Republic of Serbia
MINISTRY OF
INFRASTRUCTURE

PUBLIC ENTERPRISE
ROADS OF SERBIA

Manual Cost Benefit Analysis

Republic of Serbia

NEA
a member of Panteia

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Preface

Serbia is anticipating huge investments in road infrastructure. These investments are to contribute to the socio-economic development of Serbia and need to be justified. First of all because available resources are scarce and need to be spent in an optimal way. In addition, economic justification of infrastructure investments is a pre-condition in working with International Financing Institutions (IFIs). In the light of the strong requirements from IFIs in relation to justification of investments, it is important to build capacity in this field in Serbia.

Building capacity in planning and programming of road infrastructure has been the key ambition of the technical assistance project that started earlier this year and has resulted in this CBA Manual. The project is part of a Government-to-Government Cooperation programme between Serbia and the Netherlands. Cooperation has indeed been the driving force. Not only between Serbian and Dutch experts. But also between experts in Serbia. As an illustration, a multi-disciplinary working group has been created with representatives from the Ministry of Infrastructure, the Ministry of Finance, PE Roads of Serbia and the Highway Institute. This working group has closely cooperated throughout the year.

The Dutch organisations NEA Transport research and training and ECORYS have contributed greatly in the above-mentioned ambition related to building capacity. This through the provision of basic training, doing case studies and training on the job and by developing this CBA Manual. The cooperation has been in the spirit of true partnership. This fits in with the working approach as established in the Dutch Serbian Business Council.

The CBA Manual comes at a very important time. The General Transport Master Plan was approved earlier this year. Serbia may be on its way to EU membership. New road infrastructure investments are needed and foreseen. The CBA Manual needs to set a standard and contribute to the quality of planning and programming of road infrastructure. Good luck in using this CBA Manual.

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Belgrade, December 3rd, 2010

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Abbreviations

B/C	Benefit/Cost
BCR	Benefit/Cost Ratio
CBA	Cost Benefit Analysis
CC	Candidate Countries
CF	Cohesion Fund
DCF	Discounted Cash Flows
EC	European Commission
EIA	Environmental Impact Assessment
ENPV	Economic Net Present Value
ERDF	European Regional Development Fund
EU	European Union
FNPV	Financial Net Present Value
FRR	Financial Rate of Return
G2G	Government to Government
GDP	Gross Domestic Product
GMPT	General Master Plan for Transport
IFI	International Financial Institution
IPA	Instrument for Pre-Accession
IRI	International Roughness Index
IRR	Internal Rate of Return
MCA	Multi-Criteria Analysis
MIPD	Multi-annual Indicative Planning Document
NMS	New Member Sates
NNC	New Neighbouring Countries
NPV	Net Present Value
O/D	Origin/Destination
OP	Operational Programmes
PERS	Public Enterprise Roads of Serbia
PPP	Public Private Partnership
SCF	Strategic Coherence Framework
SCGE	Spatial Computable General Equilibrium Mode
STM	Serbian Transport Model
TEN	Trans European Network
ToR	Terms of Reference
TRN	Transport Note
VOC	Vehicle operating costs
VoT	Value of Time
WB	World Bank

1 Introduction

1.1 Background

The EVD granted the NEA-ECORYS consortium the contract for the project "Assisting Serbia in Planning and Programming of Road Infrastructure" (G2G09/SB/5/2), as part of the G2G initiative. The project is part of the G2G programme, which aims at strengthening the relations between the governmental bodies of the Netherlands and the New Member Sates (NMS), the Candidate Countries (CC) of the European Union (EU) and the New Neighbouring Countries (NNC) to the EU.

1.2 Objective of the CBA Manual

The main objective of this Manual is to provide the Public Enterprise Roads of Serbia (PERS) and all other organisations with a guideline on how to conduct and present Cost Benefit Analyses (CBAs) of road transport projects according to the principles and rules established by international organisations, such as the European Commission and International Financial Institutions (IFIs). This will offer a more solid ground for the investment decision-making process in the Serbian road transport infrastructure sector. It will also help interested parties to access internationally available financial funds.

There are quite a large number of elaborated and detailed manuals on Cost Benefit Analysis available in literature. These manuals either focus on general methodological principles[1] or are more country-specific[2].

This Serbia CBA Manual provides an overview of the main CBA steps, i.e. an outline on how to structure a CBA for a road infrastructure project. At the same time, this manual proposes values to be included in CBA projects in Serbia, mostly based on values established during the implementation of the General Transport Master Plan (GTMP) for Serbia (2009)[3]. This way, it fills the gap between the existing theoretical guidelines and Serbian road sector reality. An essential element is that the CBA Manual will be institutionalised; a follow-up project has been defined for this. In this follow-up project relevant stakeholders will be included in order to define a process to assess infrastructure projects.

1.3 Target Audience and application of the CBA Manual

Target audience

The CBA Manual can be used both by government authorities, such as PERS, or financial institutions for the preparation of a Terms of Reference (ToR) or for

[1] For example EU Guide to Cost-benefit Analysis of Investment Projects, World Bank Notes, HEATCO, etc.

[2] Examples are Romania - Technical Assistance for the Elaboration of the General Transport Master Plan, Requirements for Preparation of CBA in Transport Sector for Bulgaria.

[33] Serbia General Transport Master Plan, EC funded project, carried out by Italferr, NEA, Witteveen + Bos, IIPP.

appraisal of projects through CBA on the one hand and monitoring of the quality of a CBA project on the other hand. At the same time the CBA Manual should be used by consultants as a guide on how to carry out cost benefit analyses of road infrastructure projects.

Application

The contents and requirements of this CBA Manual are generic and are intended to be applicable to all users, as presented above. The application of the CBA Manual is obligatory for those who carry out pre-feasibility studies and feasibility studies procured by PERS.

The CBA Manual is the main document for CBA issues in infrastructure assessment. The process and proposed values, as included in the CBA Manual should be applied. However, in specific cases where other solutions are applied, an explanation needs to be given for deviation from the CBA Manual. This may eventually lead to an amendment of the Manual. As such, the CBA Manual is a "living document". The updated version of the CBA Manual will be available on the PERS website (http://www.putevi-srbije.rs/).

Where requirements of the CBA Manual cannot be applied due to the nature of the transport infrastructure project or institution/organisation involved, this can be considered for exclusion. Also here, the specific reason and its implications should be mentioned.

Worth mentioning is the fact that selected key documents are translated into Serbian language during the course of the project. The Guide to Cost Benefit Analysis of Investment Projects (EC, DG REGIO) is considered an essential document for future CBA applications. Furthermore, HEATCO, Deliverable 5 (Proposal for Harmonised Guidelines) presents a cross-country comparison of European CBA aspects, and provides a valuable information source for Serbia.

1.4 Contents of the CBA Manual

The CBA Manual consists of three main sections.

Section 1: Process and Principles
Chapter 2 explains the place of CBA in the project appraisal process and presents an overview of the main process steps. Chapter 3 presents the importance of traffic analysis and transport modelling for the CBA process. Special attention is paid to the Serbian Transport model and how to use its outcomes as input factors for CBAs in Serbian projects.

Section 2: CBA Calculations
Chapters 4 and 5 describe the main elements, steps and indicators for financial and economic analysis. In chapter 6 sensitivity and risk analysis are described.

Section 3: Checklist
Chapter 7 provides a checklist that can be regarded as a summary of the previous sections and can be used as a useful tool for checking the quality of a CBA.

Section 1 Process and Principles

2 Role, Place and Process of CBA

2.1 Background

This chapter contains two main blocks, (i) a description of the role and place of CBA in the decision-making processes; why CBA is used and (ii) a description of the process of carrying out CBA; how a CBA is done.

After having read and understood the contents of this chapter, the reader will know:

a. What CBA is used for?
b. The key features of CBA
c. The process steps of a CBA project

2.2 Role and Place of CBA

2.2.1 Appraisal and CBA

The purpose of economic appraisal is to ensure that the scarce public funds available to the road sector are allocated in an efficient manner. In a situation where proposals for public sector investment in roads exceed the available resources, careful selection and prioritisation of projects is a necessity.

An investment is worthwhile and can be considered for (co)financing through public funds only if the (socio-economic) benefits of a planned investment (project or programme) outweigh the (socio-economic) costs. Project appraisal also plays an important role during project implementation and after the finalisation of projects to ensure project targets and objectives have been met.

In this way, appraisal is an ongoing process that can be applied during all stages of the project cycle. It requires a consistent and comprehensive framework to establish the merits of each project proposal. All project effects have to be identified and presented in such a way that they can be compared in an objective manner. Cost Benefit Analysis provides such a framework.

CBA provides information that can be used to evaluate an individual project's level as well as to compare and prioritise groups of different projects or programmes. CBA should provide evidence that a project is:

- **Needed and is consistent with national policies**, for example, the IPA (Instrument for Pre-Accession) operational programme and other Community policies, as well as the policies of other major IFIs that might support the implementation of a project. This is achieved by checking that the output produced by the project contributes toward reaching the programme and policy goals.
- **Desirable from a socio-economic point of view**. This is demonstrated by the result of the economic analysis and particularly by a positive economic net present value. Here it is important that not only the project option, but also alternative options are considered in the analysis.
- **Requiring co-financing**. More specifically, the financial analysis should demonstrate that there is a funding gap (negative financial net present

value) and that financial assistance from the government, EC and/or other IFI is needed to make the project financially viable.

2.2.2 Important Features of a CBA

Project Effects on all Stakeholders and Society

From a societal perspective a CBA is often called a socio-economic cost-benefit analysis. A socio-economic CBA involves the identification of all the effects a project will have for all stakeholders and on the welfare of all members of society. The unit with which to measure these impacts is money.

The rationale behind a CBA is that project inputs should be valued at their opportunity cost and project outputs at consumer willingness to pay. However, the opportunity costs do not always correspond to the observed financial costs. Similarly, willingness to pay is not always correctly revealed by observed market prices, which may be distorted or absent. In order to correctly monetise the social value of costs and benefits, it is necessary to make some corrections[4].

Nonetheless, some impacts that cannot be valued in money (intangibles) may still remain outside the quantitative analysis. In fact, the effects that cannot be monetarised will be taken up as pro memori items in the CBA, and should be described qualitatively in the best possible way. This enables decision-makers to attach their own value to these non-quantified effects.

Discounted Cash Flows in Time

CBA uses the discounted cash flow approach to calculate the project's financial and economic performance indicators, i.e. Internal Rate of Return (IRR) and Net Present Value (NPV). The purpose of discounting is to express the flow of costs and benefits involved in a project lifetime — or a determined appraisal period — in present values. Once the set of future values are expressed in present values they are comparable and can therefore determine whether the overall welfare gain arising from a project is worth its costs.

Using the discounted cash flow implies that:
- Only cash inflows and outflows are considered (depreciation, reserves and other accounting items which do not correspond to actual flows are disregarded).
- The aggregation of cash flows occurring during different years requires the adoption of an appropriate financial discount rate in order to calculate the present value of the future cash flows (see Section 4).
- The determination of the project cash flows should be based on the incremental approach.

[4] Section 5 provides further details on how to make corrections of financial costs and monetise non-market impacts.

An Incremental Approach – Base and Project Case

CBA uses an incremental method that compares a scenario with the project with an alternative scenario without the project. This is done in both the financial and the economic analysis. The incremental method is applied as follows:

- Firstly, a projection is made of all cash flows related to road operations in the project area for each year during the project lifetime in the *situation without the proposed project*. For example, these costs could include costs for maintaining an existing road to a minimum level that it is still operable, or even planned investments in the road network that were planned to take place anyway.
- Secondly, a similar projection of cash-flows is made for the *situation with the proposed project*. This takes into account all the investment costs and the financial and economic costs and benefits resulting from the project. This could include, amongst other things, changes in maintenance and operating costs, travel time, road safety, environmental impact or toll revenues (if relevant).
- Finally, the CBA (e.g. the financial and economic analysis) only considers the difference between the cash flows in the "with project scenario" and the "without project scenario". If the proposed project is entirely new, the "with project scenario" is the basis for the incremental cash-flow.

Valuation in Constant or Current Prices

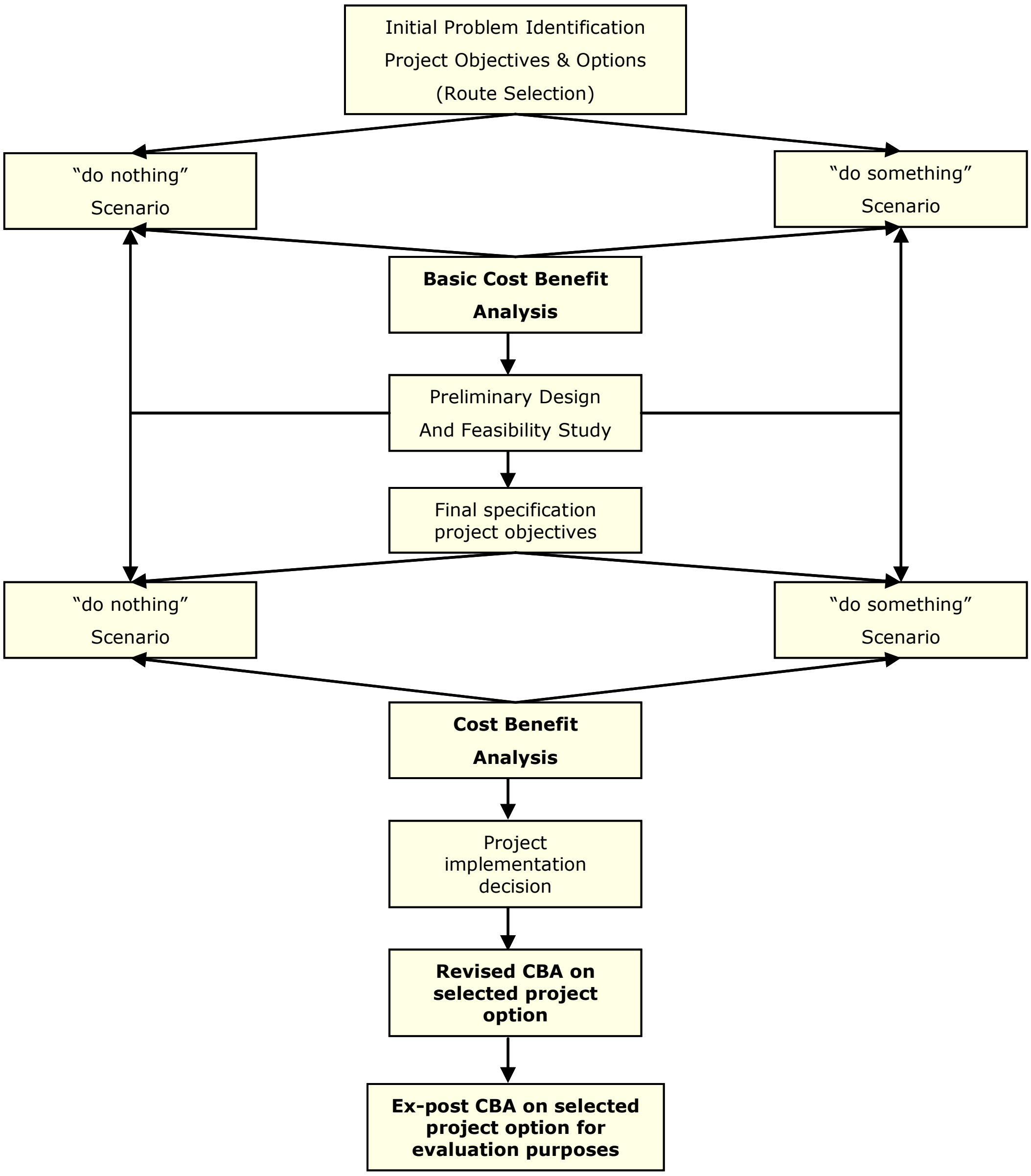
Costs and benefits can be valued either in real terms (constant prices) or in nominal terms (current prices). It is important that a consistent approach is adopted throughout the analysis. In project analysis, it is customary to use constant prices, that is to say prices adjusted for inflation and fixed at a base-year. However, the European Commission's (2008) Guide to Cost Benefit Analysis of Investment Projects recommends the use of current prices. These are nominal prices effectively observed year by year. The use is recommended in order to eliminate the effect of inflation, or rather the general increase in the price index, on the calculation of the financial return of the investment.

2.2.3 When is CBA required?

CBA in the Project Cycle

For large road projects the process from project identification towards route selection and the final project implementation and evaluation of the project, is often lengthy and complex. Throughout this process CBA can provide useful information to decision-makers. This is illustrated in Figure 2.1.

Figure 2.1 Role of CBA in Decision-making



In the project initiation phase a (simplified) CBA can be used to compare project alternatives as well project options (route selection). The CBA is used to reduce the number of routes that will be considered for further in-depth analysis. Therefore the outcome of the CBA must reflect the relative benefits of competing options. Usually the results of a pre-feasibility study are used as input for the CBA. Often default parameters for issues like traffic composition, average speeds and accident rates are used. Costs are often estimated, based on agreed unit costs.

CBA is used in the option selection phase to facilitate decision-making about the option that will be carried forward and implemented. The CBA is more detailed at this phase, using the results of a more detailed and elaborate feasibility study. For a limited number of routes more robust cost estimates will be available, based on the preliminary design as well as on an assessment of project impacts for the selected routes. During this stage also an environmental impact assessment is carried out for each of the alternative routes.

During the project preparation/implementation phase CBA can be used to evaluate the project. For example when the costs for the project differ significantly from the envisaged costs prior to project tendering. A revised CBA, using the actual costs, could provide valuable insights in the effect of these changes, which might influence further decision-making. Usually, this kind of analysis is only carried out if there is an immediate cause, such as (expected) high cost overruns.

In the project finalisation phase a CBA carried out ex-post can provide useful information on the actual effectiveness and efficiency of the project compared to the ex-ante CBA. Usually, this kind of analysis is only carried out for a limited number of projects, primarily for "learning purposes". The ex-post CBA should use actual scheme costs and traffic values and is carried out after the road has opened to traffic. The CBA at this phase should use, insofar as possible, the same parameters used in the preliminary design and construction documents' CBAs.

CBA in the Context of Funding Applications

EU Cohesion Policy regulations[5] require a full cost-benefit analysis (comprising both a Financial and an Economic Analysis along with a Risk Assessment) of all major investment projects applying for assistance from the Funds. For IPA assisted transport projects the legal threshold for the definition of a "major" investment is €10 million[6] and for these projects carrying out a CBA according to the relevant guidelines and working documents[7] is a requirement. For transport projects supported by the CF or ERDF this threshold is € 50 million[8].

NOTE: for smaller projects which are not subject to a preventive appraisal and approval by the European Commission, the PERS could decide to include a requirement for the results of CBA to be assessed as part of the selection criteria. In those cases, the methodology described by these Guidelines will apply.

When determining the total investment costs the sum of all the expenditures for the planned road project and related lump sum costs for some intangible assets must be considered. This should be done regardless of the way the road project is financed (e.g. public financed, EU support, PPP). Also, any one-off expenses incurred at the start-up phase (such as preliminary studies, planning and other technical studies, costs for obtaining licenses, etc.) can be included in the calculation of the total costs. Running costs, such as costs for operation or maintenance, should not be taken into account.

[5] Article 40 of General Regulation 1083/2006, Article 157 of IPA Implementing Regulation 718/2007, etc.
[6] Article 157(2) Regulation 718/2007
[7] Including: Guide to COST-BENEFIT ANALYSIS. Final Report. 16/06/2008", Working Document No. 4, 08/2006, COCOF Notes, Implementing Regulations etc.
[8] Article 39 Regulation 1083/2006

In some cases, a number of small projects are interrelated and it could be better to consider them as one large project (for example, five stretches of the same motorway, each costing €11 million, can be considered one large project of €55 million).

Also, the World Bank considers CBA as the most relevant method for the economic evaluation of (road) transport projects. The World Bank provides methodological guidance in its Economic Evaluation Notes TRN 5 – TRN 26[9]. The evaluation focus lies on establishing the fact that individual investments represent a sensible use of resources within the context of the national economy and less on ranking between Bank funded projects. In addition the World Bank pays attention to the establishment or assurance of an appropriate institutional and policy framework for project investments. This is not directly included in the CBA.

