system exists in order to facilitate a range of activities in the economy and in society at large. Those who use the transport system do so because the inconvenience of having to travel from one location to another is outweighed by the opportunities and potential benefits which arise at the destination.

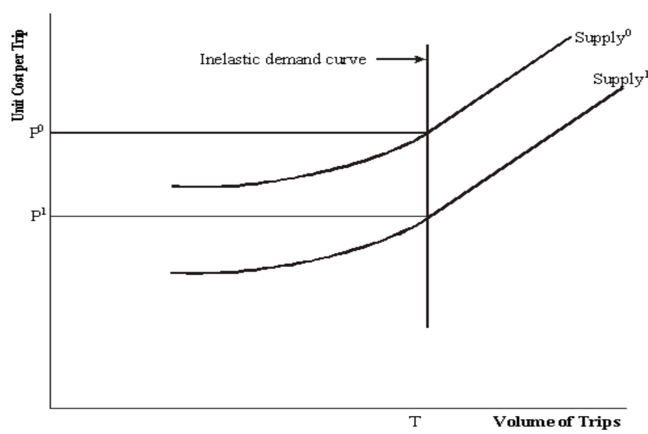
Changes in the transport system give rise to changes in the perceived cost of personal travel and freight movement from certain points of origin to certain destinations. This perceived cost is a broadly defined measure of the inconvenience to the user of moving between two points, and includes changes in money costs (such as fares, tolls and expenditure on car fuel). The items to be included when estimating changes in perceived cost for a particular journey are:

- changes in travel time;
- changes in vehicle operating costs met by the users and
- changes in user charges, including fares, tariffs and tolls[12].

> ***'Consumer surplus'*** is defined as the benefit which a consumer enjoys, in excess of the costs which he or she perceives. For example, if a journey would be undertaken by a traveller provided it takes no more than 20 minutes, but not if it takes more than 20 minutes, then the total value of the journey is equivalent to the cost to that traveller of 20 minutes of travel time. If actual travel time for the journey is only 15 minutes, then the traveller enjoys a surplus of 5 minutes. If a new proposal reduces travel time further, to 12 minutes, then the increase in consumer surplus from the proposal is 3 minutes.

Across all travellers, the change in consumer surplus is the difference between the change in the total benefit enjoyed and the change in the costs perceived. In the simplest case, where time or money costs change, but demand stays the same, the total change in consumer surplus shown in Figure 1 equals:

Figure1. Simple change in consumer surplus



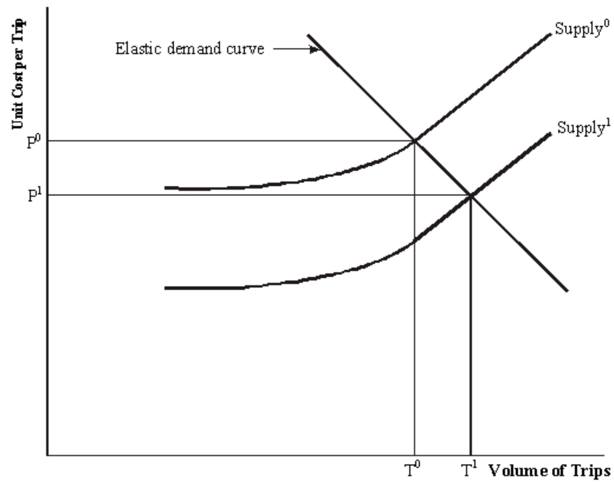
[12] See note 2 page 6 above – charges are to be excluded from the economic calculation.

change in cost * number of travellers $= (P^0 - P^1)*T$

where P^i is the perceived cost of travel (note that the superscript i is used to denote the scenario - 0 for 'Without Project', 1 for 'With Project'), and T is the number of travellers (traffic volume).

Where, as is more usual, demand changes in response to the increase or decrease in costs, there is an additional impact on new or lost travellers. With relatively small changes in costs, the convention is to attribute half of the change in costs to the trips lost or gained. The total change in consumer surplus, shown in Figure 2 then becomes:

Figure 2. C change in consumer surplus



(change in cost*without project demand) + (half change in costs * change in demand)

$$= (P^0 - P^1)T^0 + \frac{1}{2}(P^0 - P^1)(T^1 - T^0)$$

$$= \frac{1}{2}(T^0 + T^1)(P^0 - P^1)$$

This convention is known as **the 'rule of half'**, and assumes implicitly that there is a linear relationship between the cost of travel and demand[13].

In general, the true situation is highly complex compared with the above. The main substitutes and complements for travel from A to B are travel from A to other destinations, by other modes, using other routes and so on. Notwithstanding this, provided that consistency can be achieved between the pattern of travel demand

[13] If this is not the case, and the demand curve is convex to the origin, then the rule of half will tend to overstate the benefits. With very small changes in cost, the inaccuracy is not significant and this simplification can be used without problems.

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and the outturn costs - and this is key for the evaluation - the rule of a half formula can be extended to cover network appraisal with many modes and origin/destination pairs.

The extent to which the appraisal is disaggregated by mode, purpose, vehicle type, time period, vehicle availability or other category will be for analysts to decide. Whatever choice is made, the following calculations are applicable to the trip matrix for each category.

It is, however, important to **distinguish between work and non-work trips**, essentially because the unit values of time are different between work and non-work travel purposes.

Terms and definitions.

Superscript i - denotes the scenario:

'0'	= 'without project'
'1, 2, etc.'	= 'with project option 1, 2, etc.'
TUB	transport users benefis
S^i_{ij}	consumer surplus for travellers between i and j;
P^i_{ij}	perceived cost of trip between i and j;
VoC^i_{ij}	vehicle operating costs (fuel, tyres, maintenance, etc.) of road trips between i and j
VoT^i_{ij}	'perceived' time cost between i and j (note that $VoT^i_{ij} = J^i_{ij} * K_T$)
J^i_{ij}	journey time between i and j
T^i_{ij}	number of trips (traffic) between i and j;
K_T	(unit) value of time.

The user benefits should be calculated as follows:

$$\mathbf{TUB^1 = (S^1 - S^0)}$$

The terms (S^1 - S^0) are the increase in consumer surplus, calculated for transport appraisal using the rule of half:

$$(S^1 - S^0) = \tfrac{1}{2} \sum_{ij} (T^1_{ij} + T^0_{ij})(P^0_{ij} - P^1_{ij})$$

where T^i_{ij} is the number of trips from i to j.

The general definition of perceived costs is:

$$P^i = VoC^i + VoT^i$$

(The ij subscripts have been omitted from these equations, for simplicity.).

Disaggregating user benefits. The calculations outlined above will produce the *overall* user benefit. This must be disaggregated into the following components: time and vehicle operating costs. This should be done by disaggregating perceived cost and applying the above procedures to each component separately.

Thus, the disaggregated **transport user benefits** are given by the following:

Vehicle operating costs: $\frac{1}{2} \sum_{ij} (T^1_{ij} + T^0_{ij})(VoC^0_{ij} - VoC^1_{ij})$

Travel time: $\frac{1}{2} \sum_{ij} (T^1_{ij} + T^0_{ij})(VoT^0_{ij} - VoT^1_{ij})$

5.4.1 Vehicle Operating Costs

These costs (VOC) depend on a number of variables, such as (for road sector):

- Category of vehicle - standard categories of vehicles include: passenger cars, light goods vehicles (LGV), heavy goods vehicles (HGV), busses;
- Cruise speed on the respective road section/sections, which in turn depends on a number of variables, including traffic;
- Condition of road surface – typically measured with the International Roughness Index (IRI);
- Other characteristics of the road (longitudinal sloping, etc.).

The HDM 4 software which is apparently used for road projects in Bulgaria includes a good module for the calculation of VOC, provided the input data (e.g. IRI of existing road, traffic structure, fuel price, etc.) is reasonable accurate and up-to-date.

HDM 4 may be therefore used for calculating VOC in road projects, but alternatively the VoC can be calculated manually or with other models as well. Regular updates should be however ensured to the main inputs parameters (such as fuel, tyres, service, wage costs, etc.).

For other modes there are no standard models, but the estimation of operating costs normally accounts for:

- Impact on energy consumption;
- Impact on personnel costs (wages);
- Impact on vehicle maintenance.

The calculation shall be done for each scenario (WPO and IO), separately for each type of vehicle, for each year over the entire period of the economic analysis.

5.4.2 *Value of Time Costs*

The (perceived) value of time costs depends on:

- The journey time, which in turn is a function of distance and speed;
- The (unit) value of time.

$$VoT^{i}_{ij} = J^{i}_{ij} * K_T$$

where:

J^{i}_{ij} = journey time between i and j;
K_T = (unit) value of time;

Journey time

Just as for VoC, the journey time will need to be forecasted within the traffic analysis distinctly for the 'without project' and each of the project options and then taken as input assumption within the economic calculations.

The unit value of time

As for the other elements of the transport user benefits, the analysis has to discriminate between business and non-business trips.

Within the transport economics theory there are a number of different methods for estimating the unit value of time in a given country or region. Typical examples are calculation methods based on wage (resource-input cost), GDP/capita (product-output value), willingness to pay (revealed or stated preferences), etc.

In our opinion the most relevant study is HEATCO, 2006[14]. The study, funded by the European Commission, aimed at providing harmonised methodologies for the evaluation of transport project within the EU-25 Member States. It recommends both best-practice methodologies for the calculation of national specific values (such as value of time or value of accident savings, etc.) as well as actual values calculated within the study that could be used directly in the absence of other national research.