2.3 Process Steps

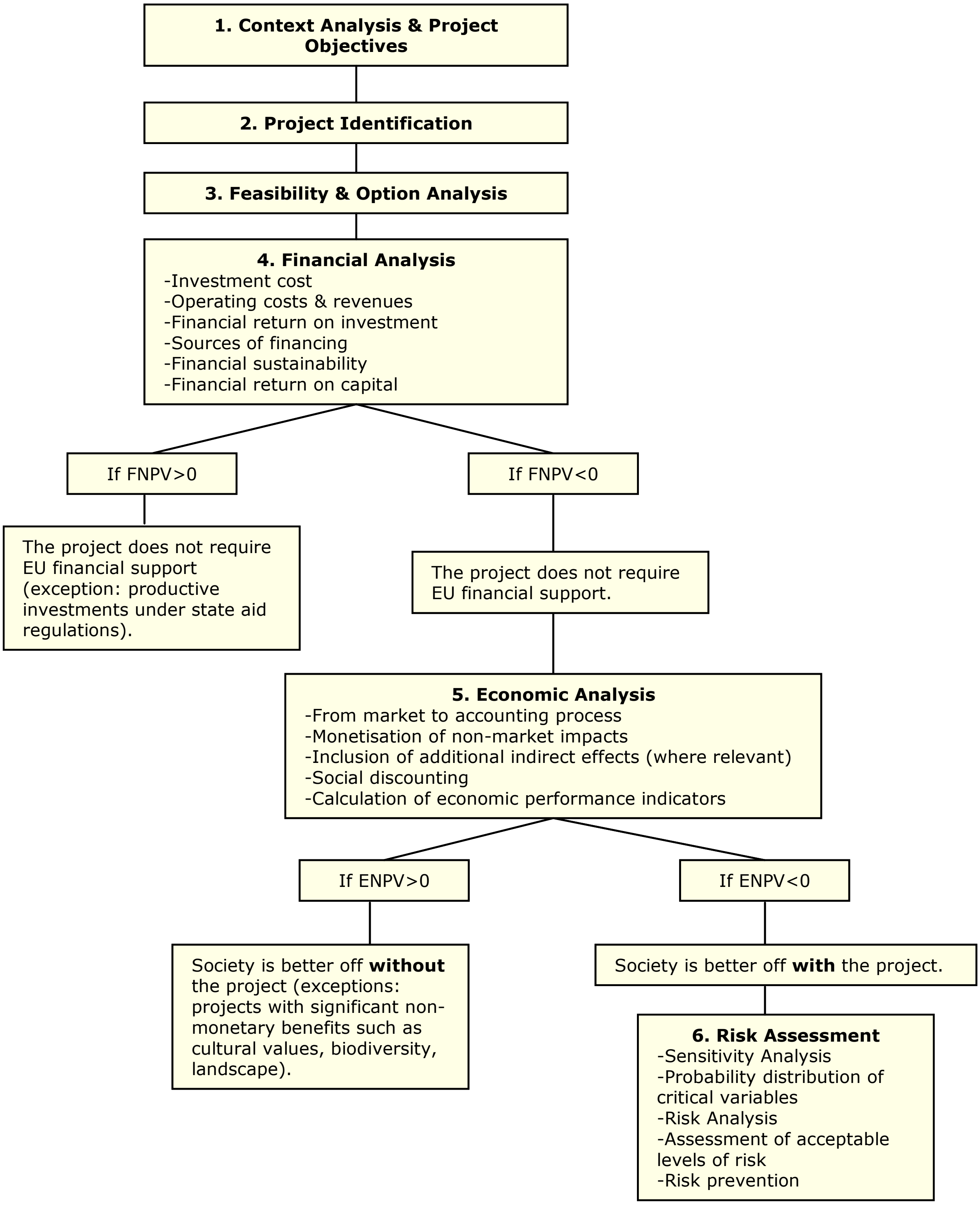
This section describes the main CBA steps. Although existing CBA manuals may define slightly different steps, they all include the following principle steps:

1. Project context and objectives
2. Identification of the project
3. Project Feasibility and alternative Options
4. Financial analysis
5. Economic analysis
6. Risk assessment

These steps are illustrated in Figure 2.2 and described in more detail afterwards.

[9] The World Bank, Transport Note No. TRN-5 to TRN-26, January 2005.

Figure 2.2 Main CBA Steps



2.3.1 Project Context and the Objectives

Before formulating a project and carrying out the CBA it is necessary to qualitatively review the socio-economic context and the objectives that are expected to be attained through the investment. From this discussion the need for the intervention should become clear.

Existing, and likely future, problems (accessibility, congestion, traffic safety) have to be described in a clear and concise manner in relation to the objectives that are to be achieved with the project. Project objectives should be expressed in terms of the benefits they are expected to provide and those whom they are intended to benefit. This requires a stakeholder analysis to be carried out.

Furthermore, the rationale of each intervention should be assessed, with reference to the consistency of objectives with the key policy priorities. These could be national priorities, but also objectives formulated in, for example the (pre)Operational Programmes (OPs) for IPA, the multi-annual indicative planning documents (MIPDs) that reflect the Community priorities and the Strategic Coherence Framework (SCF).

The objective is the explicit intended result of a particular project, measured as precisely as possible (e.g. A road is to "reduce the average travel time between A and B with 30 minutes" instead of merely stating that "traffic flow is to improve" or "travel time is to be reduced"). Also, the formulation of objectives should not point to one specific solution (e.g. a three-lane road from A to B via C). They should be expressed in a way that will facilitate consideration and analysis of alternative ways of achieving them (e.g. a two-lane road from A to B via D or even a rail link between A and B).

Whenever possible, the relationship between the project objectives and the indicators used to quantify the specific targets of the policy documents should be clearly identified. This allows linkage of the project objectives with the monitoring and evaluation system at the programme level.

Finally, a view will need to be taken on the scope of the analysis. This is often made simultaneously with the decision regarding the type and scale of the demand forecasting approach, as the two processes are inter-related.

2.3.2 Identification of the Project

A project can be defined as an economically indivisible series of tasks related to a specific technical function and with identifiable objectives.

A project should be a self-sufficient unit of analysis, i.e. no essential feature or component should be left out of the scope of the appraisal. For example, if there are no connecting roads on either side of a shore, a bridge project will not function. In that case both the bridge and connecting roads are to be considered as one project. Similarly, if a highway project connecting town A with town B, is justified only by the expectation of an industrial park being developed in the vicinity of town B and most traffic will take place between the park and town A: the project should be analysed in the context of the industrial park / highway system as a whole.

In some cases a project proposal consists of a project phase or a group of projects may be considered as one large project for the purpose of a CBA. Particularly when a given construction phase be regarded as being operational in its own right (for example several stretches or road connecting various cities on the same corridor, could be considered as several individual projects, but also as one large project).

However, when a project consists of several inter-related but relatively self-standing components and costs and benefits of the components are independent, then the components are separable and can be treated as independent projects. Appraising such a project involves, firstly, the consideration of each component independently and, secondly, the assessment of possible combinations of components.

The Standing Issue

Projects will affect different (groups of) stakeholders and different geographical areas. Therefore it is important to state "whose costs and benefits" are being considered in the analysis i.e. whose welfare counts in the aggregation of net benefits (the "standing issue"). Furthermore, whether the CBA analysis will be carried out adopting a local, regional, national, international perspective needs to be decided. When a CBA is conducted from a societal point of view on a national level, taxes and transfers between stakeholders or geographical areas are excluded from the analysis. Also impacts outside the country are usually excluded from the analysis.

Principles regarding the standing issue are:

- The level of decision-making and financing of the project is crucial. For example if the project is financed by national taxes, then the perspective is national.
- The objectives of the project are important. If the objectives have an important regional dimension then it is advisable to also report on regional impacts. For example if the transport project aims at improving the economic situation of some lagging regions then it is advisable to assess the economic impacts at the regional level (separately from the national level).
- For projects funded with the Instrument for Pre-accession (IPA) normally the perspective of the CBA for quantification of impacts is national. If possible, some international effects on the TEN-corridors and neighbouring countries can be described.

2.3.3 Project Feasibility and alternative Options

The main aim of the feasibility and option analysis is to identify the most promising option on which a detailed CBA should be carried out[10]. This includes the following steps:

- definition of options
- feasibility analysis
- option selection for CBA

[10] Sometimes this selection process is managed as part of the preparation on an operational programme or master plan.

Definition of Options

A road project is normally proposed as part of a planning process to solve a set of specific problems or to achieve certain objectives. As such there is usually a range of solutions or alternatives that require appraising. All realistic ways of achieving the stated objectives should be identified and examined critically when considering project options for the first time. The alternatives should be described in such a way that the essentials of each alternative, and the differences between them, are clear. In some cases the options may only differ on minor technical details. Typical examples of different road project options are different routes, different dimensions (e.g. 2-lanes or 3-lanes) or different construction timing. In other cases the alternatives can vary widely and contemplate actions in different transport modes (or even non-transport solutions).

These alternatives can be labelled as "do-something" scenarios. These "do-something" scenarios need to be compared against a "reference" scenario. The **reference alternative** describes the "without project" development over time (thus, need not be a static situation). It is the scenario which involves carrying out as little investment and maintenance as possible to keep the system working without excessive deterioration of the service provided. It is aimed at maintaining the *status quo* and is therefore also often referred to as "the business as usual" or "do nothing" scenario[11].

The recent CBA Guidelines of DG Regio (2008) advise comparing the "do something" option not only with the "without project" development ("reference or business as usual scenario"), but also with a ***"do minimum alternative"***. A typical "do minimum" alternative for an investment in a new road connection could be the upgrading of an existing road or link (in terms of renovation, adding more capacity/lanes, higher speed limits, construction of bypasses etc). By comparing the "do something" alternative with such a "do minimum" alternative too, the value added of the project is always compared to cheaper or smaller scale solutions.

(Pre)Feasibility Analysis

Feasibility analysis aims at identifying the potential constraints and related solutions with respect to technical, economic, regulatory and managerial aspects. A project is feasible when its design meets technical, legal, financial and other constraints relevant to the nation, region or specific site. Feasibility is a general requirement for any project and should be checked carefully. Moreover, as mentioned, several project options may be feasible. Considering the possible alternatives in the light of the constraints will usually lead to the conclusion that some of the alternatives are not feasible. Others may conflict with existing policies.

Typical (pre)feasibility reports should include information on traffic demand analysis (see Section 3.2), current and future capacity/demand ratio for a road, the project scale and description and the environmental aspects.

[11] Although technically "do-nothing", is not exactly the same as "do-minimum". Doing absolutely nothing can often not be considered as the road system would become totally inoperable and unusable in such a scenario.

Using multi-criteria analysis the broad list of options should be screened against possible qualitative criteria (to be established in the light of overall policy orientations and/or technical considerations, this needs to be agreed upon with the PERS) with the aim of already eliminating unsuitable options.

This analysis can be complemented in the next step by including the results (NPV and IRR) of a simplified CBA into the analysis to eliminate more options, narrowing it down to only a few options to be considered for an elaborate CBA.

Option Selection

Based on the results of the (pre)feasibility study, a simplified CBA or cost-effectiveness assessment should be carried out to (further) rank the options and to determine which options should be included in the more detailed CBA.

The simplified CBA should usually focus on the key financial and economic tables. At this phase it uses only rough estimates of the data[12]. Based on standard unit costs, preliminary cost estimates can be made for the options being considered. These have to be agreed upon with PERS. To reflect on the options, relative benefits of competing, default parameters for traffic composition and accident rates could be used. The options should at least be evaluated under a situation of "high" and "low" traffic growth forecasts, but other scenarios can also be studied (i.e. the impact of alternative road / junction standards or the impact that the omission of schemes that are planned nearby, but are not committed to would have).

The calculation of the financial and economic performance indicators must be made with the incremental net benefits technique. With this technique, the differences in the costs and benefits between the "do-something" alternative(s) and the reference alternative are considered.

Sometimes — especially if a large number of options are considered — a cost-effectiveness assessment can be carried out to rank the options. In such a cost-effectiveness assessment the investment costs of the options are mainly compared to the timesaving benefits. The key ratios of investment costs per time saved are then compared to rank a number of project options. A detailed CBA is then only carried out for the most promising options (in terms of low costs per hour saved).

2.3.4 Financial Analysis

The financial analysis carried out as part of a major project's CBA should particularly aim at using the project cash flow forecasts to:

1. Evaluate the financial profitability of the investment.
2. Determine the appropriate (maximum) contribution from external funds.
3. Check the financial sustainability of the project.

More specifically, the financial analysis has to cover the following steps:

- Estimate the total project investment costs, the total operating costs and revenues and their implications in terms of cash-flow.

[12] In a differential approach the absolute values of the variables involved are less important than in a fully developed comparison of alternatives.

- Calculate the project financial performance indicators, i.e. the Financial Net Present Value (FNPV) and the corresponding Financial Internal Rate of Return (FRR) in absence of co-financing from the Funds.

Co-financing and Funding Gap

It should be noted that abovementioned items 2-3 are used in the context of co-financing road sector projects by the EU, as outlined below. This CBA manual does not focus on this co-financing aspect at this stage. At a later stage this aspect could be added.

Box 2.1 EU Co-financing Principles

Article 55.2 of the Regulation 1083/2006 stipulates that the determination of the level of EU co-financing for the period 2007-2013 is based on the concept of funding gap. Co-financing will only be provided for the portion of the proposed (eligible) investment that can not be covered by the net revenues accruing for the investment itself, both expressed in term of their current (present) value. When there are any project revenues (for example from toll) these must be properly taken into account so that the EU contribution is modulated according to the project's gross self-financing margin and no over-financing occurs[13].

The following steps are important:
- Determine the funding gap of the selected option and subsequently calculate the eligible expenditure that can be co-financed by the public funds (EU, national).
- Define the project financing structure and its financial profitability, using the financial return on the investment costs.
- Verify the sufficiency of the projected cash flow to ensure the adequate operation of the project and meet all investment and debt service obligations (financial sustainability).

As co-financing is only required if the proposed project or action is not financially profitable, a project will be eligible for co-financing only if, its FNPV is lower than 0, and its FRR is lower than the chosen discount rate[14], before EU interventions.

For further information on carrying out financial analysis, see Chapter 4.

2.3.5 Economic Analysis

A CBA requires an investigation of a project's net impact on economic welfare. The economic analysis appraises the project's contribution to the economic welfare of a country. It is made on behalf of the whole society instead of just the owner of the infrastructure (as is the case in the financial analysis). The purpose

[13] For further information on determination of EU co-financing and eligibility of costs see EU document – Working Document No. 4, Guidance on the Methodology for Carrying out Cost-Benefit Analysis.
[14] The financing gap and financial profitability indicators (FRR and FNPV before and after Community assistance) are calculated using a financial discount rate of 5% in real terms, according to the regulations and more specifically according to the instructions in the Guide to Cost-Benefit Analysis of Investment Projects and Working Document 4: Guidance on the methodology for carrying out Cost-Benefit Analysis.

of the economic analysis is to prove that the project has a positive net contribution to society and is therefore, worth being financed.

Project benefits should exceed the project's costs, which are expressed as a positive Economic Net Present Value (ENPV), a Benefit/Cost (B/C) ratio higher than 1, or a project Economic Internal Rate of Return (ERR) exceeding the discount rate used for calculating the ENPV.

However, project economic (as opposed to financial) costs are measured in terms of their "resource" or "opportunity" costs. Similarly, project benefits can be measured in terms of the project beneficiaries' *willingness-to-pay* for these benefits resulting from the project. Or, alternatively, in *costs avoided* as a result of implementing the project, as well as external benefits resulting from the project that are not captured by the analysis performed in financial terms. It should be noted that the opportunity cost does not necessarily correspond to the observed financial cost; similarly, willingness to pay is not always correctly revealed by observed market prices, which may be distorted or even absent.

To calculate the economic benefits the following steps need to be taken[15]:

a) Fiscal corrections.
b) Corrections for externalities.
c) From market to accounting (shadow) prices.

Next the following steps are to be taken:

- **Discounting economic costs and benefits:** Once the stream of economic costs and benefits is estimated, these are discounted using the standard DCF methodology, but with a real social discount rate.
- **Calculation of economic performance indicators**: Economic Net Present Value (ENPV), Economic Internal Rate of Return (ERR) and the Benefit-Cost (B/C) ratio.

Non-Monetary Issues and Multi-Criteria Analysis

This CBA Manual provides practical guidance on the use of conversion factors; the discounting rate and methods for the calculation of the economic valuation of environmental impacts and the value of lives saved and injuries avoided. However, it should be noted that not all socio-economic impacts can be quantified and valued. This is why, in addition to the estimation of performance indicators, consideration of non-monetised costs and benefits should be taken into account as additional qualitative factors. For example in relation to the following issues: (net) impact on employment, environmental protection, social equality and equal opportunities. These items could be incorporated in a Multi-Criteria Analysis (MCA).

For further information on carrying out an economic analysis, see Chapter 5.

[15] These steps are described in more detail in Section 5, including Serbian values from the GMPT project.

2.3.6 Risk Assessment

As a final step of the project appraisal the project risks must be assessed, using the outcomes of the previous steps. To carry out the risk analysis the following four steps are suggested:

- Sensitivity analysis (identification of critical variables, elimination of deterministically dependent variables, elasticity analysis, choice of critical variables, scenario analysis).
- Assumption of a probability distribution for each critical variable.
- Calculation of the distribution of the performance indicator (typically FNPV and ENPV).
- Discussion of results and acceptable levels of risk and ways to mitigate risks.

For further information on how to carry out a risk assessment, see Chapter 6.

3 Traffic Analysis and Forecasts

3.1 Background

This chapter establishes the importance of traffic analysis and forecasting for CBA. Traffic is the determining factor for evaluating the financial and economic importance of a road infrastructure project; traffic "carries" the project's benefits. Traffic flows with and without the road scheme under appraisal are obtained through a traffic forecasting process that is carried out separately from a CBA. The traffic forecasting process assigns trips to the road network with and without the proposed road scheme, and forms the basis of the traffic input to the CBA.

In this chapter specific attention will be paid to traffic analysis and the role of the Serbian Transport Model, as developed in the General Transport Master Plan (2009) project.

After having read and understood the contents of this chapter, the reader will know:

a) Why traffic analysis is important for CBA
b) What kind of elements are to be included in traffic analysis
c) What is the role of the Serbian Transport Model?

3.2 Scope of Traffic Analysis

Traffic demand analysis should be as project specific as possible and should normally include the following information:

- The area of influence of the project, this aspect is important to identify the demand "without the project" and the impacts of the new infrastructure, as well as to identify the other transport modes which could be considered.
- The assumptions concerning the competing modes and alternative routes (fares and costs for users, pricing and regulation policies, the congestion and saturation levels of networks, the new investments which are expected within the time span of the analysis).
- Historic traffic volumes for the section (e.g. last 5 years), in terms of vehicles, passenger km and tonne km.
- Composition of the traffic (existing, diverted and the generated or induced traffic) on the existing road and new or upgraded road.
- Indication about O/D of the traffic (% transit, O/D and local traffic).
- Elasticity of time and costs of the traffic (this also includes a reflection on any fares that might be levied).
- Sensitivity of the expected traffic flows for some critical variables: elasticity of travel times and costs, congestion levels of competing routes or modes, etc.
- Methodology used for demand analysis and main assumptions used (macro-economic development, demographic changes, growth rates used, train occupancy, etc.).

Traffic Studies and Transport Models

It is recommended that the demand is determined through a traffic study to the extent that is possible. The extent and level of elaboration of such a 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. It should be noted that Serbia is in the fortunate situation that a dedicated transport model has been developed as part of the General Transport Master Plan (2009) project.

Where for some reason a traffic study is not relevant or cannot be done (this should, however, be well justified), a fairly rough estimate of future demand for transport services could be made through social and economic projections.

The element of traffic and transport forecasting is notably important in the CBA context. An infrastructure project is a planned extension to the existing infrastructure network, in the future. So the project will affect future transport flows. For example, EU accession of Serbia could lead to increased international transport flows in relation with EU countries. In order to forecast the transport flows, a transport model is needed. The model needs to be able to provide a forecast of the transport flows and to be able to evaluate the situation with and without the planned project. The advantage of a model is that projects are evaluated in a structural way and the calculations can be repeated for different variants. So especially in cases where a lot of projects need to be evaluated, a transport model could save a considerable amount of time. At the same time the interdependencies between different projects can be made visible.

For example, if one plans to build two more or less parallel routes, one can observe the benefits from the two routes, compared to a combined route. Another case is, for example, a bridge with heavy congestion: with a transport model one can determine from a transport planning perspective the location and capacity of a newly constructed bridge. The optimal location can be found through different iterations. Once can say that the capacity must be sufficient to handle the forecast transport volumes in the future as far as the planning horizon. In a capacity restrained transport model one will introduce future congestion levels and therewith also time losses in the future into the model. The Serbian Transport Model (STM) has been developed exactly for the purpose of, on the one side providing future values for traffic and on the other side to evaluate and prioritise different projects.

3.3 Serbian Transport Model

A multi-modal transport model that incorporates all modes was established for the project General Master Plan for Transport (GMPT)[16]. in Serbia. The purpose of a transport model in general and of the specific model developed within the GMPT is to simulate future developments and their impact on transport demand under different socio-economic and political scenarios.

Outline of the Serbian Transport Model

The EU TRANS-TOOLS modelling set[17] has been used as a basis for the elaboration of the Serbian transport model. It has been further worked out in more detail so that it is applicable to this current study area. The model includes:

- Adopted zoning system that consists of 25 districts with associated to these socio-economic data.
- Passenger and freight transport data and
- Infrastructure networks data.

Similar to the base year the multimodal network consists of separate networks for rail, road and inland waterway networks, further connected by transhipment nodes to reflect the integration of separate transport modes with transportation chains.

The model allows the determination of the relevant parameters for CBA in a structural and reproducible way. This adds to the credibility of the CBA process and will be beneficial when raising funding for the projects.

Transport Model input into CBA

The basic CBA parameters that are required to be able to conduct economic and financial analyses that are retrieved from the transport model are the following:

- Traffic volumes for freight and passenger on the different links of the infrastructure network. This is an essential input for analysis of alternative options (step 3)[18], the financial (step 4), economic analysis (step 5) and risk assessment (step 6) in a CBA.
- Number of passengers per vehicle, load factor freight, which are important for economic analysis (step 5).
- Traffic speeds and journey times, which are important for economic analysis (step 5).
- Accident rates, which are important for economic analysis (step 5).
- Emissions, which are important for economic analysis (step 5).

These parameters are usually obtained for the “with project” and “without project” scenario. As explained in previous sections the project benefits are obtained by comparing the “with project” relative to the “without project”. In the

[16] General Master Plan for transport in Serbia – Final Report (October 2009), implemented by Italferr, NEA, W+B and IIPP.

[17] More information on TRANS-TOOLS: http://energy.jrc.ec.europa.eu/TRANS-TOOLS/FTP.html.

[18] The steps mentioned here refer to the six CBA process steps, as described in Section 2.3.

GMPT a total of thirty (30) projects have been evaluated with the transport model and have been compared relative to the "without project" scenario.

Generated Traffic

The GTMP considers the "generated traffic". The model includes generated traffic, i.e. a change in "generalised travel costs" leads to a change of mobility patterns. For the generated traffic the rule of half is applied in the GTMP (see Section 5.3.1). At the same time, notably for freight transport a change in transit traffic was included in the GMPT; these benefits are directed to foreign users of the Serbian infrastructures. A reminder must be made that it is a multimodal passenger and freight model that covers all modes, so changes are simultaneously computed for all modes, including capacity use effects.

Time Horizon

The time horizon for the transport model stretches from 2005 till 2030. Besides providing the values for the base year, which is 2005, the values of all parameters are also to be given for all years towards 2030. For example, the assumption for the Value of Time (VoT) — see Section 5.3.1 — is made that it grows at the same rate as GDP. When having estimated the benefits for each year from 2005 to 2030 and after discounting, it turns out that the travel time and the changes in vehicle operating costs are the largest sources of benefits. The other benefits are a factor 10 lower. Changes in noise levels (another source of benefits) were left out in the GMPT project, as these have a small impact and values are even more difficult to determine.

The approach chosen in the model developed for the GMPT is similar to the standard CBA theory that is applied in transport project appraisal in Europe. Exception to this rule are:

- Noise valuation is left out for reasons of ambiguity.
- An extra element covering the change in wear and tear of vehicle bases on roughness (as measured in IRI, see Section 5.3.2) has been included.

Section 2 CBA Calculations

4 Financial Analysis

4.1 Background

This chapter is the first in a series of three chapters that together form Section 2 of this CBA Manual and are focused on making CBA calculations. It should be noted that these three chapters are directly interrelated. This first chapter, financial analysis, establishes the basic cash flow overviews, based on a number of standard elements. The next chapter takes the results of the financial analysis as a starting point and makes a number of adjustments in order to make the economic analysis. Finally in Chapter 6 an analysis is made of the project's risk by varying the key parameters of the CBA calculations and determining the effects on the CBA outcome.

After having read and understood the contents of this chapter, the reader will know:

a. What a financial analysis is
b. What kind of costs and benefits are included in a financial analysis
c. What time horizon is applied for CBA calculation of a road project?
d. How residual value of a project is dealt with in CBA calculation of a road project
e. How inflation is dealt with in CBA calculation of a road project
f. What kind of financial discount rate is applied?
g. What kind of indicators are calculated, i.e. Financial Net Present Value, or Financial Rate of Return

4.2 Principles of Financial Analysis

Costs and Benefits from the Operator's Point of View

Financial analysis is an assessment of all financial costs and benefits which the owner or operator of the project will have during the lifetime of the project. The general aim of the financial analysis is to determine whether a project is profitable from a financial point of view. The result of this assessment can be used to determine the amount of external resources, e.g. EU grants, that are needed.

For this purpose, the EU Guide to Cost Benefit Analysis of investment projects suggests looking at the following indicators (see Section 4.5):

- Financial Internal Rate of Return (FRR)
- Financial Net Present Value (FNPV)

Cash Flows: Costs and Benefits during the Lifetime of the Project

To calculate these indicators the information on financial cash flows (total investment costs, total operating costs and revenues) need to be assessed. These items are presented in more detail in Section 4.4. It is important to note that in the financial analysis only real, tangible cash flows are considered, i.e. real money transfers. Examples are the investment costs for building a road or the annual road maintenance costs, or revenues from operating a toll road. Intangible costs and benefits, such as time savings or reduced pollution, are not included in the financial analysis.

4.3 Basic Elements of Financial Analysis

In order to establish a financial cash flow overview, several basic elements have to be determined first, these are outlined below.

4.3.1 Time Horizon

The choice of the time horizon is important for the CBA calculation. In its guidance on the methodology for Carrying out a CBA (Working Document n4), the European Commission establishes the reference time horizon for the roads sector projects at 25 – 30 years. Therefore, the CBA and the forecasts are usually provided for this time period. The DG REGIO 2002 guidelines recommended the time period to be covered in economic appraisal for transport projects for 2000 to 2006 to be 25 years for road projects. Also the World Bank recommends an appraisal period of 25 years as the standard for the appraisal of WB-funded projects[19]. In Annex 3 an overview is included of standard appraisal periods in different EU countries.

Proposed value for Serbia
It is proposed to apply a ***25 year period*** for the evaluation of road infrastructure projects in Serbia. If a different time horizon is applied, the reason for doing so should be well argued.

4.3.2 Residual Value of Investment

Once road infrastructure is constructed it is supposed to be used for an unlimited period of time. However, for the CBA calculations and in order to have a full cash flow overview, it is necessary to establish the project's residual value. Residual value is an amount that the project owner expects to be able to receive from selling the fixed assets of the project at the end of its economic useful life.

The residual value of an investment can be determined on a case by case basis. The residual value of the investment must be included in the CBA for the end-year of the CBA as an inflow (potential revenue). The residual value should be regarded as the salvage value of fixed asset or any remaining capacity to generate net revenues or net benefits. According to literature, there are four ways to calculate the residual value:

[19] See Notes on the Economic Evaluation of Transport Projects: a Framework for the Economic Evaluation of Transport Projects – Transport Note No. 5.

1. By considering the residual market value of fixed assets, as if the transport project were to be sold at the end of the time horizon considered (corrected for any remaining net liabilities).
2. By calculating the economic depreciation of the assets of the project (for example a depreciation of 5% per year means that the residual value is 0 after 20 years). For transport projects salvation values can be used.
3. By assessing the remaining revenue generating capacity after the end year. This can be done by computing the net present value of cash flows in the remaining life-years of the project given some assumptions (such as revenues kept constant from the end year and operating costs kept constant until eternity).
4. By assessing the remaining net cash-flow of all costs and benefits after the end year. For example in CBAs performed in the Netherlands according to the Dutch OEI CBA Guidelines, often the cash-flows of costs and benefits of the end year are assumed to be constant after the end year until eternity.

Proposed approach for Serbia
It is proposed to apply residual value calculation based on the third mentioned method for Serbian toll roads. For all other roads (that do not generate revenue) applying the fourth method is recommended.

4.3.3 Adjustment to Inflation

A decision needs to be taken on whether financial flows are calculated in constant real prices (prices adjusted for inflation and fixed at a base-year) or current prices (nominal prices observed year by year). The EC Guidelines recommends using current prices in the analysis of financial flows.

Proposed approach for Serbia
It is proposed to apply current prices in the analysis of financial flows.

4.3.4 Financial Discount Rate

A discount rate is a factor used to transform costs and benefits arising in different years of the project to their present values. In the financial analysis it should reflect the opportunity cost of capital to the investor. The European Commission recommends that a 5% financial discount rate in real terms is used as an indicative benchmark for public investment projects co-financed by funds[20]. The World Bank often applies a higher standard discount rate[21].

There are different methods to calculate the financial discount rate; different countries use different methods. International comparison shows that the financial discount rate shows similar values compared to the social discount rate[22].

[20] EC, Working document n4.
[21] The World Bank applies a standard discount rate of 12%.
[22] See Section 5.6 on social discount rate.

The Serbian Ministry of Finance determines the level of the financial discount rate to be applied in CBA for road infrastructure projects. At this moment the financial discount rate is set at 10%.

Proposed value for Serbia
It is proposed to use an 10% financial discount rate in the financial analysis, as stipulated by the Serbian Ministry of Finance.

The level of the financial discount rate should be periodically reviewed by the Ministry of Finance.

4.4 Determining Total Costs and Revenues

The main expenditures take place during the two first stages of the project, i.e. the planning and construction phase. During the **project planning phase** a range of costs, such as design costs, planning authority resources and other planning costs need to be taken into account. During the **project construction phase** all the costs related to materials, labour, energy, preparation, professional fees and contingencies need to be assessed. These are investments in the project.

During its **operational phase** the project starts receiving the first revenues, while still having maintenance and potentially other operational expenditures. It is important to consider that unless the road project concerns toll roads, the financial analysis does not include benefits/revenues for the operators.

Market prices

For the financial analysis **market prices** are used; economic analysis uses accounting prices. It should be kept in mind that investment and operational costs vary a lot per project. Total costs, used in financial analysis, are obtained by summing up investment costs and maintenance and operating costs.

4.4.1 Investment Costs

Investment costs consist of the above-mentioned project planning and project construction costs. Planning costs include design and studies, as mentioned above. Construction costs are the costs which are incurred to build the physical infrastructure of the project.

The amount of the construction costs can be evaluated in accordance with the following cost items[23]:

- Net price of the structure down to road bed.
- Price of earthwork.
- Price of fortifications (support walls, etc).
- Price of large facilities (underpasses, overhead crossings, viaducts, bridges, tunnels, etc).
- Price of small facilities (drain pipes, etc).

[23] JASPERS, CBA Guidelines for Transport Sector - Bulgaria, June 2008

- Price of signalisation, telecommunications and lighting.
- Price of green layout.
- Other specific (and expensive) construction activities.
- Other price components.

Usually the estimation of these costs can be derived from the engineering design studies and estimations.

Some specific cost items are:

- **Expropriation costs** are the costs of land expropriation determined by independent licensed evaluators or valuation companies. They differ for urbanised territories, farm lands and forest. The valuations are usually done in compliance with National Legislation.
- If the **project management** is outsourced to any external companies, the project management costs need to be taken into consideration.

Contingency Costs

Contingency costs are specific cost provisions that may result from unforeseen and unpredictable conditions or uncertainties within the defined project scope. Their amounts depend on the status of the design, procurement and construction process and the complexity and uncertainties of different parts of the project. Recommended values for contingencies as a percent of the construction works value are[24:]

- Low risk projects (i.e. road rehabilitation) – 10 to 15%
- Medium and high risk projects – 15 to 20%

In cases where the project carries high risks the amount of contingency costs can be increased[25].

Proposed approach for Serbia
It is proposed to calculate contingencies as a percentage of the construction works value, 15% for low risk projects and 20% for medium and high risk projects.

4.4.2 Maintenance and Operating Costs

Maintenance and Operating costs include the annual expenditures for the regular maintenance and repair of the road sections and necessary road fortifications. These costs are normally divided into three groups: equipment, materials and labour costs.

The EC Guide to CBA of investment projects specifies that during the calculation of the operational costs, all items that do not give rise to an effective monetary expenditure must be excluded. For example these items should not be included in the operating costs:

[24] JASPERS, CBA Guidelines for Transport Sector - Bulgaria, June 2008
[25] EC Guidance states that contingencies should be excluded from financial analysis and should be dealt with in the Risk Analysis.

- depreciation and amortisation
- any reserves for future replacement costs

4.4.3 Operating Revenues

The financial analysis considers the revenues to the owner of the infrastructure. Toll free roads do not generate revenues. In this case financial analysis is limited to the collection of information on the total costs and to the calculation of the basic financial indicators. In the case of toll roads (or tunnels or bridges) the level and annual increase of tolls (per category user/payer) has to be estimated (possibly in collaboration with the operator of the road). On the basis of the traffic forecast and toll level estimates, yearly revenues can then be estimated.

4.5 Financial Analysis Indicators

Once the project financial cash flow has been carried out, the next step is to calculate the financial indicators. These indicators are aimed at showing the financial profitability of the project.

Two main indicators used for financial analysis are[26]:

1. Financial net present value of the project (FNPV)
2. Financial internal rate of return (FRR)

4.5.1 Financial Net Present Value

Financial Net Present Value (FNPV) is an indicator which helps to determine the financial profitability of the project. It is calculated using the following formula:

$$FNPV(S) = \sum_{t=0}^{n} a_t S_t = S_0 + \frac{S_1}{(1+i)} + \frac{S_2}{(1+i)^2} + \ldots \frac{S_n}{(1+i)^n}$$

Where:

S_t = balance of cash flow at time t (inflows – outflows)

$$a_t = \frac{1}{(1+i)^n} = \text{Financial discount factor}$$

$i =$ Financial discount rate
$n =$ time horizon/appraisal period

A positive FNPV means that the project will generate enough profit in the long run to cover both the operating and the investments costs. Based on these criteria it is viable for (commercial) realisation. A negative FNPV indicates that the project will not generate sufficient revenue to cover the investment and operating costs and therefore cannot be commercially realised or funded by commercial loans.

[26] For the EU funded projects both indicators need to be calculated for the investment and for the invested capital.

4.5.2 Financial Internal Rate of Return

Financial Internal Rate of Return (FRR) is an indicator which shows the financial profitability of investments. It is calculated with the help of this formula:

$$FNPV(S) = \sum_{t=0}^{n} \frac{S_t}{(1 + FRR)^t} = 0$$

Where

$S_t =$ balance of cash flow at time t (inflows – outflows)

Usually FRR is used to evaluate the future financial performance of an investment. In principle the FRR should be higher than the financial discount rate (opportunity cost of capital). If the FRR is larger than the financial discount rate it implies that the project generates enough revenues to cover investment and operating costs in the long run. In other words, in that case, the project is commercially viable and could, in principle, be financed by loans (or own equity). Sometimes FRR is also used to determine the co-financing rate. As the EC Guide postulates, "the very low or even negative financial rate of return does not necessarily mean that the project is not in keeping with the objectives of the funds". But it can be an indication that investment would never be profitable from the financial point of view.

5 Economic Analysis

5.1 Background

This chapter is the second of a series of chapters that together form Section 2 of this CBA manual, focussing on CBA calculations. This chapter on economic analysis builds directly on the results of the financial analysis.

After having read and understood the contents of this chapter, the reader will know:

a. What economic analysis is.
b. What adjustments are made in comparison to financial analysis.
c. What the rule of half is.
d. What the most commonly included externalities and values for Serbia are.
e. Which fiscal corrections need to be applied.
f. How transformation from market to accounting prices is done.
g. What kind of indicators for economic analysis are calculated.

5.2 Principles of Economic Analysis

Economic analysis is conducted from the point of view of the whole society, and its objective is to evaluate the impact of the project on the welfare of population and regions. Economic analysis is conducted on the basis of information collected within the financial analysis. Furthermore, in order to switch from the perspective of the project owner to the perspectives of the whole society, three main updates of financial flows are made:

1. Introduction of externalities (Section 5.3).
2. Fiscal corrections (Section 5.4).
3. Transformation from market to accounting prices (Section 5.5).

After establishing the economic cash flows, based on the above-mentioned adjustments, an evaluation can be made of whether a project will bring any social value to the society (Section 5.7), using a set of indicators, such as: Economic Internal Rate of Return (IRR) and economic Net Present Value (ENPV).

5.3 Introduction of Externalities

Ideally the CBA process should include all the impacts of the investment, no matter how small the impact is[27]. In reality, due to the complexity of these tasks, the number of evaluated impacts is generally limited to the impacts on: the infrastructure managers (investment and maintenance costs as described previously), transport users, transport providers and society. When dealing with the road sector, given the fact that the private sector accounts for the large

[27] HEATCO - Developing Harmonised European Approaches for Transport Costing and Project Assessment, Deliverable 5 Proposal for Harmonised Guidelines, 2006

majority of passenger traffic, a separate analysis for public transport users and providers is generally not required. To keep things simple, public transport operators are treated as users[28]. Therefore the two main groups of impacts to be analysed for road infrastructure projects are transport users' benefits and external impacts.

Transport Users' Benefits or Consumer Surplus is the consumers' willingness to pay over the cost of a trip[29]. The change in consumer surplus results from the cost of travel brought about by an improvement of the transport conditions. The standard items to be included while estimating the users' benefits are changes in (i) travel time and (ii) vehicle operating costs.

External impacts are unintended impacts on aspects of society where no market or prices exists (such as the quality of the environment and nature). Those effects do not monetarily affect the producers/owners/users of transport infrastructure, but do influence the standard of living of society as a whole. The two main categories of the external impacts of road transport projects are the impacts on safety and impacts on the environment.

5.3.1 Impact on Users – Travel Time

Time savings is one of the most significant benefits which can arise from the construction of new, or improvement of existing, road infrastructure. It is estimated that in the UK, the Netherlands and Finland as much as 80% of the measured road projects' benefits are represented through the savings in travel time. In CBA the distinction is made between the estimation of work-related and non work-related trips as consumers value time differently in these two situations, as illustrated below.

Rule of Half

The change in consumer surplus is the difference between the change in the total benefit enjoyed and the change in the costs perceived, this counts for all existing travellers. The calculation of benefits to new users should reflect the fact that they have preferred this new transport option to the other transport modes/routes, or should represent generated demand. Economic theory suggests that, for small changes, their benefits should represent approximately half of the benefits to each existing user. The travel time saving element of the consumer surplus for that origin-destination trip is therefore calculated using the "rule of half". For the more detailed explanation of the "Rule of half" please refer to Annex 6.

Value of Time for Different Travel Purposes

To estimate the value of the commuter time (work-trip) the "cost saving" approach is usually used. The idea behind this approach is that time spent for work-related trips are a cost to the employer, who could have used this time in a more productive way. Thus, the value of time for work trips would be expressed as:

[28] JASPERS, CBA Guidelines for Transport Sector - Bulgaria, June 2008
[29] HEATCO - Developing Harmonised European Approaches for Transport Costing and Project Assessment, Deliverable 5 Proposal for Harmonised Guidelines, 2006

Work Trip Value = (1 + t)w,
Where:
w = wage rate
t = value of non-wage fringe benefits expressed in percent of wage rate

Furthermore, it is possible to differentiate the work-trip value by different transport modes, different wage groups, rural and urbanised areas, etc.

Estimating the value of non-work related trips time is considered to be more complicated. As the World Bank report defines, "the economic value of time savings for non-work trips is the difference between the marginal valuation of time associated with travelling and that associated with leisure". Therefore, the values of non-work related trips depend on the travel purposes, mode of transport, culture, transport users' income, level of comfort, etc. and can vary considerably. Most often, this indicator is related to income. The World Bank methodology advises taking revealed or stated consumers' preferences into consideration.

Time and Tolling

A remark has to be made about toll roads, toll bridges or toll tunnels. If there are revenues from tolls in the financial analysis and inclusion of time saving benefits in the economic analysis then double counting can occur. In fact, part of the willingness to pay for travel time reductions by the users is passed on through tolls to the operator (supplier). In this sense the toll income can be left out of the economic analysis. Moreover, there is a relation between toll levels and traffic demand. The higher the tolls, the lower the traffic demand will be (depending on the price elasticity of the users). In that sense there can be a trade off between the toll income (financial analysis) and the consumer surplus (time savings benefits) in the economic analysis.