Unfortunately, Bulgaria and Romania were not part of this study and therefore there are no actual values that could be taken directly from the study.

The methodologies recommended could, however, be used for carrying out national research (such as stated-preferences for value of time or value of accidents).

Nevertheless, on short-run, until accurate national research data are available in Bulgaria and Romania, Jaspers proposes the following values, estimated through linear regression from the values recommended by HEATCO for comparable new EU MS.

Unit Value of Time Saved, base year *2007* **Road & Rail Modes**

K_T Business (EUR/passenger/hour)	K_T Non-business (EUR/passenger/hour)	K_T Freight (EUR/tonne/hour)
11.19	**4.13**	**0.71**

Annex A presents more detailed data, including calculation methodology.

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[14] Developing Harmonised European Approaches for Transport Costing and Project Assessment, available at: http://heatco.ier.uni-stuttgart.de/

Notes:

1. These values should be adjusted over the appraisal period on the basis of **elasticity** to growth of GDP/capita **of 0.7** i.e. using 70% of GDP/capita growth rate).

2. For calculation purpose, the traffic volumes (normally expressed as AADT) shall be multiplied with:

✓The vehicle occupancy rate (average number of passenger per vehicle) – this is normally determined through local or national road surveys. Alternatively, in the absence of specific data, the values provided on page 12 above could be used.

and with

✓365 days,

to obtain the total yearly passenger traffic to be further multiplied with the unit value of time.

3. In case the traffic share in terms of business/non-business is not available out of the traffic study, a rough 50/50 share could be assumed.

4. The calculation of the time saving benefits (using the rule of half formula above) shall be calculated per each vehicle category and subsequently consolidated.

5.5 Transport Providers Benefits

This analysis of the impact on the transport providers (operators) is particularly relevant for the railway sector.

For the road sector, given the private transport accounts for the large majority of passenger traffic, a separate analysis for the public transport users and providers is generally not required, treating for simplicity the public transport operators as users.

In the railway sector, however, the impacts on the operators (Train Operating Costs) are very important and need to be treated distinctly.

5.6 External Impacts

The most important external impacts (common to most e.g. road and rail projects) are:

1. On accidents;
2. On environment, in particular in terms of:
    (a) Air pollution;
    (b) Climate change.

In addition, particular projects (e.g. urban transport) may need to take account of other external impacts.

The table below inventories these possible external effects:

Table 6. External Impacts

Category	Cost Elements	Problems to Evaluate	Main Factors
Accidents	Medical costs Loss of human life	Price of human life Type of injury Place of accident	Type of infrastructure Volume of traffic Vehicle speed Driver's characteristics (years, state of health etc.)
Air pollution	Health costs Lost years of human life Loss of crops Damages to buildings Nature and biosphere costs	Lost years of human life Market prices of the crops Damages to buildings Long-term hazards in the biosphere	Population density Place sensitivity Level of emissions depending on: - Vehicle type and condition - Length of travel - Type of infrastructure - place - speed
Climate change	Prevention costs to reduce the hazards of climate change Cost of damages incurred due to the rise of temperature	Long-term hazards of climate change, Level of emissions	The levels of emissions depend on: - vehicle type and additional equipment (i.e. air conditioner) - speed - manner of driving - use of fuel and type of fuel
Noise	Loss of rentals Irritations/discomfort costs Health costs	Irritations	Density of population Day/night Level of noise depending on: -type of infrastructure - vehicle type and condition
Traffic jams (congestion)	Price of time Safety and environmental costs	Flow speed Economic linkage of the price of time	Type of infrastructure The traffic and level of capacity depend primarily on: - time of day -place -accidents

Category	Cost Elements	Problems to Evaluate	Main Factors
			-construction
Absence of service costs (for transport according to timetable)	Costs of: - delay -lost opportunities - loss of time for other traffic users	Level of traffic Capacity of the infrastructure segment	Type of infrastructure The traffic and level of capacity depend primarily on: - time of day -place
Nature and change of landscape/environment	Costs of reducing the impact effects Compensatory costs for provision of biodiversity	Basically related to the type of infrastructure, does not depend so much on the volume of traffic	Type of infrastructure Place sensitivity
Additional environmental costs for the environment (water and soil pollution)	Costs of providing quality soil and water	Related to the volumes of traffic	Type of infrastructure Levels of emissions

The values of the individual categories of external (economic) costs for Bulgaria are generally determined on the basis of the mean values of the relevant costs for the EU-member countries as indicated in the *Handbook on estimation of external cost in the transport sector (Version 1.0, December 2007)*. The values are re-estimated for Bulgaria following the methodology set forth in the Handbook and, more specifically:

- the mean values for the EU-member countries in prices in the relevant year are re-calculated for Bulgaria on the basis of GDP per capita for the same year;
- the values for Bulgaria thus obtained are estimated for the next years up to 2007, taking into account the average GDP growth per capita for the country (Table 2).