Proposed Value for Serbia

The value of time (VoT) is preferably to be determined within the context of the projects, however this is very costly. Usually these are obtained from studies carried out at the national level. In the case of Serbia no study was at hand, the value of time was determined based on the HEATCO values for different countries. A relationship between the Value of Time and the GDP was estimated and applied in the analysis of the General Transport Master Plan. A distinction was made between VoT for freight and passenger transport users. Table 5.1 presents the VoT for passenger and freight in 2010.

In the GMPT VoT was calculated for different years. VoT increases at the same rate as GDP growth. The values are calculated in Euros as in the long-term these form a more stable unit for calculation. The growth of GDP is taken in real terms (not in nominal). A full overview is presented in Annex 7

Table 5.1 Serbian VoT

Year	Time values	
	Passengers Euro/hr	Freights Euro/hr/ton
2010	3.75	0.05

Source: General Transport Master Plan Serbia (2009)

5.3.2 Impact on Users – Vehicle Operating Costs

Vehicle operating costs (VOC) are the costs/benefits that the owner of the transport vehicle makes or receives in the form of the increase/reduction of the operating costs of his vehicle. The HEATCO study define VOC as "comprising the standing costs, which are invariant with distance, and operating costs, which vary with distance, of the transport vehicle". The same study recommends including the following components in the calculation of the VOC:

- **Standing (Fixed) Cost components**: depreciation (time-dependent share), interest of capital, repair and maintenance costs, material costs, insurance, overheads, administration.
- **Operating (Variable) Cost components**: personnel costs (if not included in travel time savings), depreciation (distance-dependent share), fuel and lubricants, maintenance cost (distance –related).

In the road transport sector VOC usually includes the costs of fuel, lubricating oil, spare parts, maintenance (labour hours), tyres, depreciation and crew. These costs vary on a number of variables[30]:

- **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 World Bank has developed HDM-4 computer software, which is often used to estimate VOCs, also in the case of the GMPT (see below).

An improvement of the roads in Serbia can have a positive effect on the operating cost as a result of (i) shorter routes which will lead to lower operating costs and (ii) improved quality of roads that will lead to reduced wear and tear of the vehicle. A reduction in the IRI (international Roughness Index) gives an idea in how far this will lead to reduced wear and tear of the vehicle. This aspect of IRI is a specific element in CBA analyses for countries where the infrastructure is in (rather) poor condition.

[30] JASPERS, CBA Guidelines for Transport Sector - Bulgaria, June 2008

Proposed Value for Serbia
The speed is obtained from the GMPT. So the VoC is calculated for each link. A change in IRI and a change in speed will lead to a new value of VoC. An improvement in infrastructure leads to a lower IRI resulting in a lower VoC. A lower VoC is a benefit to society.

The relationship between speed and VOC is a quadratic function, as shown below (see Annex 5 for more elaboration):

VoC = a+b*speed +c*speed^2

The values for the parameters for medium passenger cars for a flat terrain are listed in Table 5.2. A full overview of calculated VOCs for different types of vehicles and different terrains is presented in Annex 5.

Table 5.2 VOC for Medium Passenger Car

Type of terrain	Flat			
IRI	2	5	8	12
a	0.25427	0.26845	0.29948	0.33829
B	-0.00313	-0.00347	-0.00458	-0.00619
C	0.00002	0.00002	0.00003	0.00006

Source: General Transport Master Plan Serbia (2009)

5.3.3 Broader Impacts Society — Safety

The cost of accidents is an important socio-economic cost of transport. The following accident classification is traditionally applied to the CBA of transport projects:

- Fatal accident: Death within 30 days of causes arising from accident.
- Serious injury: Cases which require hospitalisation, hospital treatment and results in lasting injuries, but do not lead to death within 30 days.
- Slight accident: Cases that do not require major hospital treatment, or if they do, the effects of the injuries can be quickly overcome
- Damage-only accidents: accidents without casualties.

The main three categories of the accident costs are: material damage (cost of vehicle damage, cost of lost or damaged goods), personal loss or casualties, costs to society. They can be further detailed into the following items: damage to property, cost of emergency services, legal and court costs, insurance costs, lost economic output, delays to other transport users, welfare loss, human costs including pain and suffering, etc.

In order to include road safety (savings) in a CBA the value of life needs to be monetarised. The values that are applied for Serbia in the GMPT are presented below.

Proposed Value for Serbia
Besides the effect of improvement of the roads there is also an autonomous increase in road safety as a result of a safer vehicle park and better driving capabilities over a period of time. So not all increase in traffic safety can be allocated to the project benefits. Therefore estimation was made of which increase in traffic safety could be attributed to the projects. This was monetised again with HEATCO adapted values for Serbia.

Table 5.3 presents the 2010 values in Euros for different injuries in accidents are listed. The values are in Euros and have been obtained from HEATCO and are adapted to GDP values for the Serbian situation. The values are calculated for the period 2007-2030 and are presented in Annex 8.

Table 5.3 Road Safety Values

Year	Average value of fatalities serbia	Average value of severe injuries serbia	Average value of slight injuries serbia	Average value of accident serbia
2010	295,916	39,508	2,992	88,800

Source: General Transport Master Plan Serbia (2009)

The improvement of roads will lead to lower accident rates. It should be noted that in the GMP only the accidents outside urban areas are evaluated. A method has been defined to make this distinction for the base year. Also, as mentioned, there is an autonomous development towards a safer environment as the vehicle park will improve. More details are presented in Annex 8.

5.3.4 Wider Impacts on Society - Environment

The different impacts that transport projects have on the environment should be considered within a CBA analysis: air pollution, climate change, noise pollution, congestion, absence of service costs, nature and landscape change. Usually a separate Environment Impact Assessment (EIA) is required for the projects financed by the European Commission. If this EIA (which is a legal procedure and study on environmental impacts) is available, then the CBA study team can make use of the results of this study. In principle the main environmental impacts of transport projects should quantified and monetized be as much as possible in the CBA study.

It is important that the CBA study team assesses whether the environmental impact on, for example, air quality are additional effects or a substitution of effects. For example, the diversion of traffic from other roads to the new road can result in lower emissions instead of higher emissions because of travel time reductions when compared to the scenario without the project. Newly generated traffic will generally result in higher emissions.

For the environmental effects, an estimation of the emissions is made; this is based on fuel/energy use of the vehicles (for road diesel and gasoline, for rail diesel and electric). The fuel/energy use is transformed in volume of the following emissions: CO, NO_x, VOC, CH_4, PM, CO_2 and SO_x. With monetary values per kg or tonne of emission derived from HEATCO, these were transformed into monetary values. Also here the HEATCO report provided useful references for estimating values for Serbia.

Air Pollution Costs

It is known that road transport considerably affects the atmospheric pollution. The CBA method usually includes the monetary values of the following effects in order to estimate the air pollution costs of the particular road project: human health, material damage, loss of crops and losses caused by damages incurred on the ecosystems. In road transport projects the level of these costs depends on the vehicle standard emission, year of manufacture, speed, type of fuel, technology of burning, factor of loading, vehicle size, etc.

The pollution costs are related to the energy use of road and rail transport. The following emissions are calculated on the basis of energy use: CO NO_x, VOC, CH_4, PM, CO_2, SO_x. The speed on a link and the length of the link determine the litres of fuel, either gasoline or diesel, depending on the type of car of rail link. For rail it counts where a link is electrified. Once the litres of fuel are determined and converted into specific amounts of emissions then monetary values are related the type of emissions.

Table 5.4 presents proposed air pollution values for Serbia, i.e. the values in Euros per tonne. These are a cost to society.

Table 5.4 Proposed Air Pollution Values in Serbia

Pollution	Value (EURO/tonne)
CO	460.4
NOx	7.6
VOC	1.5
CH_4	60.0
PM	33.3
CO_2	3.0
SO_x	9.5

Source: General Transport Master Plan Serbia (2009)

If transport is becoming more efficient through improved shorter links then a lower emission cost will result.

Noise Pollution

Noise pollution can be defined as undesirable sound (in terms of decibels) or sounds of different duration, intensity and other characteristics causing mental disturbance in people. There are several ways to monetise noise effects of transport projects. One method is to use revealed preferences (market values of real estate or health costs). There is literature on the effects of additional noise on (lower) house values. Given the amount of houses affected by noise because of the project and the average house price a total cost can be calculated. Other methods (stated preferences) use irritation and health and the willingness to accept compensation or willingness to pay for noise reductions. The noise costs vary upon the time of the day, population density near the source of noise and existing noise level. In road transport projects this value depends on vehicle speed, share of trucks, condition, road gradient, surface and driving style.

Noise pollution is not included in the GMPT; there are many improvements possible here. But a large part of the improvement will be autonomous as the quality of the vehicle park will increase with and is to a large extent not related to the investment project. However it would be relatively easy to include noise if some benchmark values were available and if a vision towards noise regulation in Serbia would be available.

Climate Change Costs

As mentioned in HEATCO, there is no consensus on whether or not and how climate change and greenhouse effects should be included in the CBA. Most developed countries incorporating greenhouse effect use monetary valuation of CO_2 emissions.

In the GMPT no values are included for climate change specifically.

Congestion Costs

Traffic jams can have different impacts on society: costs of vehicle maintenance and operation, the increase in the price of time, increase in fuel costs, cost of lack of transport service, etc.

There are no congestion costs included in GMPT. As such congestion is incorporated in the model with speed flow curves. If links become congested this will lead to a reduction in speed and result in a lower time gain relative to an unconstrained assignment.

5.3.5 Wider Impacts Society - Economy

Often an important objective of transport projects is to improve the economic situation in the country or in some regions. Therefore it is important to consider whether the project has any wider economic benefits, for example in terms of productivity and employment impacts.

The wider economic impacts of transport projects stem from the reductions in commuting and transport costs for the users. Lower commuting costs increase the search area for workers and firms and can result in a better match on the labour market. Lower transport costs for freight and business trips will result in lower overall costs of companies and therefore reduced prices and more demand for products and services and higher employment. Finally, lower transport costs for leisure trips can lead to more leisure expenses of consumers who make new trips and profits in the leisure sector.
However, in case of non-market failures all these economic benefits are already reflected in the transport costs reductions (direct effects). In that case the commuting and transport costs savings are just passed on to other markets. Only in case of market failure can additional effects be expected (such as market failure and unemployment on regional labour markets). Moreover, in the conversion factor approach the employment benefits of the labour inputs are

already reflected. Also gross employment impacts should be corrected for displacement and substitution effects. This implies that the wider economic benefits are only expected to be significant in specific circumstances.

Therefore, it is recommended that in principle no wider economic benefits are quantified for most road projects. Only in case of new connections between regions or with neighbouring countries with significant reductions of travel times it is proposed to quantify additional economic benefits. It is advised to use economic models which translate travel costs reductions into economic impacts such as SCGE (Spatial Computable General Equilibrium) or macro-econometric models for this. The TRANS-TOOLS model includes an SCGE model with which these indirect effects can be estimated.

5.4 Fiscal Corrections

In the economic analysis the real prices for users and suppliers on markets in society are relevant. However, the prices used in the financial analysis often do not reflect the real value for society because of market failures or missing markets and missing information. Moreover, taxes or subsidies are often from the perspective of society transfers (redistributional). For these reasons, fiscal corrections need to be done and conversion factors need to be applied in the economic analysis for all inwards and outwards flows from the financial analysis.

The cash flows used in the financial analysis need to be corrected for the amount of all identifiable fiscal transfer payments, mainly from the capital costs and operating costs. In the case of transport infrastructure projects, basic transfers include VAT, payments involving salaries, pension scheme and other taxes (e.g. fuel tax)[31]. Very often it is difficult to estimate the prices of net tax that is why EC guidance recommends applying some basic rules:

- Prices of inputs and outputs to be considered for CBA should be net of VAT and other indirect taxes.
- Prices of inputs to be considered in CBA should be gross of direct taxes.
- Pure transfer payments for individuals, such as social security payments, should be omitted.
- In some cases indirect taxes/subsidies are intended as corrections of externalities. Only in these cases will the tax or subsidy effects be included in the economic analysis.

Proposed Value for Serbia

The conversion factors used in the GMPT to transform financial costs into economic costs have been developed for two classes. The first is associated to the construction works, while the second relates to operating costs.

The conversion factors established for construction works related to:

- Labour costs (imported and national labour).
- Materials (imported and domestically produced).
- Equipment (imported and domestically produced).
- Design, work supervision and studies.

[31] JASPERS, CBA Guidelines for Transport Sector - Bulgaria, June 2008

The conversion factors associated to operating costs relate to:

- Road vehicles, spare parts and tyres costs.
- Gasoline and diesel fuels.
- Electric energy for train traction.

In the tables below the conversion factors are shown. The first table summarises the conversion factors which are used in the GMPT for construction and maintenance works. The second table shows the conversion factors for operating costs as applied in the GMPT. For a detailed treatment of the calculation of the conversion factors it is referred to the GMPT Final Report[32]. The conversion factors multiplied with the benefit and cost values used in the GMPT study will yield the economic values.

Table 5.5 Conversion Factors for Construction and Maintenance Works

Item	Conversion factor
Imported skilled labour	1.000
National skilled labour	0.918
Imported material	0.884
National material	0.982
Imported equipment	0.855
National equipment	0.871
General expenses	0.906
Profits	0.900

Source: General Transport Master Plan Serbia (2009)

These conversion factors can only be applied if the investment costs are broken down into materials, equipment and labour costs. In case this information is not available, it is recommended to apply a conversion factor of 0.9 for construction and maintenance costs.

[32] GMPT Final Report, (page 98-105).

Table 5.6 Conversion Factors for Operating Costs

Item	Conversion factor
Bus	0.905
Articulated truck	0.929
Heavy truck	0.929
Medium and light truck	0.905
Passenger car medium	0.884
Tyres and spares	0.884
Gasoline	0.450
Diesel	0.571
Electricity	0.950

Source: General Transport Master Plan Serbia (2009)

These conversion factors can only be applied if the vehicle operating costs are broken down into depreciation, tyres and spare parts, and fuel consumption. If this information is not available, it is recommended to apply a standard conversion factor of 0.7 for vehicle operating costs.

5.5 Transformation from Market to Accounting Prices

Transformation of market prices into accounting prices is done with the help of conversion factors. The costs used in financial analysis are converted for the use of economic analysis by applying conversion factors for the following separate cost components:

- Land: acquiring land is often a cost to the initiator, but a benefit to the land owner.
- Equipment: often import duties tend to distort the price of equipment purchased abroad.
- Materials: idem.
- Labour: input of labour is often a cost to the project initiator, but labour also has a benefit in terms of lower unemployment for unemployed persons (and society as a whole). Therefore the costs of labour are adjusted downwards in the economic analysis (depending on the skill level and labour market situation of the workers).
- Other costs.

Normally the overall conversion factors used in CBAs in pre-accession countries vary between 0.85 and 0.94. A calculation of precise conversion factors for Serbia for these cost components could not be made due to some data not being available.

The unemployment levels are rather high in Serbia. This holds also true for the labour force in Serbia related to skills in the road construction and maintenance sector. Therefore the economic costs of labour inputs for transport construction and maintenance should be corrected for the positive employment benefits in these sectors. For this reason it is proposed to use a conversion factor to be applied on the total investment and operating costs of 0.9.

5.6 Social Discount Rate

In order to bring all the costs and benefits to the same base year, the discounting process is undertaken. As the EC Guide to CBA[33] defines, the discount rate in the economic analysis of investment projects — the social discount rate — attempts to reflect society's view on how future benefits and costs should be valued against present ones (the time preference of society). The EC Guide to CBA recommends using a 5.5% Social discount rate for pre-accession or accession countries as a standard benchmark for EU co-financed projects.

In practice a variation exists in the discount rates used by national transport ministries within the EU. This can be explained partly on the basis of differential opportunity costs of capital in countries, and partly because of the fact that some countries incorporate project risks in the discount rate. In Europe, there are in general two approaches to determine the social discount rate: the Social Time Preference (STP) rate approach and the real long-term government bond rate with a mark-up for risks. The STP approach is based on the long-term rate of growth in the economy and considers the preference for benefits over time, taking into account the expectation of increased income, or consumption, or public expenditure. The real long-term government bond rate approach is based on the minimum long-term rate of return (risk free) for an investment.

The following table provides an overview of the social discount rate used in several EU Member states (old EU15 and new EU12):

Table 5.7 Social Discount Rate used in Member States

Country	Discount Rate
Old MS (EU15)	
Austria	3%
Belgium	4%
Denmark	6%
Finland	5%
France	4%
Germany	3%
Italy	5%
Ireland	4%
Netherlands	5,5% (2,5% risk free, 3% risk mark up)
Portugal	5%
Spain	6%
Sweden	4%
UK	3,5%

[33] Evaluation Unit DG Regional Policy European Commission (Structural Fund – ERDF, Cohesion Fund and ISPA) - Guide to Cost Benefit Analysis of Investment Projects

Country	Discount Rate
New MS (EU12)	
Czech Republic	5%
Estonia	6%
Hungary	5%
Latvia	5,5%
Lithuania	5%
Malta	6%
Poland	5%
Romania	5,5%
Slovak Republic	5%
Slovenia	7%

Sources: National CBA manuals, JASPERS, HEATCO

The recommended methodology to establish the socio-economic discount rate for Serbia is to use the long-term interest rate of the National Bank (in real terms) and add a mark-up for risks. In Serbia the long-term interest rate is around 9% (in current prices) and inflation amounts to 5%, meaning a real interest rate of 4%. The mark-up for risks is to be determined. It is recommended for the Ministry of Finance to define the social interest rate in line with international practice. Currently, the Serbian Ministry of Finance has set the level of the social discount rate at 10%.

Proposed value for Serbia
It is proposed to use an 10% social discount rate in the financial analysis, as stipulated by the Serbian Ministry of Finance.

The level of the social discount rate should be periodically reviewed by the Ministry of Finance, taking into consideration the above-mentioned methodology.

5.7 Economic Analysis Indicators

The standard approach to economic analysis is to sum up positive (benefits) and negative (costs) impacts and thus, to estimate the overall economic result of the project. The main economic indicators used to describe the economic value of the project are: Net present value, internal rate of return and cost/benefit ratio.

5.7.1 Economic Net Present Value of the Project

Economic Net Present Value (ENPV) is in indicator which gives an estimation of the welfare gain from the project during its economic life. It is calculated as the discounted sum of all future benefits minus the discounted sum of all future costs, or using the formula described below.

$$B_0 - C_0 + \frac{B_1 - C_1}{(1+r)} + \frac{B_2 - C_2}{(1+r)^2} + \ldots + \frac{B_t - C_t}{(1+r)^t} + \ldots + \frac{B_n - C_n}{(1+r)^n} = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

Where:
Bt = Benefits in year t
Ct = Costs in year t
R = Discount rate
N = Horizon year
$\frac{1}{(1+r)^t}$ = Discount factor in year t

In other terms,

NPV = PVB-PVC=Present Value of Benefits – Present Value of Costs = $\sum_{t=0}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$

Decision goes in favour of the project when NPV >0, which means that overall benefits of the project are higher than its costs for society.

5.7.2 Economic Internal Rate of Return of the Project

The Economic Internal rate of Return (IRR) is an indicator used to measure and compare the profitability of investments. It is the rate at which benefits are realised over the appraisal/evaluation period of the transport infrastructure project following an initial capital investment[34]. Below is a formula to calculate IRR:

$$B_0 - C_0 + \frac{B_1 - C_1}{(1+IRR)} + \frac{B_2 - C_2}{(1+IRR)^2} + \ldots + \frac{B_t - C_t}{(1+IRR)^t} + \ldots + \frac{B_n - C_n}{(1+IRR)^n} = 0$$

Where

$B_t =$ Benefits in year t
$C_t =$ Costs in year t
$r =$ Discount Rate
$n =$ Horizon year
$IRR =$ Internal Rate of Return

[34] Ministry of Transport Romania, Transport Sector Project Evaluation And Prioritisation Method Working Paper (2008)

Only when the IRR is higher than the social discount rate (the cut off rate) will the project's benefits be larger than the costs for society. For the decision-makers, the higher a project's IRR is, the more desirable it is for implementation. However, when the FRR is already higher than the financial discount rate this does not imply the project justifies a subsidy (in this case the project can be financed by a loan). Only when the economic IRR is larger than the social discount rate (project is good for society) and the financial rate of return on investment (FRR) is lower than the financial discount rate can a subsidy be justified.

5.7.3 Benefit/Cost Ratio of the Project

BCR is an indicator which illustrates how much net benefit would be obtained in return for each unit of cost. This indicator is independent of the year for which it is calculated.

BCR = discounted sum of all future benefits/discounted sum of all costs.

Projects are recommended when the BCR >1.

5.8 A Calculation Example

A calculation Example can be found in Annex 1. The example is based on one of the case studies included in this manual.

6 Risk Analysis

6.1 Background

This chapter on risk analysis builds directly on the results of the financial and economic analysis.

After having read and understood the contents of this chapter, the reader will know:
a. What the scope of risk analysis is.
b. What the critical parameters are.
c. What the a probability distribution for the variables is.
d. How to calculate distribution of the performance indicators.
e. The importance of defining acceptable risks and how to mitigate risks.

6.2 Risk Analysis

Risk analysis can be defined as "studying a probability that a project will achieve a satisfying performance (in terms of IRR and NPV), as well as the variability of the result compared to the best estimate previously made". For risk assessment it is advised to:

- Carry out sensitivity analysis (identification of critical variables, elimination of deterministically dependent variables, elasticity analysis, choice of critical variables, scenario analysis).
- Make assumptions of a probability distribution for each critical variable.
- Make calculations of the distribution of the performance indicator (typically FNPV and ENPV).
- Hold a discussion on the results and acceptable levels of risk and ways to mitigate risks.

6.3 Sensitivity Analysis

The main objective of the sensitivity analysis is to identify critical variables on which the further information need to be collected and to study what the impact will be of the changes in these "critical variables" and parameters determining costs and benefits on the financial and economic indices calculated.

To conduct a sensitivity analysis the following steps need to be taken[35]:

1. Identify all the variables used to calculate the output and input of the financial and economic analysis. EU Guidance suggests grouping them in homogeneous categories, as for example, in Table 6.1.
2. From these variables, identify possible deterministically dependent variables, which will distort the results and give rise to double counts. It is then necessary to eliminate them or to change the model to eliminate internal dependencies. The objective is to consider independent variables in a sensitivity analysis as far as is possible. Conduct a qualitative analysis of the selected variables in order to select those that gave little

[35] EU Guide to CBA of investment projects

or marginal elasticity. The quantitative analysis that follows can then be limited to the more significant variables, verifying them if needed.

3. Once the most significant variables are chosen, their elasticity needs to be evaluated. Each time it is necessary to assign a new value to each variable and recalculate the IRR or NPV indicators. The objective is to estimate the differences (absolute and percentage) compared to the base case.
4. Identify the critical variables, applying the chosen criterion.

Table 6.1 Identification of Critical Variables

Categories	Examples of Variables
Parameters of the model	Discount rate
Price dynamics	Rate of inflation, growth rate of real salaries, energy prices, changes in prices of goods and services
Demand data	Population,demographic growth rate, specific consumption
Investment costs	Duration of the building site (delays in realisation), hourly labour cost, hourly productivity, cost of land, cost of transport, cost of concrete aggregate, distance from the quarry, cost of rentals, depth of the Wells, useful life of the equipment and manufactured goods.
Operating prices	Prices of the goods and services used, hourly cost of personnel, price of Electricity, gas and other fuels
Quantitative parameters for the operating costs	Specific consumption of energy and other goods and services, number of people employed
Prices of revenues	Tariffs, sale prices of products, prices of semi-finished goods.
Quantitative parameters for the revenues	Hourly (or other period) production of goods sold, volume of services provided, productivity, number of users, percentage of penetration of the area solved, market penetration.
Accounting prices (costs and benefits)	Coefficients for converting market prices, value of time, cost of hospitalisation, cost of deaths avoided, shadow prices of goods and services, valorisation of externalities
Quantitative parameters for costs and benefits	Sick rate avoided, size of area used, added value per hectare irrigated, incidence of energy produced or secondary raw materials used.

Source: EU CBA Manual (2008)

The criteria upon which the critical variables are chosen vary according to the specific project and must be carefully chosen case by case. EU guidance recommends considering those parameters for which a variation (positive or negative) of 1% gives rise to a corresponding variation of 1% in IRR or 5% in the base value of the NPV.

Another recommendation is to repeat the calculations of elasticity for different arbitrary deviations, as there is no guarantee that the elasticity of the variables will always be a linear function.

Creation of "what if" scenarios is also part of the sensitivity analysis. That is done in order to reflect the principle risks surrounding the project. Usually "optimistic" and "pessimistic" scenarios are considered. For this for each critical variable and the extreme values among the range defined by the probability distribution are chosen. Then for each hypotheses project performance indicators are calculated.

The World Bank's preferred approach is to base the sensitivity analysis on the calculation of the switching values. These are the values of the "risky" variables at which the IRR of the project equals the discount rate, and the NPV=0. Switching values illustrate how unlikely the change can be and how each variable is important for the project.

6.4 Assumption of a Probability Distribution for the Variables

The probability distribution for each variable maybe derived from different sources, for example, previous studies, experimental data or literature. Cases as similar as possible to the one studied in a concrete project must be chosen. The most common way is to use the results of studies carried out previously with an objective to obtain the same experimental values.

Another common option is to use the Delphi method which consists of consulting a group of experts. Experts are required to estimate the probability to be assigned to defined intervals of values of the parameters in question and then combine the values obtained with the rules of statistics.

6.5 Calculation of the Distribution of the Performance Indicator

Once probability distribution of the critical variables is established, it is necessary to calculate the probability distribution of the IRR and NPV for the concrete project.

If the number of variables and independent events is small, then the analytical method can be used. In the majority of cases the number of combinations is so high, that it is necessary to use specialised calculation software. The World Bank uses the Monte Carlo method[36] for this purpose.

As EU guidance specifies, the most helpful way of presenting the result is to express it in terms of the probability distribution or cumulated probability of the

[36] Monte Carlo simulation process consist on three main steps (WB Transport Note n 7):
- Define a probability distribution for each variable.
- Monte Carlo procedure samples randomly from each of the different distributions and calculates the IRR or NPV many times over. By taking a very large number of sample from each distribution, the sampling distribution is made to approximate closely the theoretical distribution.
- The outcome is a distribution in terms of IRR or NPV. The more samples are taken the more stable the distribution becomes.

IRR or the NPV in the resulting interval of values. The cumulated probability curve (or a table of values) allows to the assignment of a degree of risk of the project. That can be done, for example, by verifying whether the cumulated probability is higher or lower than a reference value that is considered critical. One can also assess what the probabilities are that the IRR or NPV will be lower than a certain value, which in this case is also adopted as the limit.

The project considered as a risky one, if there is a high probability that it will not overcome a certain threshold of IRR.

6.6 Discussion of the Results and of the Ways to Mitigate Risks

The general objective of the risk analysis is to determine the project's risk level and its dependency on some critical parameters. By analysing the risk one can assess the probability of a poor outcome but also identify ways in which the project can be more robust.

Very often the risk of the project is also compared with the social benefits it brings: compromises need to be made for high risk projects which bring high social benefits and low risk projects with low social benefits.

Sensitivity and risk analysis are very important, as they allow the effective management of possible risks. It is necessary to identify and recognize that the possibility of a particular risk exists and further, on the basis of this information, the ways of prevention, control and transfer of this risk can be elaborated.

Section 3 Checklist

7 CBA Checklist

7.1 Background

The chapter presents a CBA checklist. The checklist is based on the process steps and descriptions, as presented in the previous parts of this CBA Manual. As such, this checklist can be regarded a summary of the CBA Manual. The CBA checklist is meant to be a tool to check the quality of a project's CBA.

7.2 First Check on Completeness

When assessing a project and a project's CBA it is important to realize that the CBA is likely to be based on the results of other studies. So in order to assess the outcomes of the CBA, one should also review the major inputs. This would include amongst others a document describing the project's objectives, the traffic analysis, an assessment of environmental impacts, road design and cost estimates, a financial analysis, etc. Several of these elements are often combined in a feasibility study, but this is not always the case.

Therefore, it is useful to check whether information on the main inputs for the CBA are readily available to the appraiser before starting with the appraisal itself.

Documents to be presented making an EU-(IPA) funding Application

The European Commission provides a useful checklist of the documents that should be presented with a funding application:

1. A duly filled out application form, including:
   - information on the body to be responsible for implementation;
   - information on the nature of the investment, its description and location (including maps);
   - the results of the feasibility studies;
   - a timetable for implementing the project or its phases;
   - a cost/benefit analysis including risk assessment;
   - an analysis of the environmental impact;
   - a justification for public contribution;
   - the financing plan.
2. A Natura 2000 declaration.
3. A Cost-Benefit Analysis study (or, alternatively, a feasibility study including a CBA).
4. The relevant EIA documentation, where required.

Note: more detailed information on the documentation required and the scope of the ex-ante appraisal can be found in Sections 1.3 and 1.4 of the DG REGIO, 2008, Guide to CBA of Investment Projects (see reference in the Annex to these guidelines).

7.3 Assessing Project Identification and Objectives

This section should be based upon your examination of the main documents. It should include an analysis of the status of the documents; the potential interaction between them; their completeness and their coherence. The project should fit within a larger strategic framework.

The following issues need to be assessed in particular, but not exclusively:

- **Project identification**: Briefly describe the project and assess whether the project can be clearly identified as a self-sufficient unit of analysis (e.g. a bridge + access roads). Specifically, the activities included in the project must lead back to clear objectives as well as to a coherent and coordinated entity of actions and roles. A project can consist of different components. If these are mutually dependent they should be considered together (see also section 2.2 of the DG REGIO, 2008 - Guide to CBA of Investment projects, in the annex to this guideline). Is there a relation to other (EU-financed) programmes or projects?
- **Project's contribution to the overall strategy**: Give a concise assessment whether the planned road project is coherent with the objectives and targets that have been set out at local, regional, national and international levels. Please note that this paragraph should be short, especially in the positive cases! Issues regarding the coherence to general (EU) infrastructural policies will be discussed further on in the appraisal. Here one can confine oneself to some short comments for the field of transport infrastructure.
- **Project objectives and targets**: Is a proper description given of the socio-economic variables that will be affected by the project? Have goals been quantified using socio-economic variables and physical indicators? Are the goals, variables and indicators logically connected?

7.4 Assessing the Technical Evaluation

The technological aspects of the project should be assessed as described in a project application and/or other relevant documents that should be made available to you. Such as the results of the feasibility study, technical designs, etc.

Feasibility and Options

Has an appropriate analysis of alternative options been carried out?

Issues to pay attention to include:

- Possible alternatives considered for the solution of the main problems: Is the project the right kind of project for the perceived problems? Are there any other solutions or type of projects that should be considered? (See also section 2.3 of the DG REGIO, 2008 - Guide to CBA of Investment projects.) Is a justification provided for the preferred option? Has a plausible scenario without the project been identified to compare project options and perform the CBA?

Technical Design

What is the quality and appropriateness of the main technical design of the project considering the technological option chosen, assessing the following:

- Is the project solution technically sound, bearing in mind the specific location, conditions of the site, environmental concerns, national requirements, etc.?

- Are there any risks? Is there a need for mitigating measures? Are these described adequately? (See also the Risk Assessment part.)
- Does the technical solution have appropriate dimensions? Is the capacity sufficient to cope with (future) demand; can it be extended? Is it not too high? The assumptions on the proposed technical capacity should be consistent with assumptions on (future) demand — see further on in this guideline – and capacity to manage the project in the future. Check whether physical features, technical characteristics, installed equipment and levels of services are appropriate (see for examples of certain infrastructural works section 3.1.3.2 of the EU Guide of CBA of Investment Projects).

Timing

- Is the project mature and can it be implemented within the given timeframe? Is the timeframe realistic for the different steps in its development (tendering, construction etc.)? If the project is split into phases, have these been clearly and correctly identified and is the timetable for implementation reasonable? Is the project well embedded? Meaning is there formal/real acceptance by the public/region/stakeholders/national authorities?

7.5 Assessing the Financial Analysis

One should assess whether the analysis presented to you and accompanying documents (i.e. / e.g. CBA) is complete and consistent, has been undertaken according to the standards that can be expected for such an investment and is based on reliable and coherent assumptions. When looking for EU funding support it should also be consistent with the applicable EU guidelines (Guide to CBA of Investment projects, section 2.4; Guidance on the Methodology for Carrying Out Cost Benefit Analysis, Working Document No. 4, 08/2006; and Guidance Note on Article 55 of Council Regulation (EC) No 1083/2006: Revenue-generating Projects).

Particular attention should be paid to:

Project Costs

How accurate and relevant are the costs of the project:

- One should assess the investment, operating and maintenance costs, taking into account recent similar projects, best practice and any other parameters available. Are the costs in line with recent similar projects or for example the costs indicated in competitive tender processes for this kind of project? Are the costs at market prices? Have all costs been taken into account and have they been calculated and reflected correctly in the CBA? Has VAT been considered correctly (When applying for EU funding also see DG REGIO-note: "*Treatment of VAT in the major project applications*" that will be provided to you)? Have operating cost savings been correctly included where relevant?
- Also, clearly taking into account any previous remarks you may have made on the project dimensions or alternative technical solutions, provide your opinion on whether the project is cost effective?

- Have the operating costs been calculated correctly in accordance with sections 4.4.2 of this guide; at market prices, not including depreciation/amortisation costs or financial reserves for goods/services that are not actually consumed (see also EU Guide of CBA of Investment Projects sections 2.4.2 and 3.1)?
- What is the level of contingency costs within the investment costs (should be below 15% for low risk projects and 20% for medium and high risk projects in Serbia) How have contingency costs justified and how have they been treated (should not be part of the CBA, but reflected upon in the sensitivity analysis)?
- Have expropriation costs been calculated correctly?

Economic Life of the Project

- Is the assumption made about the economic lifetime of the project realistic (these guidelines propose to assume 25 years)? The choice of time horizon affects the calculation of the main indicators of the cost benefit analysis. When applying for EU funding they may also affect the determination of the Community contribution.

Demand Analysis and Revenues Generated (Over the Project's Lifetime)

In case of toll roads, the revenues that can be generated depend on the use of the road (traffic) and the tariffs or levies charged. Therefore you should assess both the demand analysis and the proposed fees/charges (and their interrelation). Specific topics and questions are:

- Whether the analysis of the demand/capacity ratio of the new road infrastructure is based on the service level of the road infrastructure, the travel times and costs of the user, transport performance indicators, traffic safety levels, quantification of the non-fulfilled demand and definition of the relevant alternatives evaluated from an environmental, financial and economic viewpoint (see also section 3.2 of this Guide and 3.1.1.3 of the EU Guide to CBA of investment projects).
- The accuracy of the traffic demand analysis and forecast: Has an appropriate forecasting methodology been used that includes current, induced and forecasted demand? Are traffic and traffic growth factors in line with those used in the Serbia Transport Model? The effect of the investment on the use and economic viability of modes or projects? The sensitivity of the expected traffic flows for some critical variables?
- How does the current demand compare to other regions, the national average or other EU countries? Are the assumptions made on future demand realistic?
- Where relevant: What is your opinion on the appropriateness of the assumed fares or charges? Do they reflect the full costs? Are they in line with Community regulations? Are they (too) high or artificially low (creating a funding gap and/or promoting over consumption)? How do they compare to other regions, national average or other EU countries? Can they be considered to be affordable?

- Has any "polluter-pays principle" been applied correctly, if needed? (See also section 2.4.2.2 of EU CBA Guidelines.)
- Have the revenues been included in the financial analysis correctly, for example not including VAT or subsidies in the revenues?

Residual Value of the Investment and Inflation

- Has the investment residual value been considered? Is the method for determining the residual value reported in the CBA, using distinguished methods for toll and non-toll roads as proposed in this guide? Has this been included in the financial analysis correctly (see section 4.3.2 of this guideline)?
- Has the effect of inflation been taken into account in the financial analysis? The use of current prices is generally recommended for the financial analysis. If constant prices are used, corrections must be entered for changes in the relative prices when these changes are significant. Please note that the use of constant or current prices should also be correctly reflected in the CBA tables and in the use of the discount rate.

Discount Rate

- Is a real discount rate used with constant prices or alternatively a nominal discount rate used with current prices?
- Is the financial discount rate consistent with the rate suggested in this guideline for Serbia (see section 4.3.4)

Financial Profitability and Sustainability

The results from the financial analysis should provide insight into three major issues:

1. Does a project generate sufficient income to pay for itself (profitability), or does it need financial support from national public authorities?
2. Can national public authorities contribute sufficient funds to pay for all the investment cost and operation and maintenance costs, or is it necessary to attract additional funding from other sources (EU contribution, World Bank grants or loans etc.) to fill the "funding gap"?
3. Have sufficient funds (irrespective of their source) been secured to fulfil all financial obligations in each year during the project's lifetime, thus is the project financially sustainable?

In order to review the financial profitability of the project the financial performance indicators should be considered (see section 4.5 of this guide).

- Is the project in need of public funding (national government, EU, etc) (i.e. is the FNPV/C<0)?
- Are the investment cash-flows correctly determined with an incremental approach (i.e. based on the difference between the "with the project" scenario and a counter-factual scenario "without the project")?
- Are the financial performance indicators correctly calculated according to the CBA guidelines?

In order to determine whether the project is financially sustainable you should check whether the project generates a positive cumulated net cash flow over the entire reference period e.g. sources of financing (including revenues and any kind of cash transfers) should match disbursements over the reference period.

- How is the financial sustainability of the project? Are the assumptions made on the level and timing of expenditures and generated cash flows realistic? Is there enough cash every year to pay for the operating expenses and capital maintenance when needed?
- Is the cumulated net cash flow sufficient to cover the disbursements year by year?
- Has the financial rate of return (both on investment and invested capital) been calculated correctly according to the CBA guidelines, for example not including the residual value in the calculation? Is it realistic, taking into account previous comments for example on investment costs or revenues?
- Can the project continue to be funded when the public/donor subsidy ends? Have these funds been identified? Is there firm commitment to provide these funds?

7.6 Assessing the Economic Analysis

What is the quality of the economic analysis presented in the application form and accompanying documents (CBA) is it complete and is it based on reliable and coherent assumptions? Has it been undertaken according to the standards that can be expected for such an investment (incremental approach)?

- Overall assessment on the CBA methodology should be followed (in line with these CBA guidelines – see chapter 5).

Specific points of attention include:

- Have the main economic performance indicators been calculated (ENPV, IRR, B/C ratio)?
- Is the investment desirable from a socio-economic point of view, i.e. is the ENPV>0, IRR>social discount rate and B/C ratio>1? If not, are there important non-monetised benefits to be considered?
- Have any subsidies, pure transfer payments, VAT and other indirect taxes been excluded from the analysis?
- Have all the relevant externalities been considered, see section 5.3 of this guide? Is the typology of benefits considered in the economic analysis appropriate for this project? Are the key assumptions for valuing the costs and benefits of these externalities realistic? Have they been priced correctly when possible (see section 5.3 of this guide, as well as annex 4 and 7 for VoT in Serbia; annex 5 for VoC; annex 8 for safety benefits)? Is there any risk of double-counting benefits?
  Note: important externalities relate to the environmental impacts. Issues related to the environmental impact and the EIA should also be discussed in a separate section later on in the appraisal document.
- Have the non-quantifiable / non-monetisable costs and benefits been described sufficiently?

- If capital assets (e.g. land, buildings etc.) that are state-owned or bought or leased from the government can be used alternatively, have these been valuated at realistic opportunity costs?
- Make sure the rule of half is used as described in section 5.3.1 and a while calculating the economic benefits of the consumer's surplus (An additional explanation can be found in Annex 6 of this guide).. Are the welfare changes of diverted traffic determined correctly?
- Have prices been converted from market prices into accounting prices to include social costs and benefits? See section 5.5 of this guide for suggestions on conversion rates to be used in Serbia. This is particularly important in projects in distorted markets (e.g. monopolies, price regulation) or where wages do not relate to labour productivity. Also special attention should be paid to assessing the way capital assets are valuated (preferably at opportunity costs, see section 5.5)
- Is the social discount rate used, consistent with the rate proposed in this guide (see section 5.6)
- Please reflect on the project profitability ratios, taking into account previous comments on the economic analysis?
- Economic Rate of Return, Economic Net Present Value and B/C ratio
- Taking these ratios into account and the assessment provided of non-quantifiable / non-monetisable costs and benefits, do you think that it is sufficiently clear and convincing that social benefits exceed social costs?