Table 7. Real GDP Growth per Capita.

Year	2001	2002	2003	2004	2005	2006	2007
Real GDP growth per capita	9.9%	5.9%	1.9%	8.7%	4.3%	8.8%	3.2%

5.6.1 Impact on safety (accidents)

The impact of the project on safety is particularly relevant for:

- ✓ **Road** projects;
- ✓ Projects in other modes (in particular **railways**) – to the extent the project would affect the traffic on a competing road (by diverting certain traffic that without project would use the road to railway).

The costs of expected accidents and casualties shall be determined for each scenario, including:

- Costs of fatalities
- Costs of severe injuries
- Costs of slight injuries

The costs of road accidents normally include the overall costs of an accident to the society, including direct and indirect economic costs (lost output, medical costs, legal and emergency service costs, material damages, etc.) as well as the value of safety (statistical value of life) per se.

Further to the estimation of such costs, aggregated accident unit values are determined and used, which are then multiplied with the number of occurrences (fatalities/severe injuries/light injuries) forecasted for both scenarios (WOP and WP), following the formula below:

Table 15 Formula for calculating costs of road accidents and casualties

$$ASB = VoA^0 - VoA^1$$

$$VoA = (K_f * a_f) + (K_{sj} * a_{sj}) + (K_{li} * a_{li})$$

where:
Superscript i denotes the scenario:
'0' = 'without project'
'1, 2, etc.' = 'with project option 1, 2, etc.'

ASB - Accident Savings Benefits
VoA - Value of Accidents (aggregated) for a given year, EUR
K_f - unit costs of a fatality in a given year, in EUR,
K_{sj} - unit costs of severe injuries in a given year, in EUR,
K_{li} - unit costs of light injuries in a given year in EUR,
a_f - number of fatalities in a given year,
a_{sj} - number of severely injured persons in a given year,
ali - number of lightly injured persons in a given year.

5.6.1.1 Estimating the unit value of accidents

The accident values recommended for Bulgaria within the CBA Guide 2008 issued by EC DG Regio, are listed and below and shall be used in the economic analyses:

Table 8. Unit cost of accidents

	Fatal	Severe	Light
Euro	573,646	78,951	5,670

The table below presents the costs for road traffic accidents per vehicle/km in different travel environment conditions and for different vehicle types, as estimated for Bulgaria on the basis of the *Handbook on estimation of external cost in the transport sector, Version 1.0, December 2007*.

Table 9. Cost of Road Traffic Accidents in Bulgaria

Travel by Car	**Measure**	**Value 2007**
City conditions	€ct/vkm	1.87
Highway	€ct/vkm	0.14
Other roads	€ct/vkm	0.71
Travel by Motorcycle		
City conditions	€ct/vkm	13.75
Highway	€ct/vkm	0.09
Other roads	€ct/vkm	2.45
Travel by Heavy Trucks		
City conditions	€ct/vkm	4.77
Highway	€ct/vkm	0.14
Other roads	€ct/vkm	1.21

* €ct/vkm –euro cent per vehicle per kilometre

Note:
The values should be adjusted over the appraisal period on the basis of **elasticity** to growth of GDP/capita of **0.7**.

5.6.1.2 Estimating the number of accidents

For road projects

The first step is collecting statistics[15] of the actual number of road accident occurrences within preferably past 5 but minimum 3 years broken down into fatalities and severe/light injuries.

For WOP scenario forecasting should be done through extrapolation of the past trend following the forecasted traffic over the appraisal period, considering however in the same time the positive effect on safety generated by 'congestion effects' (which lead to a reduction in speed and in turn to decrease of the accidents risk).

For WP scenarios, forecasting would depend on the type of the project – rehabilitation of an existing road or new motorway.

For new motorways, an adjustment factor based on the average accident rate on existing comparable motorways in the country/region (per vehicle/km) is recommended. This requires as well colleting statistical data on past accidents track on such comparable motorways normally over 5 but minimum over 3 years.

Alternatively in case data on actual accident numbers are not available, a simplified approach can be followed, using average values per vehicle/km per mode and type of infrastructure from international studies (table 9 above).

For spot improvements/rehabilitations, adjustment factors determined in Poland are provided as indicative benchmark in annex B for various types of rehabilitation features.

For railway projects

The savings of accident costs generated (without project) by the additional traffic on a competing road could be estimated on the basis of actual accident records for that road section compared with average railway accidents rate in Bulgaria – which is the most accurate method.

Alternatively, in case data on actual accident numbers are not available, a simplified approach can be followed, using an average differential ratio of accident cost between modes (per vehicle/passengers km). On the basis of international studies such as (*INFRAS/IWW, 2004*) a ratio of 1:40 (rail:road) could be used.

5.7 Air Pollution Costs

All air pollution costs are caused by the principal air pollutants – dust particles PM, NOx, SO_2 and volatile organic compounds (VOC). The costs incurred by air pollution include:

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[15] Normally such statistics should be available from Road Traffic Police or Roads Infrastructure Manager.

- Health costs,
- Material damages,
- Loss of crops,
- Losses caused by damages incurred on the ecosystems (biosphere, soils, water).

Health costs are the most important category. Therefore a key factor for air pollution costs are the proximity and density of the population exposed to transport pollution.

For road transport the level of costs depends on the vehicle standard emission, determined by the year of manufacture. Furthermore, the level of emissions released by the vehicle depends on speed, type of fuel, technology of burning, factor of loading, vehicle size and the geographical location of the road.

In railway transport the key factors influencing costs are speed of movement, type of fuel, factor of loading and geographical location.

The most important factor in air transport is the type of engine.

The key factors influencing costs in water transport are type of engine, type of vessel, fuel quality and direction (against the stream or downstream).

The air pollution costs for road, railway, air and water transport in Bulgaria for different kinds of pollutants are shown on Table 7. The values presented are based on a model accounting for the different population density in the different regions of the country, the specific meteorological conditions and the traffic structure in 2000. The values for 2007 are determined taking account of the real GDP growth per capita for the country.

Table 10. Air pollution costs in road, railway air and water transport

Pollutant	Measure	2000	2007
NOx	€/ton	1800	2717
NVOC	€/ton	200	302
SO_2	€/ton	1000	1510
PM2.5	€/ton	43000	64912
PM10	€/ton	17200	25965

If the vehicle emission factor is known the damages costs presented in Table 7 can be directly applied to obtain the specific costs in €/vkm.

5.8 Climate Change Costs

The climate change costs have a high level of complexity in view of the fact that they are long-term, global and it is very difficult to predict hazards. Therefore it is difficult to estimate transport damages on a national level.

The impact of transport on global warming is due primarily to greenhouse gases carbon dioxide (CO_2), nitric oxide (N_2O) and methane (CH_4). No less significant are the hydro-flour-hydrogen compounds from vehicle air conditioners. Among emissions released by aviation in the highest layers of the atmosphere water steam, sulphates, aerosols and nitric oxides have the highest impact.

Table 11. Average costs of climate change

	Measure	Average for EU-15, 2000 *	2007
Climate change, city, petrol	Ect/vkm	0.67	0.3

* Euroct/vkm –euro cent per vehicle per kilometre

Cost estimation per vehicle per kilometre for a specific type of vehicle and traffic is a simple multiplication of vehicle emissions per kilometre and the cost factor for the specific type of emissions. Today the average costs of released CO_2 emissions per vehicle in the world are about 200 gr/кm. At a price of 25 euro/ton CO_2, that makes 0.005 €/km. By 2030 these numbers will be 120 gr/кm, 55 €/tons CO_2, or 0.007 euro/km.

The average price of one ton CO_2 in the second period of the European emissions trade scheme (2008 - 2012) will be 20-25 euro/ton. The prices of carbon credits are linked with the goals of the Kyoto Protocol. The latest objectives after the period of the Kyoto Protocol envisage a higher percentage of reduction of the carbon emissions, (20-30% reduction in 2020 as compared to 1990), resulting in a gradual rise of the price per ton of CO_2.

Table 12. Expected prices per ton of CO_2.

	Year	2010	2020	2030	2040	2050
Climate change, average	€/ton CO_2	25	40	55	70	85

5.9 Costs of Traffic Jams and Lack of Transport

Note: *It is recommended to include this impact in the analysis only for urban environment projects.*

Depending on the type of transport, type of users, infrastructure characteristics, travel time and alternative activities the effect of traffic jams may differ:

- The price of time is rising. That is the most important component of traffic jams. Applying the standard estimations of travel time, that category is responsible for 90% of the economic costs of traffic jams;

- Costs of vehicle maintenance and operation;

- The discomforts in the congested systems are related to traffic jams on the road and in public transport;

- Additional fuel costs;

- Reliability: longer delays as compared with the standard time of arrival on site by the respective vehicle are generally linked with unreliability of travel time caused by traffic jams;

- Costs of lack of transport service. That phenomenon is linked with the access to the regulated infrastructure following a timetable. The costs are related to the impossibility of service provision on time, i.e. hour of arrival and departure.

For calculation of time and vehicle operating costs savings, see sections 4.3.1 and 4.3.2 above.