Broader Economic Benefits and Impact on Employment

- For very large infrastructure investments and when not already included in the CBA, assess whether broader economic benefits and impact on employment have been adequately / sufficiently described. Although benefits may not arise on a national level (but only redistribution or transfers between groups, areas etc), redistribution effects or transfers might be equally important in decision-making. It is recommended that in principle no wider economic benefits are quantified in the CBA for most road projects (see section 5.3.5 of this guide).

7.7 Assessing the Sensitivity and Risk Analysis

Have risks and uncertainties been assessed sufficiently? See chapter 6. Have all the critical variables been identified correctly in the sensitivity analysis? Has the analysis been carried out on all the critical project variables defined in the sensitivity analysis? Have reasonable values for these main variables been used to estimate the effect of changes in these parameters (e.g. realistic positive or negative scenarios)?

Based on the results of the risk analysis, is the project risky? What is the probability of having a negative ENPV? Is the level of risk acceptable? Have risk mitigation measures been foreseen where appropriate?

Section 4 Case Studies

8 Case Studies

8.1 Introduction

In this section of this manual two case studies are elaborated in order to work out the guidelines as proposed in this document along two practical examples. In this way it can be shown how the proposed methodology will work out along the lines as proposed in this report. The following cases studies are included:

- E-761 motorway Pojate-Preljina.
- M-21 main road, Novi Sad – Ruma – Šabac, and the continuation of the M-19 main road, Šabac – Loznica

The two projects are included in detail in Annex 2 and have been further detailed during the discussions during the training stage of this project. The 2 case studies are among the measures with the highest priority as in identified in the GMPT. The project with highest priority in the GMPT are the projects on corridor X as identified in GMPT, these are being constructed at the moment and will finish in 2011. After that the projects, presented here as case studies, are first in line to be executed.

In the figures below the extracts from the GMPT are shown, these graphical representations are taken from the GMPT document that includes the project fiches of the projects included in the GMPT. The figures show the location of the projects in Serbia and the forecast on the network according to the GTMP. It should be considered that these projects are evaluated within the overarching evaluation scheme of the GMPT, and is a first step in national prioritisation of infrastructure projects within a harmonised scheme. What follows is a second step by going into detail in the projects and with the aid of the recommendations made in this document.

It should be remembered that the GMPT had as goal to prioritise the projects on national scale but also in relation to benefits related to transport in relation with foreign countries. Notably, for freight transport it is important to consider the cross border traffic, especially since this is related to future scenarios like entrance into the European Union. This will lead to changing trade and transport patterns within Serbia.

In this chapter a comparison will be made between de GMPT outcome for the 2 case studies on the on hand and the pre-feasibility studies as carried out by PERS on the other hand. As stated the outcome of the pre-feasibility is included in the Annex 2. By comparison it is learned what the difference is in the methods applied and moreover what is recommended for CBA methods in this document.

In the next paragraph (paragraph 8.2) the comparison between GMPT and pre-feasibility carried out by PERS will be made. In the last paragraph (paragraph 8.3) of this chapter a revised approach according to the scheme as proposed in this document.

Figure 8.1 Project Fiche E-761 Motorway Pojate-Preljina from GMPT

General Master Plan for Transport in Serbia 05SER01/04/016 October 2009

PROJECT RDC8 : POJATE - PRELJINA

MAIN PROJECT CHARACTERISTICS:

Pojate – Preljina project is motorway E-761 which is very important for the Serbian road network, even though in Trans-European road network has a secondary importance. This motorway connects the central part of the country with two important links: corridor X to the west and South Adriatic to East. The motorway alignment follows the corridor of Main road M-5, and the total length is around 109.6 km. On this section 5 important bridges and 12 new interchanges are foreseen.

PROJECT DESCRIPTION:

Project Code:	RDC8
Lenght:	109.6 km
Width:	4 lanes of 3.75 m width, two emergency lanes 2.5 m,2 shoulders of 1.0m
Other Technical Data:	IRI=2; Design speed: 120 Km/h
Investment Cost (Euro Million):	413
Yearly Maintenance Costs (Euro Million):	4.2

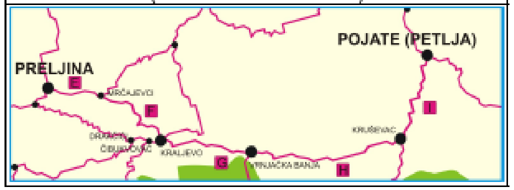
ENVIRONMENTAL ISSUES:

Influence on nearby		Motivation
Urban Areas	YES	According to Corina land cover
Ramsar Sites	NO	
Natura 2000 Sites	NO	
National Parks	NO	
Nature Parks	NO	
Cultural Heritage	NO	

SERBIAN ROAD NETWORK

WITHOUT PROJECT

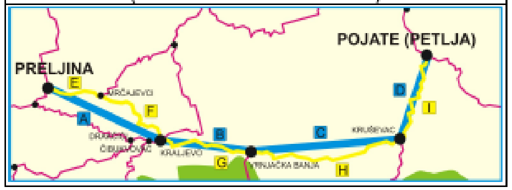
(Do Minimum Scenario 2027)



LINK	Traffic (Vehicle/day)		Operating Speed (Km/h)		Design Speed (Km/h)	
	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.
E	11391	1573	37	31	60	50
F	8013	398	51	43	60	50
G	14489	547	35	29	60	50
H	8096	564	50	42	60	50
I	15989	702	38	31	60	50

WITH PROJECT

(Do Minimum Scenario Plus 2027)



LINK	Traffic (Vehicle/day)		Operating Speed (Km/h)		Design Speed (Km/h)	
	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.
A	12337	1097	120	80	120	80
B	16182	1128	119	80	120	80
C	14748	1612	120	80	120	80
D	21553	1368	118	79	120	80
E	6692	1167	50	42	60	50
F	4058	321	58	48	60	50
G	6941	0	55	46	60	50
H	5688	0	57	47	60	50
I	6858	0	57	47	60	50

EVALUATION ELEMENTS	Do Min. Plus Project
Unit Transport Cost:	
- Euro Passenger Km	0.324
- Euro Ton Km	0.121
2027 Benefits (Euro Million)	533
Benefit NPV(5%) (Euro Million)	4,431
Economic Cost NPV(5%) (Euro Million)	318
Priority Indicator: NPVBenefits / NPV Costs	13.93
OVERALL PROJECT RANKING	2
MODAL RANKING	2

PROJECT CYCLE	Serbian Regulation (YES/NO)	International Regulation (YES/NO)	Months Needed
Prefeasibility Study, Alternative Analysis, General Design	YES	NO	
Preliminary Design, Feasibility St.	NO	NO	12
EIA	NO	NO	12
Final Design	NO	NO	12
Financial Agreements	NO	NO	
Expropriation Procedure	NO	NO	12
Tender Procedures	NO	NO	6
Works	NO	NO	36

Figure 8.2 Project Fiche M-21 main road, Novi Sad – Ruma – Loznica from GMPT

General Master Plan for Transport in Serbia | 05SER01/04/016 | October 2009

PROJECT RDB12 : NOVI SAD - RUMA - ŠABAC - LOZNICA

MAIN PROJECT CHARACTERISTICS:

Novi Sad – Ruma – Šabac – Loznica, is a route connecting Novi Sad and Vojvodina with western parts of the country, following Main Roads M-21 and M-19. Very high level of traffic especially on section Šabac – Ruma is assessed, and on this section a full motorway profile is foreseen. On other sections a two lane road is foreseen. Total length of this section is around 120 km.

PROJECT DESCRIPTION:

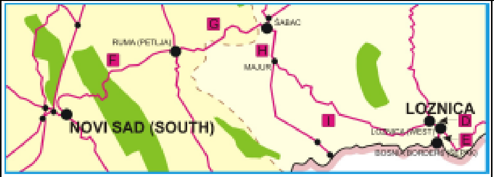
Project Code:	RDB12
Lenght:	120 Km
Width:	2 Lanes road 3.75 m width, ……, 2 shoulders of
Other Technical Data:	IRI=2; Design speed: 120 Km/h
Investment Cost (Euro Million):	200
Yearly Maintenance Costs (Euro Million):	2.4

ENVIRONMENTAL ISSUES:

Influence on nearby		Motivation
Urban Areas	YES	According to Corina land cover
Ramsar Sites	NO	
Natura 2000 Sites	YES	Fruška gora
National Parks	NO	
Nature Parks	YES	Fruška
Cultural Heritage	NO	

SERBIAN ROAD NETWORK

WITHOUT PROJECT
(Do Minimum Scenario 2027)



LINK	Traffic (Vehicle/day)		Operating Speed (Km/h)		Design Speed (Km/h)	
	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.
D	15777	1975	43	35	80	65
E	7378	640	54	45	60	50
F	11567	2535	38	31	60	50
G	11698	1980	40	33	60	50
H	13085	1965	34	25	55	40
I	8017	1612	45	33	55	40

WITH PROJECT
(Do Minimum Scenario Plus 2027)

LINK	Traffic (Vehicle/day)		Operating Speed (Km/h)		Design Speed (Km/h)	
	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.	Pass. Veh.	Freight Veh.
A	8868	2968	55	45	80	65
B	21224	3420	111	74	120	80
C	7589	2822	74	59	100	80
D	19189	3667	28	23	80	65
E	7348	666	90	72	100	80
F	10285	962	48	40	60	50
G	8012	0	55	46	60	50
H	17793	1114	30	21	55	40
I	7528	620	50	36	55	40

EVALUATION ELEMENTS	Do Min. Plus Project
Unit Transport Cost:	
- Euro Passenger Km	0.332
- Euro Ton Km	0.122
2027 Benefits (Euro Million)	68
Benefit NPV(5%) (Euro Million)	568
Economic Cost NPV(5%) (Euro Million)	152
Priority Indicator: NPVBenefits / NPV Costs	3.74
OVERALL PROJECT RANKING	8
MODAL RANKING	5

PROJECT CYCLE	Serbian Regulation (YES/NO)	International Regulation (YES/NO)	Months Needed
Prefeasibility Study, Alternative Analysis, General Design	YES	NO	
Preliminary Design, Feasibility St.	NO	YES	
EIA	NO	YES	
Final Design	NO	NO	12
Financial Agreements	NO	NO	
Expropriation Procedure	NO	NO	12
Tender Procedures	NO	NO	6
Works	NO	NO	36

8.2 Comparison GMPT and Pre-Feasibility Studies

As stated in this section the comparison between the pre-feasibility carried out by the PERS and the GMPT will be made. This comparison will be carried out along the following lines:

1. first traffic forecasting, these form the crucial input for the benefit estimation.
2. secondly the traffic flows will be transformed in benefits by the Value of Time (VoT) and the vehicle operating costs which are estimated through IRI (International Roughness Indicator). These are called direct benefits.
3. External costs: besides the direct benefits associated with the traffic flows as mentioned in the previous point, there are also other elements that lead to benefits or costs that are more of an indirect nature. These so called external effects consist of costs related to accidents, noise and emissions.
4. The investment costs are the other inputs, these consist of the construction costs and the maintenance costs.
5. Once the cost and benefits are fixed the CBA analysis can start and a discount rate needs to be chosen. It is proposed to use an 8.0% discount rate.

8.2.1 Traffic Modelling and Forecasting

- Distinction between short distance transport for freight and passenger transport is important. The flows in the 2 cases studies are much higher than in the GMPT, the reason is that local traffic is not included in GMPT. The values of the PERS are to be included here. The added value of the GMPT is that it focuses on the long distance traffic (including international traffic). Within the prefeasibility studies this distinction is not made.
- The most recent year should be used in assessment, traffic counts for freight and passenger transport are available for 2009. The GMPT used 2005 as starting point, as the information is available for 2005. The focus of the GMPT was on long distance and international traffic[37] and for 2005 this information was available. One of the case studies uses 2007 as base year the other 2004. The case studies had 2015 as the first year of completion so from that year on the benefits of the project started. The GMPT is to be brought on the level of 2015.
- The traffic growth rates of GMPT seem to be in line with the 2 cases studies, traffic intensities in both increase with 100% (i.e. are doubling) in 20 years.
- For GDP forecasts it is preferred to use the official forecast of the Ministry of Finance, so far for different studies different sources for economic growth are used. A harmonisation process is advised here for longer term. So far the institutionalised method is published in the "Official Gazette of the RoS[38]". The drawback is that a long-term harmonised forecast is needed. For this purpose it is proposed to use in the long-term rate of 5% as is used in the GMPT.

[37] However it should be considered that 2009 is a year in the midst of the crisis. A better solution would be to compare 2008 with the growth path as included in GMPT (i.e. what value would result in GMPT in 2008 if an interpolation would be made between 2005 and 2008).

[38] On the basis of Article 31, par.1. item 1) of the Budget System Law ("Official Gazette of the Republic of Serbia", No. 54/09), The Government adopts every year the revised Memorandum On The Budget And Economic And Fiscal Policy For The 3 Years Ahead.

- It is advisable to investigate the effects of road investment on other modes. Notably case 1 has a railway line running adjacent to the highway. The analysis of this aspect is included in the GMPT is for this purpose a good source, notably in the cases study for Novi Sad there is a railroad running parallel. The GMPT can be taken in order to evaluate this effect, as rail transport concerns longer distance transport.
- The division between freight and passenger transport is important. In the 2nd case studies show a higher share of freight 20% while the GMPT is about 10%. This can be the result of the reduced coverage of short distance traffic in the GMPT. In the first case study no distinction is made between freight and passenger, it reports the total number of vehicles (passenger en freight together).
- The period chosen in the 2 cases studies seems reasonable: horizon up to 2035 which is 20 years after the construction period 2011-2014.

8.2.2 Direct Benefits

The VoT is the main important source for benefits, the following recommendations are made:

- the VoT for passenger used in the GMPT is higher than the one used in the 2 cases studies. The source of the VoT is working hours and productivity lost. It is proposed to use the VoT from the GMPT. These are based on conversion of EC values corrected for income differences, and increase with an increase in GDP.
- For freight no VoT value is applied in the case studies, it is proposed to apply the VoT derived from the GMPT.
- The IRI method is similar for GMPT and the 2 case studies. The IRI method is used in HDM, as well as in the case studies. Lower IRI values lead to lower vehicle operating costs.

8.2.3 External costs

- The values for traffic accidents (casualties and injured and damage) is much higher in GMPT than in the 2 cases studies. The reason for this is that valuation from the EC values is used which tend to be higher as income is higher in the EC (although a correction is made for lower income). The value increases with the rise in income in the future.
- Noise is not included in the CBA guide, this will be added. In the two case studies noise benefits are included (qualitatively). It is proposed to leave out noise valuation within the project, an alternative would be to include the costs of noise abatement measures in urban areas. A new regulation concerning noise of traffic is in preparation and a study has been carried out concerning the noise levels and their abatement cost on the network. It is proposed to include the abatement cost in the CBA.
- In the GMPT values for emissions have been included, in the 2 cases no values are included. It is recommended to include the method as proposed in the GMPT.

8.2.4 Costs

The investment cost consists of the construction and maintenance cost of the infrastructure project. The following results for a comparison:

- The costs items can be compared as they are related to construction and operating costs and maintenance. The latter costs are incurred after the construction fase.
- The costs of expropriation are in most cases higher than is anticipated. It was found that in some cases the expropriation costs can amount to 8 times higher than foreseen. The expropriation costs are to be included in the construction costs.
- The conversion factor for costs as used in the 2 cases studies is 0.8 It is proposed to use the conversion factors for different cost items (labour, material, equipment, general expenses) as established in this CBA guide (section 5.8). If no detailed information is available on the composition of the costs, it is recommended to use the 0.8.
- It should be remembered to apply conversion factors on prices including taxes (i.e. VAT). Another method is to use prices excluding VAT (and consequently not to apply the conversion factor)..
- No conversion factor has been applied for operating and maintenance costs. It is proposed to use the conversion factors for different cost items (bus, truck, passenger car, fuel) as established in this CBA guide (section 5.8). If no detailed information is available on the composition of the costs, it is recommended to use the conversion factor 0.7. In general there are higher taxes on fuel which has a larger portion in maintenance activities. This explains the lower conversion factor to be used for operating costs.

8.2.5 Discount Rate

The value in the 2 case studies is 10% while in the GMPT a lower vale is used of 5%. A higher social discount rate is advised by the Serbian Ministry of Finance. The higher rate is justified among others through the higher risk profile of Serbia.

It is noted that the discount rate in the economic analysis of investment projects — the social discount rate — should reflect the social view on how future benefits and costs are to be valued against present ones. Broadly speaking there are two approaches, namely the **social rate of time preference**, taking the view that the discount rate should reflect government policy preferences and the **social opportunity cost of capital**, basically adopting the same discount rate used for financial analysis.

This CBA guide advises to use 8% social discount rate, however it is however normal practice in EU that the social (and the financial) discount rate is established by the Ministry of Finance. The value to be used should be agreed with the Ministry of Finance.

8.3 CBA According to Proposed Guidelines

In this section the results of applying the proposed guidelines in this report are presented. This means that the proposed values and methods from the previous section will be applied to one of the pre-feasibility (to be abbreviated in this section as FS) studies. The section Kraljevo-V.Banja out of the Pojate-Preljina highway construction project was taken. The results of this comprehensive CBA which is referred to as a "quick scan CBA" are presented in this section. The results of the quick CBA are presented in Annex 1. The quick CBA has been carried out with the group of experts at the workshop on 20-22 September 2010 in Belgrade. On the following items assumptions were made:

- Traffic forecasts and inclusion of local traffic
- VOT for freight and passenger and time gains
- GDP development
- IRI values
- Benefits/costs from external effects including noise
- Costs related to infrastructure investment and maintenance
- Expropriation costs
- Interest rate

Finally the results can be compared.

Traffic forecasts

- One section of the total road was considered, for benefit calculation the representative section Kraljevo-V.Banja, which is 20 kilometre, out of stretch Pojate-Preljina, which is altogether 105 kilometre, was taken.
- A combination of GMPT and figures from the pre feasibility studies (FS) was made: around 11,000 AADT vehicles in 2015 without project; around 13,000 AADT with project.
- The FS study contained no distinction between freight and passenger, this distinction was obtained from GMPT.
- The FS studies had much higher AADT; this was a result that these contained short distance traffic, this was not included in GMPT.
- Assumptions were made on the distribution of long and short distance traffic based on the differences between the GMPT (no short distance) and FS forecast (short and long distance included)

Time savings and Value of Time and GDP growth

- A rough indication is obtained in the basis of operational speeds; it is assumed that all traffic is diverted to the new road. This means an overestimation, in reality around 25% of the traffic will use the existing road and will have lower time savings.
- There was no Value of Time (VoT) for freight included in the FS, a value for freight was included based on the GMPT assumptions.
- It was assumed that the Value of Time assumed to with 2.5%, in the FS no growth of VoT was included.
- Yearly traffic growth of 3% used based on 5% GDP also without the project traffic will growth with this rate.
- It is proposed to rely on the HEATCO method of

IRI values

The same method is applied, the same IRI values were used in the GMPT and in FS. In principle these lead to the same source of benefits, as the IRI value goes from 5 to 2 a benefit is obtained as depreciation of rolling stock is lower with higher quality of infrastructure.

Benefits/costs from external effects

For other external such as traffic safety and air pollution it is not clear what was used in the FS. In our calculation example the values used in GMPT are included. In the example as included in Annex 1 the CO_2 valuation based on rough calculation on fuel consumption. The cost of noise abatement could be included in the investment costs.

Costs

Total investment costs are used and are converted into Euro. The yearly routine maintenance costs have been estimated as 5% of total investment. It is not clear what was used in FS. The expropriation costs are as is understood included in the investment costs, however it was mentioned that these tend be higher than budgeted. It is advised to take these separately and use higher values for expropriation costs and to monitor these costs.

Discount rate

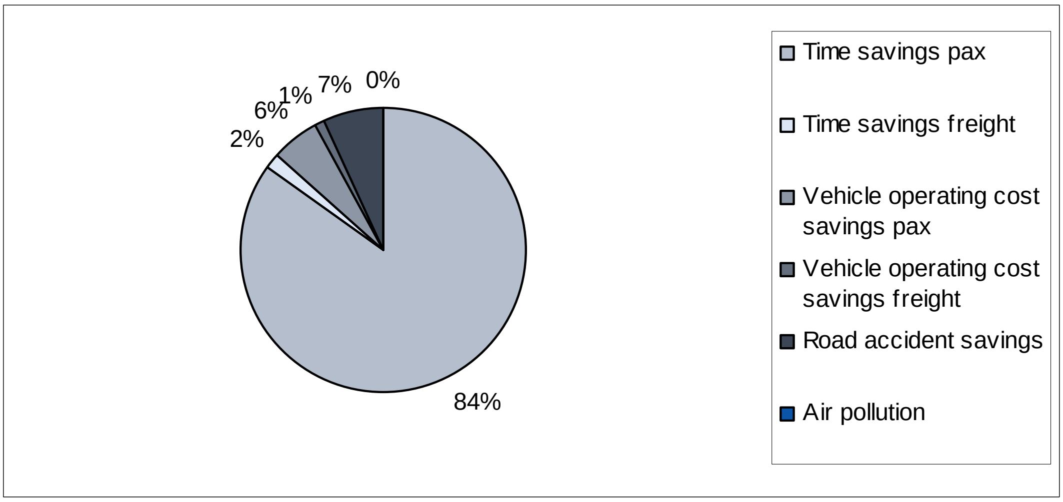
The discount rate used in the example in Annex 1 is 8% as is explained in the previous section. In the FS a rate of 10-12% is used this has a tendency to lower benefits in that are further away in the future. In the GMPT a value of 5% is used, this tends to increase the future benefits in present value.

Results comparison with FS

The comparison of results between the Annex 1 and FS can only be carried out on the EIRR. Since discount rate differs, the NPV and B/C ratio cannot be compared.

The EIRR is for the FS 13.4% and for the exercise result in Annex 1 the EIRR is 15.1%. In the GMPT the benefits are calculated for the whole stretch Pojate-Preljina, with a discount rate of 5% this leads to a B/C ratio of 13.9. If a 5% discount rate is applied to the exercise the a B/C ratio of 2.1 results. In the figure below the main sources of benefits can be observed.

Figure 8.3 Sources of Benefits Section Kraljevo-V.Banja



ANNEX 1 Example for CBA Calculations

A quick CBA has been developed together with the experts from PERS. This exercise was oriented on applying CBA principles that have been developed in the present manual. The method is applied to one section of the Pojate-Preljina link. The outcome of this exercise is to be valued as a result of applying the methodology as presented in this manual. It was carried out while stressing the feasibility of methodology and not the preciseness of the outcome, more research needs to be done in order to get a more precise result. However the result can be seen as a first approximation.

Table 1 Detailed CBA Table with Flow of Costs and Benefits over Time

E-761	Present Value	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BENEFITS														
Road users														
Time savings pax	€ 45.0	0	0	0	3.6	3.8	4.0	4.3	4.5	4.7	5.0	5.3	5.6	5.9
Time savings freight	€ 0.9	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vehicle operating cost savings pax	€ 4.3	0	0	0	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
Vehicle operating cost savings freight	€ 0.6	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Safety														
Road accident savings	€ 3.6	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Environment														
Air pollution	€ 0.1-	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
TOTAL BENEFITS	**€ 54.2**													
COSTS														
Investment	€ 22.7-	-6.6	-9.4	-10.8	0	0	0	0	0	0	0	0	0	0
Maintenance and operating costs	€ 9.3-	0	0	0	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
TOTAL COSTS	**€ 32.0-**													
TOTALS		-6.6	-9.4	-10.8	3.4	3.7	3.9	4.1	4.4	4.7	5.0	5.3	5.6	5.9

E-761	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
BENEFITS												
Road users												
Time savings pax	6.2	6.6	6.9	7.3	7.7	8.2	8.6	9.1	9.6	10.2	10.7	11.3
Time savings freight	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Vehicle operating cost savings pax	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.8
Vehicle operating cost savings freight	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Safety												
Road accident savings	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Environment												
Air pollution	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
TOTAL BENEFITS												
COSTS												
Investment	0	0	0	0	0	0	0	0	0	0	0	0
Maintenance and operating costs	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
TOTAL COSTS												
TOTALS	6.3	6.6	7.0	7.5	7.9	8.3	8.8	9.3	9.9	10.5	11.1	11.7

Results CBA	
Net Present Value (NPV; million Euro)	€ 22.2
Economic Internal Rate of Return (EIRR)	15.6%
Benefit / Cost ratio	1.7

General assumptions		
Yearly traffic growth 2015-2035	3.0%	
Economic Discount Rate	8.0%	
Horizon	25	years
Start construction	2012	
End construction	2014	
Conversion factor investment (general)	0.8	
Conversion factor maintenance & opera	0.7	
Conversion from day to year	300	

Values		
VoT passengers 2015	5.3	Euro/hr
VoT freight 2015	0.2	Euro/hr/ton
Average truck load	10	ton
VoT yearly growth	2.5%	equal to half of GDP growth
Value of fatality	397,000	Euro
Value of severe injury	53,000	Euro
CO2 emitted per liter fuel	2.4	kg
Value of CO2	0.003	Euro/kg

Table 2 Input Data for the CBA

E-761	WITHOUT project 2015	WITH project 2015	DIFFERENCE
BENEFITS			
Average commercial speed (km/h)			
Long distance passenger	35	80	
Long distance freight	29	60	
Short distance passenger	35	80	
Short distance freight	29	60	
Length long distance (km)	15	15	
Length short distance (km)	4	4	
Average travel time long distance passengers (hours)	0,43	0,19	0,24
Average travel time long distance freight (hours)	0,52	0,25	0,27
Average travel time short distance passengers (hours)	0,11	0,05	0,06
Average travel time short distance freight (hours)	0,14	0,07	0,07
Traffic per day			
Long distance passengers (AADT)	8000	9440	1.440
Long distance freight (AADT)	350	420	70
Short distance passengers (AADT)	2500	2950	450
Short distance freight (AADT)	150	180	30
International Roughness Indicator (IRI)	5	2	
Vehicle operating costs passengers (Euro/km)	0,135	0,125	0,01
Vehicle operating costs freight (Euro/km)	0,405	0,375	0,03
Number of accidents per year			
Fatalities	1	0	1
Severe injuries	15	14	1
Air pollution, tonnes CO2 emitted, per day			
Liter fuel consumption (per day)	13.585	16.042	-2.457
COSTS			
Investment costs, incl VAT (million EUR)		33.446.043	
Implementation schedule			
Year 1		24,8%	
Year 2		35,0%	
Year 3		40,2%	
Maintenance costs (% of total investment)		5,0%	

ANNEX 2 Case Studies

This annex presents the two pre-feasibility studies carried out by the PERS. These will be used to test the methodology as presented in this manual.

Case Study 1: General Design for E-761 Motorway Pojate-Preljina

Subject of the Pre-Feasibility Study

The Subject of the Pre-Feasibility Study is the General Design for E-761 Motorway Pojate-Preljina.

Basic Traffic Problems on the Existing Roads M-5 And M-5/M-22

The basic traffic problems on roads M-5 and M-5/M-22 in its existing condition, taking into account the achieved traffic flows in 2006 and 2007, are as follows:

- Low traffic safety level with the heaviest traffic accidents with fatalities;
- Appearance of bottlenecks from the aspect of practical capacity on a significant section of the motorway, particularly on sections passing through residential areas;
- Low speeds, primarily on sections passing through residential areas;
- Increased vehicle operating costs and costs of time spent on the road for passengers and goods;
- Environmental endangerment caused by noise and air pollution on sections passing through residential areas.

Objectives of E-761 Motorway Design

The objectives of the designed E-761 motorway primarily reflect in removing the main traffic problems on the existing road M-5 and M-5/M-22, as mentioned above. These problems will be solved by redirecting the transit and traffic flows between the towns from the overloaded sections of the existing road M-5 and M-5 / M-22 onto the motorway.

With the construction of the E-761 motorway,traffic conditions for traffic flows on the motorway will improve both for the traffic flows which will remain on the existing road M-5 and for the M-5/M-22. Improvement of traffic conditions will lead to savings in:

- Vehicle operating costs,
- Travel time costs, and
- Traffic accident costs

Besides the stated savings, the E-761 motorway will have positive effect on environment as well as on accelerated socio-economic development in the area. Accelerated socio-economic development of the area will reflect on the generated traffic as well as on the economic benefits due to the generated traffic.

Tasks of the Pre-Feasibility Study

The main tasks of the Pre-feasibility Study for the construction of E-761 motorway Pojate-Preljina are the following:

1) Based on the basic information and on field surveys of the current condition of the existing road, to provide all relevant information on the existing road M-5 and M-5 / M-22;
2) Based on the study "Traffic analyses and forecasts" and field researches of the current condition of the existing road and traffic, to provide basic data on the achieved and forecast traffic flows based on normal traffic on the existing road M-5 and M-5 / M-22 (on the network without investments);
3) Based on the General Design to provide main data on the designed motorway E-765;
4) Based on the study "Traffic analyses and forecasts" and field researches of the current condition of the existing road, to provide main data on the distribution of forecast traffic flows based on normal traffic on E-761 motorway and the existing road M-5 and M-5 / M-22, which together with E-761 motorway make the network with investments;
5) By applying adequate methodological procedures to realistically forecast the expected generated traffic on future motorway E-761;
6) Through the procedure of functional evaluation, to provide answer to the question whether the existing road M-5 and M-5 / M-22 is capable of satisfying the forecast traffic flows and for how long, from both the quantitative aspect (practical capacity) and the qualitative aspect (service level);
7) By applying adequate cost models to determine the economic costs of exploitation of the network without investments and the network with the investment in an initial period of 20 years;
8) To determine the expected direct economic benefits based on the expected normal and generated traffic in network exploitation over a period of 20 years with investments in the motorway in order to compare the expected economic benefits with the economic costs for constructing E-761 motorway and thus analyse the justification for investment in project implementation from a socio-economic aspect;
9) To determine economic justification for investing in the selected E-761 motorway alternative from a socio-economic aspect;
10) To determine the relative priority (dynamics) for the phased implementation of the project for E-761 motorway Pojate-Preljina in stretches;
11) To determine relevant arguments for decisions on the next steps for producing study design documents, i.e. for producing a Preliminary Design and Feasibility Study.

Initial Planning Period for Project Realisation and its Exploitation

- Planned construction period is 2011 – 2013.
- 20-year long operation period is 2016 – 2035.

Documentation Basis for the Preparation of Pre-Feasibility Study

The following documents were used in the preparation of this Study:

1) General Design of E-761 motorway, Highway Institute, January 2007.
2) Informational basis on roads, PE Roads of Serbia.
3) Publication on traffic counting from 2000 to 2007, PE Roads of Serbia.
4) Traffic analyses and forecasts for E-761 motorway, Highway Institute, January 2007.
5) Statistical data on the prices of representative vehicles and vehicle brands, prices of liquid fuels and lubricants, average salaries in Serbia, costs of average traffic accident on road network, etc.
6) Statistical data on traffic accidents on road M-5 and M-5 / M-22 Pojate-Preljina.

Normative Bases followed in the Preparation of the Study

Tasks of this Pre-Feasibility Study also include the selection of an optimal variant. The selection of optimal variant within the Pre-Feasibility Study is pursuant to Article 106 of the Law on Planning and Construction ("Official Gazette of the RoS" No. 47/03), in accordance with which the Minister for capital Investments passed the Rulebook on the content, scope and manner of preparing the Pre-Feasibility Study and the Feasibility Study for structure construction. The latter was published in the Gazette No. 80, on September 20th, 2005, under Section II – Pre-Feasibility Study. Within its Section 8, Item 4, the proposal of an optimal variant is being requested.

As the only possible space for the continual alignment of the corridor route for future E-761 motorway is the construction free zone in the valley of Morava river bed and as that this space is mostly agricultural land of good quality ranging from the river valley to urban areas, there appears to be only one corridor – through the valley of Morava.

Therefore in the General Design the selection comes down to the position of the route compared to the river bed (along left or right bank), but in the same corridor. Any detailed research on the route alignment in the same corridor on the level of General Design would carry the risk of encroaching into the activities of Preliminary Design.

Designers have scrutinized options on three stretches and made a selection of the alignment. The selection was done taking into consideration construction costs and limitations, because of potential water springs, existing and planned tourist attractions, usurpation of good quality land, etc. General Design gives the designer's realistic opinion that the selected route in General Design does not oblige the producer of PRELIMINARY DESIGN to choose either the selection of the left or the right bank because it is one corridor. Because of all the abovementioned, the opinion and choice option of the designer of GENERAL Design is accepted and will be evaluated.

Methodology Applied in Pre-Feasibility Study Preparation

a) The CBA is applied to the option that is chosen from General Design for the E-761 motorway. Through this method, the option is economically justified and analysed in sections through the sensitivity test. By applying IRR and NPV criteria and after operating for one year, the optimal dynamics of phased project implementation is defined.
b) The actual amounts of traffic and forecast normal traffic on the existing road M-5 and M-5 / M-22 Pojate-Preljina, as well as the distribution of the forecast and normal traffic between the existing road and the designed E-761 motorway in the initial planned period of 20 years have been taken from the study "Traffic analyses and forecasts for E-761 motorway" done by the Highway Institute.
c) In this study, the forecast of the generated traffic on the future E-761 motorway was done by applying the theory of economic surplus.
d) The HCM-2000 procedure was followed, to assess traffic conditions — per criteria: the relation between flow/capacity and operation speeds — on the discussed networks (without investments and with investment). as well as a new classical procedure that has been developed by local experts
e) Technical-operational characteristics of the existing road M-5 and M-5 / M-22 (Network Inventory) are based on the information database on roads available in the PE "Roads of Serbia", as well as on data determined in field surveys.
f) Technical-operational characteristics of the E-761 motorway are determined based on the General Design.
g) The HDM-4 model was implemented in the calculation of operation costs of moving vehicles on the relevant networks (network without investments and network with investments) during a 20-year period,. Basic vehicle types and representative vehicle brands were used from the HDM-4 model, taking into account that the basic operational and economic parameters (prices) were adjusted to local conditions.
h) In the calculation of additional vehicle operation costs in the function of cyclic speed changes of V-0-t_o-0-V type, caused by vehicles passing through signal-controlled junctions, an appropriate model was developed.
i) In the calculation of travel time costs during a 20-year period on relevant networks (without investments and with investments) and the costs of maintaining such networks, the classical procedure of direct analysis was applied.
j) In the calculation of traffic accident costs in a 20-year period on relevant networks (without investments and with investments), empirical models were used, developed within the publication of the Faculty of Transport and Traffic Engineering titled **"Determination of needs and feasibility of extracting transit traffic from city arteries by constructing bypasses"**, Belgrade, 1997. These models are based on traffic accident surveys conducted on approximately 349 miles (562 km) of two-lane roads in the state of Illinois (USA), in the period 1981-1987, as well as on surveys on the changes in the number of accidents on road sections before the improvement and after the improvement.
k) Calculation of expected direct economical benefits in terms of the normal traffic was determined on the basis of discrepancies in costs of using the

network without investments and the network with investments in a 20-year long initial period of operation.

l) The procedure developed in Instructions from 1947 was used to calculate the expected economic benefits based on the generated traffic.

m) The economic costs of construction were determined at 80%, compared to financial costs for the realisation of the E-761 motorway project, defined under the General Design.

n) Project valuation indicators from a social-economic aspect, the EIRR and ENPV, were established by applying the EVAL program. EIRR and ENPV indicators were also subjected to the SENSITIVITY TEST with regard to the possible deviations in achieving the expected economic costs for E-761 motorway construction ($\Delta T=\pm 10\%$) and economical benefits ($\Delta E=\pm 10\%$).

o) Evaluation of feasibility of E-761 motorway construction (by traffic stretches and in total) from social-economic aspect was established by comparing the EIRR values with OCC=10% and by comparing ENPV values (determined on the basis of OCC=10%) with zero.

p) Dynamics of the appearance of needs for E-761 motorway by traffic sections was determined with regard to the following aspects:
  - from the aspect of traffic requirements, by applying the functional evaluation procedure using the service level criterion, SL=F (q/C and Ve);
  - from the economical aspect, by applying the form for determining the optimal year for putting into operation E-761 motorway.

Basic Findings of the Pre-Feasibility Study

The most significant results of the Pre-Feasibility Study for E-761 motorway on the direction M-5 and M-5 / M-22 Pojate-Preljina are presented in the following paragraphs:

a) Observed road networks:

- Network without investments consists of the existing road on direction M-5 and M-5 / M-22 Pojate-Preljina
- Network with investments consists of:
  - Adopted option of E-761 motorway Pojate-Preljina.
  - Road routes listed in the network without investments.

b) Traffic flows on the existing road M-5 and M-5 / M-22, on the network without investments in base year and forecast based on the normal traffic in the first and target year of the initial planning period.

- Average Annual Daily Traffic (AADT) in base year 2004 and forecast based on the normal traffic in the first year 2016 and target year 2035.

No.	Traffic section	AADT(vehicles/day)		
		2004	2016	2035
1	Čačak (East) - Preljina	-	9,640	18,423
2	Preljina - Mrčajevci	8,353	14,738	26,329
3	Mrčajevci - Kraljevo	6,700	11,820	21,116
4	Kraljevo - Kraljevo 1	6,700	11,820	21,116
5	Kraljevo 1 - Ribnica	8,023	14,199	25,276
6	Ribnica - Beranovac	9,346	16,577	29,435
7	Beranovac - Novo Selo	9,346	16,577	29,435
8	Novo Selo - Vrnjci	8,964	15,900	28,261
9	Vrnjci - Čairi	7,855	13,907	24,759
10	Čairi - Stopanja	7,968	14,102	25,227
11	Stopanja - Kruševac Bypass	8,046	14,239	25,363
12	(beginn.)	3,500	6,138	11,859
	Kruševac Bypass (beginn.) –			
13	Kruševac Bypass (end)	3,721	6,511	11,715
14	Kruševac Bypass (end) - Ćićevac	4,652	7,549	14,653
	Ćićevac - Pojate			

Traffic flows on the network with investment in the first and target year of initial plan period.

a) Expected traffic flows on the selected alternative of E-761 motorway in the first and target year based on the normal and the generated traffic

No.	E-761 highway section	AADT (vehicles/day)			
		on the basis of normal traffic		on the basis of generated traffic	
		2016	2035	2016	2035
1	Pojate - Ćićevac	6,900	13,185	1,510	2.884
2	Ćićevac – Kruševac East	4,904	9,364	1,073	2.049
3	Kruševac East – Kruševac West	4,898	9,348	1,072	2.045
4	Kruševac West – V. Drenova	9,286	17,746	2,032	3.882
5	V. Drenova - Trstenik	9,854	18,830	2,156	4.119
6	Trstenik – V. Banja	9,716	18,567	2,126	4.062
7	V. Banja - Ratina	10,789	20,617	2,360	4.510
8	Ratina - Kamidžora	10,788	20,617	2,360	4.510
9	Kamidžora – Adrani	7,550	14,428	1,652	3.156
10	Adrani – Mrčajevci	8,284	15,830	1,812	3.463
11	Mrčajevci - road to M-5 / M-22	9,640	18,423	2,109	4.030
12	road to M-5 / M-22-Preljina	9,640	18,423	2,108	4.030

b) Expected traffic flows on the existing road M-5 and M-5 / M-22 after the construction of E-761 motorway in the first and target year based on the normal traffic

No.	Traffic section	AADT (vehicles/day)	
		2016	2035
1	Preljina - Mrčajevci	4,126	7,879
2	Mrčajevci - Kraljevo	2,757	5,263
3	Kraljevo - Kraljevo 1	2,757	5,263
4	Kraljevo 1 – Ribnica	3,687	7,037
5	Ribnica - Beranovac	4,618	8,811
6	Beranovac - Novo Selo	4,618	8,811
7	Novo Selo - Vrnjci	4,430	8,457
8	Vrnjci - Čairi	3,232	6,168
9	Čairi - Stopanja	3,280	6,259
10	Stopanja – Kruševac Bypass (beginn.)	3,974	7,587
11	Kruševac Bypass (end) - Ćićevac	1,220	2,320
12	Ćićevac - Pojate	762	1,448

c) Main data on the selected option of the designed motorway E-761

Section	Length (km)	Cross section		Longitudinal section	
		Lane width	Number of lanes	UN average	UN maximum
Pojate - Preljina	109,612	3.75 m	2 driving lanes + 1 emergency lane per direction	< 2%	< 3%

d) Realisation costs for the selected alternative of E-761 motorway project with investment dynamics by years

Financial and economic costs of realisation for the entire length and by sections, with investment dynamics by years

from – to (km)	Financial construction costs (RSD)	Economic construction costs (RSD)	Investment dynamics (RSD)	
Pojate Preljina (109,612)	33,446,043,153	26,756,834,522	2013	6,689,208,631
			2014	9,364,892,083
			2015	10,702,733,809

e) Expected economic benefits for entire length of the selected alternative of E-761 motorway project in the first and target year

Section	Economic benefits on the basis of benefits from normal traffic only (RSD)		Total economic benefits from normal and generated traffic (RSD)	
	2016.	2035.	2016.	2035.
Pojate - Preljina	3,312,803,080	5,717,268,851	3,679,740,025	6,341,804,089

f) Size of the main indicators of economic evaluation for the selected alternative of E-761 motorway for entire length and by sections:

a) Economic evaluation indicators for entire length:

- EIRR=**13.47% (%)**
- ENPV=**10,063,422,751 (RSD)**

b) Economic evaluation indicators by sections:

Road stretch	EIRR (%)	ENPV (RSD)
For M-5 / M-22-Preljina	**10.5%**	**57,492,581**
Preljina – Kraljevo	**15.1%**	**3,939,125,139**
Obilaznica Kraljeva	**17.9%**	**3,642,515,933**
Kraljevo-Kruševac	**12.4%**	**2,566,672,663**
Obilaznica Kruševca	**12.9%**	**324,965,204**
Kruševca – Pojate	**7.6%**	**-868,309,659**

g) Assessment of economic justification for investing in the realisation of the project of the selected alternative in initial planned period from socio-economic aspect for entire length and by sections:

a) Investment in the realisation of E-761 motorway project on the entire length from Pojate to Preljina has **satisfactory economic justification**, since **EIRR=13.47%**, which is higher than OCK=10%-12%.

b) Relative sequence (priorities) for the realisation of E-761 motorway project by sections has the following economic justification:

		EIRR (%)	ENPV (RSD)
1.	Obilaznica Kraljeva	17.9%	3,642,515,933
2.	Preljina – Kraljevo	15.1%	3,939,125,139
3.	Obilaznica Kruševca	12.9%	324,965,204
4.	Kraljevo-Kruševac	12.4%	2,566,672,663
5.	For M-5 / M-22-Preljina	10.5%	57,492,581
6.	Kruševca – Pojate	7.6%	-868,309,659

Conclusions and Recommendations of the Pre-Feasibility Study

Conclusions

a) In order to eliminate extremely unfavourable traffic conditions on the existing road M-5, which are manifested through the occurrence of bottlenecks from the aspect of practical capacity and Service Level (primarily through Kraljevo), as well as through a significantly low traffic safety level, there are realistic needs for the realisation of the designed road in the initial planning period.