5.10 Noise Costs

> ***Note:*** *It is recommended to include this impact in the analysis only for urban environment projects.*

Noise can be defined as undesirable sound or sounds of different duration, intensity and other characteristics causing mental disabilities in people. In general 2 kinds of negative impacts of noise in transport can be differentiated:

- Irritation costs – usually resulting in economic and social costs as restrictions on rest activities, discomfort and inconvenience and based on the preferences of the individual.

- Health costs – transport noise may also cause physical injuries of human health, such as hearing disabilities (at levels over 85 dB(A) and at lower levels of noise (over 60 dB(A)) – stress, palpitation, high blood tension, hormonal alterations, impaired sleep quality etc. The negative impact of noise on human health results in different kinds of costs such as medical costs, costs through lost productivity and higher mortality. Air transport has an additional negative impact: many governments establish the so-called "cordons sanitaires" around locations as strong sources of noise. Land use in such locations is prohibited, for example, the construction of new buildings.

There are three key factors that determine noise costs:

- Time of the day: irritations at night are much stronger than during the day;
- Population density near the source of noise;
- Existing noise level: depending on traffic volume, type and speed.

Roads

Noise depends on vehicle speed, type (share of trucks), condition. The road gradient and surface as well as the manner of driving are also a factor of influence.

Railway Transport

Noise emissions depend on train speed, type of wagons, the state of the surface (of rails and wheels), type of wagons, including maintenance. The type of brakes, train length and availability of sound walls are also of great importance.

Air Transport

The airplane noise emissions are released mostly at take off and landing. Other important factors are the type of plane and the engine.

The noise emissions costs for 2000, average for EU-15, are borrowed from *INFRAS/IWW* (2004).[16] The costs are differentiated by type of traffic, place and time of the day. Unfortunately only day and night are included while it is preferred that evening traffic be also considered, i.e. three periods (day, evening, night), yet there are next to no studies including 3 periods. The data have been transferred to Bulgaria for 2000 and then estimated for 2007, taking account of the real GDP growth per capita in the country. Road transport costs are presented in Table 10, and railway costs – in Table 11.

Table 13. Noise Emission Costs in Road Transport

	Measure	Average for EU-15, 2000	2007
Cars			
Day			
City conditions	Euroct/v/km	0.76	0.30

[16] C. Schreyer, M. Maibach, W. Rothengatter, C. Doll, C. Schneider, D. Schmedding, INFRAS/IWW, External costs of transport: update study, 2004a,

	Measure	Average for EU-15, 2000	2007
Out-of-city conditions	Euroct/v/km	0.12	0.05
Rural areas	Euroct/v/km	0.01	0.00
Night			
City conditions	Euroct/v/km	1.39	0.56
Out-of-city conditions	Euroct/v/km	0.22	0.09
Rural areas	Euroct/v/km	0.03	0.01
Buses	Euroct/v/km		
Day			
City conditions	Euroct/v/km	3.81	1.52
Out-of-city conditions	Euroct/v/km	0.59	0.24
Rural areas	Euroct/v/km	0.07	0.03
Night			
City conditions	Euroct/v/km	6.95	2.78
Out-of-city conditions	Euroct/v/km	1.1	0.44
Rural areas	Euroct/v/km	0.13	0.05
Light vehicles for freight transport			
Day			
City conditions	Euroct/v/km	3.81	1.52
Out-of-city condition	Euroct/v/km	0.59	0.24
Rural areas	Euroct/v/km	0.07	0.03
Night			
City conditions	Euroct/v/km	6.95	2.78
Out-of-city conditions	Euroct/v/km	1.1	0.44
Rural areas	Euroct/v/km	0.13	0.05
Heavy vehicles for freight transport			
Day			
City conditions	Euroct/v/km	7.01	2.80
Out-of-city conditions	Euroct/v/km	1.1	0.44
Rural areas	Euroct/v/km	0.13	0.05
Night			
City conditions	Euroct/v/km	12.78	5.11
Out-of-city conditions	Euroct/v/km	2	0.80
Rural areas	Euroct/v/km	0.23	0.09

* The conversion index for Bulgaria for 2000 is 26.5.
** Euroct/vkm –euro cent per vehicle per kilometre

Table 14. Noise Emissions Costs in Railway Transport

	Measure	Average for EC-15, 2000	2007
Passenger train			
Day			
City conditions	Euroct/v/km	23.65	9.46
Out-of-city conditions	Euroct/v/km	20.61	8.24
Rural areas	Euroct/v/km	2.57	1.03
Night			

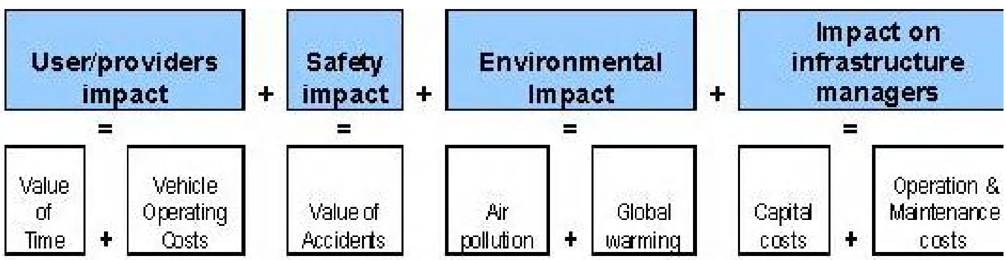
	Measure	Average for EC-15, 2000	2007
City conditions	Euroct/v/km	77.99	31.20
Out-of-city conditions	Euroct/v/km	34.4	13.76
Rural areas	Euroct/v/km	4.29	1.72
Freight train			
Day			
City conditions	Euroct/v/km	41.93	16.77
Out-of-city conditions	Euroct/v/km	40.06	16.03
Rural areas	Euroct/v/km	5	2.00
Night			
City conditions	Euroct/v/km	171.06	68.43
Out-of-city conditions	Euroct/v/km	67.71	27.09
Rural areas	Euroct/v/km	8.45	3.38

* * The conversion index for Bulgaria for 2000 is 26.5.
** Euroct/vkm –euro cent per vehicle per kilometre

6 Conclusions of economic and financial analysis. Recommended Presentation Format

6.1 Economic Analysis

The economic cost-benefit calculation shall be made for each project option, by summing up the above-mentioned incremental (with project – without project) impacts (positive = benefits or negative = costs):



The share of the various categories of benefits (vehicle operation, time, safety, environment) expected within the total normally depends on the type of the project.

For spot improvements like black spots, crossings, intersections etc where safety features are most important and reconstruction or rehabilitation works are predominant, the main economic benefits will be generated by accidents costs savings whilst no or even negative time savings (i.e. economic costs) may be experienced.

For construction of a new road along a new alignment the main economic benefits will be generated by savings in value of time costs.

For rehabilitation of an existing road within the existing alignment without upgrading to higher category or capacity, the main economic benefits will be generated by savings in vehicle operating costs and accidents costs and quite often small benefits in a value of time costs savings can be seen.

For reconstruction of an existing road with a higher capacity (widening with additional lanes), the main economic benefits will be generated by savings in value of time costs and vehicle operating costs, whilst no, small or even negative benefits may be experienced in accidents costs.

The table 19 below is an example on how the results of an economic analysis could be presented:

Euro, present value

No	Economic impact	Without project	With Project	Incremental Cost or Benefit	Share in total costs/ benefits
A	**To Infrastructure Manager/Government**				
1	Capital/Investment Costs				
2	Maintenance & Operation Costs				
B	**To Users & Providers**				
3	Value of Time (VoT)				
4	Vehicle Operating Costs (VoC)				
C	**External impacts**				
5	On safety (Accidents)				
6	Air pollution				
7	Climate change				
8	Others…				
9	**Total Costs**				
10	**Total Benefits**				
11	**Net Present Value** (NPV)				
12	**EIRR**				
13	**Benefit/Cost Ratio**				

6.2 Sensitivity & Risk analysis

The recommendations from the General Guidance (section 3.5) apply with the following particular qualifications for transport projects:

1. Sensitivity testing on several key parameters should be carried out within each appraisal

2. The sensitivity tests adopted depend on the particular features (e.g. assumptions and risks) of the project in question and therefore no universal parameters and levels of testing can be prescribed.

3. Indicatively, however, the following parameters are typically expected to be tested:

Traffic	- 30%
Capital costs	+ 30%
Maintenance costs	+ 30%
Value of Time	- 40% if HEATCO derived values are used

In addition, a risk analysis should be normally performed – see DG Regio's Guide to CBA (2008) which provides guidance on a simplified approach for this analysis.

6.3 Final Selection Decision

The CBA will give economic performance indicators for each investment option as one element on which to base the decision on the final option to be selected. In theory if the pre-feasibility stage work pre-selected only feasible, affordable, environmentally acceptable options then the one with the best indicators, usually expressed as the level of ERR and BCR, should be selected.

However it is rarely so clear that the economic results alone should be the determining factor. For example if the results for two options of significantly different cost were both considered acceptable (usually taken to mean exceeding the discount rate) and were of a similar order, then other factors may govern. If affordability were the main driver the lower cost option would be adopted, freeing up resources for other projects. If the more expensive project better filled a key objective and the money was available that would be selected.

The logic for the final decision should be presented on the application form if a grant is sought. Clearly if an option with a significantly poorer economic result was chosen over an option with much stronger returns the decision will be challenged and the reasons would need to be given why this choice had been made.

6.4 Financial Analysis

The General CBA Guidlines (chapter 3.4) offer the general framework which is directly applicable to any transport project. They will not be repeated here, apart of underlining once again the essential issue of applying the incremental approach (with – without project) in determining both the inflows and the outflows.

In the particular case of the transport sector, many typical projects (such as non-tolled roads) are not revenue-generating in the meaning of the Regulation 1083/2006 and of the Working Document no. 4, either because there are no cash revenues collected from users or because such revenues do not exceed the operation & maintenance costs.

In such cases the financial analysis shall not aim at determing the financial gap and corresponding grant level, but should limit at calculating the basic financial indicators (such as FNPV which would be negative and/or FIRR which woud be well below the discount rate).

In developing the estimates in the financial analysis one can use an unlimited number of supportive and aggregate tables. However, the mandatory format is applied in defining the following indicators:

Net present value (NPV) with and without EU grant;

- Internal rate of return (IRR) with and without EU grant.

It is obligatory to define the sources of financing and to prove the financial viability of the project. To meet these requirements the minimum scope of the tables should have the following format:

6.4.1. Sources of Financing

	Source of Financing	1	2	...	...	30
1	Private capital (PC)					
2	Municipal government					
3	Regional level					
4	Central level					
5	Loans					
6	**Total National Co-Financing (=1+2+3+4+5)**					
7	**EU Grant**					
8	**Total Guaranteed Financial Sources (=6+7)**					

6.4.2. Financial Return on Capital FNPV/C

	Indicator	1	2	...	...	30
1	**Revenues**					
2	Operating Costs					
3	Total Investment Costs					
4	**Total Project Costs (=2+3)**					
5	**Net Cash Flows (=1-4)**					
6	**Financial NPV of Investments (FNPV/C)**					
7	**Financial IRR of Investments (FIRR/C)**					

6.4.3 Financing Gap

In compliance with Working Document № 4 each cost and benefit analysis should envisage a certain financing deficit and amount under the EU Grant Provision Decision. The financing deficit is not calculated only if the project does not generate revenues or the net revenues are negative. In that case "N/A" is written on line 11. It is obligatory to draw up the following tables:

6.4.3.1. Gap Calculation

	Key Elements and Parameters		Value Not Discounted	Value Discounted (Net Present Value)
1	Period of Analysis (years)	30		
2	Financial discount rate (%)	5%		
3	Total investment costs (in euro, not discounted)		Table H.1 A10-(A5+A6)	
4	Total investment costs (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)			
9	Net revenues = revenues – operating costs + residual value (in euro, discounted) = (7) – (8) + (6)			
10	Eligible expenditure (Art. 55 (2)) = investment costs – net revenues (in euro, discounted) = (4) – (9)			

11	Financing gap rate (%) = (10) / (4)	

6.4.3.2. Decision Amount

The amount subject of the EC Decision is set in an absolute amount and as such it is written in the Decision on the ground of the estimates in the following table:

	Category	Value
1	Eligible investment costs (in euro, not discounted)	*Table H.1 item C12*
2	Financing gap (%)	*Item.11 of Table 6.4.3.1*
3	Decision Amount in the Decision, i.e. „amount to which the per cent of co-financing for the main area of activity is referring" (Art. 41 (2)) = (1)*(2) (while observing the threshold of public participation in accordance with the regulations on state grants)	
4	Co-financing rate of the priority axis (in per cent) (%)	*(Depends on the OP)*
5	Community financing (in euro) = (3)*(4)	

6.4.4. Financial Return of Own/National Resources FNPV/K

	Indicator	1	2	...	...	30
1	Revenues					
2	Residual Asset value					
3	**Total Inflows (=1+2)**					
4	Operating Costs					
5	Total Investment Costs excluding EU grant					
6	**Total outflows (=4+5)**					
7	**Net cash flows (=3-6)**					
11	**Financial NPV of Investments (NPV/K)**					
12	**Financial IRR of Investments (FIRR/K)**					

6.4.5. Financial Sustainability of the Project

	Indicator	1	2	...	...	30
1	EU Grant					
2	Total national Co-Financing					
3	Loans					
4	Other Sources					
5	Total Sources of Financing **(=1+2+3+4)**					

6	Revenues					
7	**Total Inflows (=5+6)**					
8	Investment Costs					
9	Operating Costs					
10	Loan principal and interest					
11	Taxes					
12	**Total Outflows (=8+9+10+11)**					
13	**Net Cash Flows (=7-12)**					
14	**Cumulative Cash Flow**					

Note: The financial sustainability is proved through a positive or zero value of the cumulative cash flow for each year of the period of forecast

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And reviewed, discussed and revised by Jaspers in 2008.