According to the indicators of the economic evaluation of investing in the realisation of the selected alternative of E-761 motorway, the following was determined:

a) Investing in the construction of E-761 motorway along the entire length in the initial planned period has satisfactory economic justification because Internal Rate of Return (EIRR=13,47) is higher than the Opportunity Cost of capital (OCC=10 to 12%) and Net Present Value ENPV >0.

b) Investing in construction per stretch is different, which points at the justification of the phased realisation of the E-761 motorway project.

Recommendations

a) The results of the economic evaluation of the Pre-Feasibility Study reveal that further activities on the production of Preliminary Design and Feasibility Study for Pojate-Preljina motorway should be undertaken,

Starting from traffic volume on the existing road M-5 Preljina-Požega and on the existing road M-5/M-21 Požega-Užice-Sušice and taking into consideration that within the E'763 motorway project a General Design was made for the stretch Preljina-Požega-Užice-Sušice. It is necessary to produce a General Design for the motorway from Sušice to border with Bosnia and Herzegovina, through which the General Design of E-761 motorway on the stretch Preljina-Požega-Užice-Sušice-border with Bosnia and Herzegovina would be completed and Pre-Feasibility Study for the E-761 motorway stretch Preljina-Požega-Užice-Sušice-border with Bosnia and Herzegovina would be finalised.

Case Study 2: M-21 main road, Novi Sad – Ruma – Šabac, and M-19 main road, Šabac – Loznica

Subject of the Pre-Feasibility Study

The subject of the Pre-Feasibility Study is the General Corridor Design for the M-21 main road, Novi Sad – Ruma – Šabac, and the continuation of the M-19 main road, Šabac – Loznica.

Basic Traffic Problems on the Existing M-21 and M-19 Roads

The basic traffic problems on the segments of the existing M-21 and M-19 roads in their present condition, taking into account the achieved traffic flows in 2006 and 2007, are identified as follows:

- Extremely low traffic safety level with a large amount of the heaviest traffic accidents with fatalities;
- Appearance of traffic jams from the aspect of practical capacity on a significant part of these road routes, particularly on the roads through Irig, Ruma, Šabac and the villages Jarak, Hrtkovci and Platičevo;
- Low speeds, primarily on the roads through Irig, Ruma, Šabac and the villages Jarak, Hrtkovci and Platičevo;
- Increased vehicle operating costs and travel time costs for passengers and goods.
- Environment endangerment caused by noise and air pollution on the roads through Irig, Ruma, Šabac and the villages Jarak, Hrtkovci and Platičevo.

Objectives of the New Road Design on the M-21 Road Route, Novi Sad – Ruma – Šabac, and on M-19, Šabac – Loznica

The objectives of the designed new road are primarily reflected in resolving the manifested basic traffic problems on the existing roads M-21 and M-19. These problems shall be resolved by redirecting transit and traffic flows between the towns from the overloaded existing roads M-21 and M-19, which currently pass through a great number of settlements, to the new road.

Construction of the new road, apart from improving traffic conditions which will lead to savings in vehicle operating costs, in travel time costs, and traffic accidents costs, shall have a positive influence on the environment, as well as on an enhanced socio-economic development of the area. The stated positive effects shall also reflect on the appearance of the generated traffic, as well as on the emergence of economic benefits with regard to the generated traffic.

Pre-Feasibility Study Tasks

The essential tasks of the Pre-Feasibility Study for the construction of the new road along the M-21 route, Novi Sad – Ruma – Šabac, and on the route M-19, Šabac – Loznica, are the following:

a) To provide all relevant information on the existing roads, on the achieved and planned traffic flows (on the network without investments). As well as the data on the designed new road with the distribution of planned traffic flows onto the new road and the existing roads which, together with the new road, constitute the network with investments;

b) To provide answers to the question whether the M-21 road, Novi Sad – Ruma – Šabac, and the M-19 road, Šabac – Loznica, are capable of fulfilling the requirements of the planned traffic flows, within the time period expected, considered from a quantitative aspect (Practical capacity) and from a qualitative aspect (Service Level);

c) To determine the economic costs of operation (exploitation) of the network without investments and the network with investment;

d) To determine the expected economic benefits during a 20-year operating period of the network with investment of the new road, in order to analyze the feasibility of investments in the project realisation from a social-economic aspect, by comparing the economic benefits with the economic costs for constructing the new road;

e) To select the optimal alternative of the General Design on those stretches of the new road where alternative solutions exist.

f) To provide an evaluation of the economic feasibility of investing into the optimal alternative of the new road, from a socio-economic aspect;

g) To determine the optimal dynamics of new road project realisation in phases.

h) To provide arguments for decision-making on taking up the next steps in the preparation of Study and Design documents, i.e. in the preparation of the Preliminary Design and the Feasibility Study.

Initial Planning Period for Project Realisation and its Operation

- Planned construction period is 2011 – 2014.
- 20-year long operation period is 2015 – 2034.

Documentation Basis for the Preparation of Pre-feasibility Study

The following documents were used in the preparation of this Study:

- Traffic Study of the M-21 road, Novi Sad – Ruma – Šabac, and the M-19 road, Šabac – Loznica. The Study was based on a detailed survey of traffic flows (counting and polls) executed on the relevant network of existing roads, with a conducted traffic analysis in base year 2007, as well as the traffic forecast.

- Informational database on roads.

- Traffic Counting publication from 2000 to 2006.

- General Design of a new 4-lane road on the M-21 route, Novi Sad – Ruma – Šabac, and a 2-lane road on the M-19 route, Šabac – Loznica.

- Feasibility Study for the road "Novi Sad – Šabac – Loznica – Požega", the preparation of which was organised by the European Agency for Reconstruction and performed by EPTISA from Spain, Traffic Study, draft, June 2007.

- Statistical data on the prices of representative vehicles and vehicle brands, on the prices of liquid fuels and lubricants, on average salaries in Serbia, on the costs of an average traffic accident on the road network, etc.

- Statistical data on traffic accidents on the M-21 road, Novi Sad – Ruma – Šabac, and on the M-19 road, Šabac – Loznica.

Normative Bases followed in the Preparation of the Study

The tasks of this Pre-Feasibility Study also include the selection of an optimal alternative. The selection of optimal alternative within the Pre-Feasibility Study is pursuant to Article 106 of the Law on Planning and Construction ("Official Gazette of the RoS" No. 47/03), in accordance with which the Minister for Capital Investments passed the Rulebook on the content, scope and manner of preparing the Pre-Feasibility Study and the Feasibility Study for structure construction. The latter was published in the Gazette No. 80, on September 20th, 2005, under the section II – Pre-Feasibility Study. Within its Section 8, Item 4, the proposal of an optimal alternative is being requested.

Considering that the concrete contract for the preparation of technical documents is General Design, the application of road designing methodology is anticipated, therefore this Study recognizes the implementation of recommendations given in the road designing methodology, described under activities No. 114, for selecting the optimal alternative.

This way, the Law on Planning and Construction was followed in such a manner that the optimal alternative selection was done within the Pre-Feasibility Study, simultaneously following the concrete contract for preparation of technical documents for the General Design, by applying the recommendations given within the road designing methodology.

Methodology Applied in Pre-Feasibility Study Preparation

Taking into account that alternative corridors are designed in the General Design of the new road by stretches, the procedure of economic valuation was conducted in two steps, as follows:

- The goal of the first step was the selection of corridor alternative.
- The goal of the second step was the evaluation of economic feasibility of the selected alternative on the total length and by specific stretches. Followed by a check through the sensitivity test, as well as the determination of the optimal dynamics of project realisation through phases, by applying the optimal opening year criterion.

a) Selection of optimal corridor alternative of General Design of the new road by stretches was executed by applying the Cost/Benefit method and using the IRR and NPV criteria, as well as using the criterion of the impact of the road on environmental and spatial consequences.

The economic feasibility was also analysed on the total length and by stretches by applying the Cost/Benefit method for the optimal corridor alternative of General Design of the new road, together with the implementation of the sensitivity test. By applying the IRR, NPV and optimal year criteria, optimal dynamics of the project realisation through phases was clearly defined.

Data was taken from the Traffic Study on the achieved and forecast traffic on the existing M-21 road, Novi Sad – Ruma – Šabac, and on the M-19 road, Šabac – Loznica, as well as the distribution of forecast traffic among the existing roads and the designed new road in a 20-year long initial planning period. These data are based on conducted detailed surveys of traffic flows (polls and counting), as well as on other available data. Primarily the data from the publication on traffic counting on the road network in Serbia.

The HCM-2000 procedure was followed to assess traffic conditions (relations between flow/capacity and operation speeds) on networks (without investments and with investment). As well as a new classical procedure developed by local experts.

Technical-operational characteristics of the existing roads M-21 and M-19 (Network Inventory) are based on the information database on roads owned by PE "Roads of Serbia", with an appropriate adjustment to the manner of traffic flow creation. The data provided in the Feasibility Study for the "Novi Sad – Šabac – Loznica – Požega" road, prepared by EPTISA from Spain, were also available.

Technical-operational characteristics of the new road were determined based on the General Design.

The HDM-4 model was implemented to calculate moving vehicle operation costs during a 20-year period on the relevant networks (network without investments and network with investment). Basic vehicle types and representative vehicle brands were used from the HDM-4 model. Taking into account that the basic operational and economic parameters (prices) were adjusted to local conditions.

An appropriate model was developed to calculate additional vehicle operation costs in the function of cyclic speed changes of V-0-t_o-0-V type, caused by vehicles passing through signal-controlled junction.

The classical procedure of direct analysis was applied in the calculation of travel time costs during a 20-year period on relevant networks (without investments and with investment) and the costs of maintaining such networks.

Empirical models were used to calculate traffic accidents costs in a 20-year period on relevant networks (without investments and with investments). These were developed within the publication of the Faculty of Transport and Traffic Engineering titled **"Determination of needs and feasibility of extracting transit traffic from city arteries by constructing bypasses"**, Belgrade, 1997. These models are based on traffic accident surveys conducted on approximately 349 miles (562 km) of two-lane roads in the state of Illinois (USA), in the period 1981-1987, as well as on surveys on the changes in the number of accidents on road sections before the improvement and after the improvement.

Calculation of expected direct economical benefits in terms of normal traffic was determined on the basis of discrepancies in costs of using the network without investments and the network with investment in a 20-year long initial period of operation.

The economic costs of construction were determined at 80%, compared to financial costs for the realisation of the new road project on M-21 and M-19 routes, defined under the General Design.

Project valuation indicators from a social-economic aspect, the EIRR and ENPV, were established by applying the EVAL program. EIRR and ENPV indicators were also subjected to the Sensitivity Test with regard to the possible deviations in achieving the expected economic costs for new road construction ($\Delta T=\pm 10\%$) and economical benefits ($\Delta E=\pm 10\%$).

The evaluation of the feasibility of new road construction (per traffic section, longer stretches and total) on the M-21 and M-19 routes, from a socio-economic aspect, was established by comparing the EIRR values with OCC=10% and by comparing ENPV values (determined on the basis of OCC=10%) with zero (0).

The dynamics of the demand for new road per traffic section and longer stretches was determined with regard to the following aspects:

- from the aspect of traffic requirements, by applying the functional evaluation procedure using the service level criterion, SL=F (q/C and Ve);
- from the economical aspect, by applying the form for determining the optimal year of new road opening.

Basic Results of the Pre-Feasibility Study

The most significant results of the Pre-Feasibility Study for the new road on the M-21 route, Novi Sad – Ruma – Šabac, and on the M-19 route, Šabac – Loznica, are presented under the following paragraphs:

1) Relevant road networks:

- Network without investments comprises the existing roads on M-21 route, Novi Sad – Ruma – Šabac, and on the M-19 route, Šabac – Loznica;
- Network with investment comprises the following:
  - adopted alternative of the new road on the M-21 route, Novi Sad – Ruma – Šabac, and on the M-19 route, Šabac – Loznica
  - road routes stated under the network without investments

2) Traffic flows on the existing M-21 and M-19 roads, on the network without investments in base year, and forecast in the first and target year of initial planning period.

Average Annual Daily Traffic (AADT) in Base year (2007)

Traffic section		Length	**AADT 2007.** (vehicles/day)						
Label	Title	(km)	P V	BUS	L V	M V	H V	T T	**Total**
Traffic sections along the existing M 21 road: Novi Sad-Ruma-Šabac (link to M 19 road)									
01PP	N.Sad (Petrovaradin) - N.Sad (tunnel)	2.970	9,490	220	525	185	230	1050	**11,700**
02PP	N.Sad (tunnel) - Sremska Kamenica (entry)	2.875	8,990	210	505	170	225	1050	**11,150**
03PP	Sr.Kam. (entry) - Sr.Kamenica (exit)	0.560	7,119	82	425	122	201	827	**8,776**
04PP	Sr.Kam.(exit) - Sr.Kam. (end of settlement)	1.780	8,222	238	496	145	229	1079	**10,409**
05PP	Sr.Kam.(end of settlem.) - Fruška G. (ridge)	5.595	7,072	211	470	112	226	1091	**9,182**
06PP	Fruška Gora (ridge) - Irig (entry)	5.000	6,439	213	442	104	231	1093	**8,522**
07PP	Irig (entry) - Irig (Vrdnik)	2.935	7,498	210	420	190	227	1155	**9,700**
08PP	Irig (Vrdnik) - Ruma (entry)	7.150	6,805	206	386	220	221	1164	**9,002**
09PP	Ruma (entry) - Ruma (Stara Pazova)	2.225	3,483	66	225	165	174	1140	**5,253**
10PP	Ruma (Stara Pazova) - Ruma (Pećinci)	0.745	4,207	77	161	171	270	1245	**6,131**
11PP	Ruma (Pećinci) - Ruma (exit)	3.115	4,564	82	204	183	284	1258	**6,575**
12PP	Ruma (exit) – Link to E 70	2.215	5,587	144	223	234	189	1296	**7,673**
13PP	Link to E 70 - Jarak (R 103.3)	6.895	5,754	216	224	244	147	1160	**7,745**
14PP	Jarak (R 103.3) - Hrtkovci	4.095	6,427	227	226	245	152	1167	**8,444**
15PP	Hrtkovci - Platičevo	6.455	7,127	232	227	241	170	1163	**9,160**
16PP	Platičevo - Klenak	6.745	7,825	237	228	239	188	1161	**9,878**
17PP	Klenak - Šabac (bridge)	4.135	8,166	238	246	233	197	1250	**10,330**
18PP	Šabac (bridge) - Šabac (link to M 19)	2.235	8,166	238	246	233	197	1250	**10,330**
Traffic sections along the existing M 19 road: Šabac (link to M 19 road) - Loznica									
19PP	Šabac (link to M 19) - Šabac (R 209)	9.730	8,166	238	246	233	197	1250	**10,330**
20PP	Šabac (R 209) - Petlovača (R 208a)	14.875	6,441	210	264	115	211	587	**7,828**
21PP	Petlovača (R 208a) - Prnjavor (R 210)	7.425	4,944	201	203	96	171	510	**6,125**
22PP	Prnjavor (R 210) - Lešnica	8.200	4,687	195	185	87	159	507	**5,820**
23PP	Lešnica - Lipnički Šor (entry)	9.930	6,098	198	191	91	163	509	**7,250**
24PP	Lipnički Šor (entry) - Loznica (entry)	1.340	8,996	206	205	99	172	517	**10,195**
25PP	Loznica (entry) - Loznica (Šepak)	6.640	3,777	53	62	51	70	362	**4,375**

Average Annual Daily Traffic (AADT) in the First year (2015)

Traffic section		Length	**AADT 2015.** (vehicles/day)						
Label	Title	(km)	P V	BUS	L V	M V	H V	T T	**Total**
Traffic sections along the existing M 21 road:		**Novi Sad-Ruma-Šabac (link to M 19 road)**							
01PP	N.Sad (Petrovaradin) - N.Sad (tunnel)	2.970	14,369	322	782	275	342	1,564	**17,654**
02PP	N.Sad (tunnel) - Sremska Kamenica (entry)	2.875	13,612	307	752	253	335	1,564	**16,822**
03PP	Sr.Kam. (entry) - Sr.Kamenica (exit)	0.560	10,779	120	633	182	299	1,231	**13,244**
04PP	Sr.Kam.(exit) - Sr.Kam. (end of settlement)	1.780	12,449	348	739	216	341	1,607	**15,699**
05PP	Sr.Kam.(end of settlem.) - Fruška G. (ridge)	5.595	10,708	309	700	167	337	1,625	**13,844**
06PP	Fruška Gora (ridge) - Irig (entry)	5.000	9,749	312	658	155	344	1,628	**12,845**
07PP	Irig (entry) - Irig (Vrdnik)	2.935	11,353	307	625	283	338	1,720	**14,626**
08PP	Irig (Vrdnik) - Ruma (entry)	7.150	10,303	302	575	328	329	1,733	**13,569**
09PP	Ruma (entry) - Ruma (Stara Pazova)	2.225	5,274	97	335	246	259	1,698	**7,907**
10PP	Ruma (Stara Pazova) - Ruma (Pećinci)	0.745	6,370	113	240	255	402	1,854	**9,232**
11PP	Ruma (Pećinci) - Ruma (exit)	3.115	6,910	120	304	273	423	1,873	**9,902**
12PP	Ruma (exit) – Link to E 70	2.215	8,459	211	332	348	281	1,930	**11,561**
13PP	Link to E 70 - Jarak (R 103.3)	6.895	8,712	316	334	363	219	1,727	**11,671**
14PP	Jarak (R 103.3) - Hrtkovci	4.095	9,731	332	337	365	226	1,738	**12,728**
15PP	Hrtkovci - Platičevo	6.455	10,791	340	338	359	253	1,732	**13,812**
16PP	Platičevo - Klenak	6.745	11,848	347	340	356	280	1,729	**14,899**
17PP	Klenak - Šabac (bridge)	4.135	12,364	348	366	347	293	1,861	**15,580**
18PP	Šabac (bridge) - Šabac (link to M 19)	2.235	12364	348	366	347	293	1,861	**15,580**
Traffic sections along the existing M 19 road: Šabac (link to M 19 road) -							**Loznica**		
19PP	Šabac (link to M 19) - Šabac (R 209)	9.730	12,364	348	366	347	293	1,861	**15,580**
20PP	Šabac (R 209) - Petlovača (R 208a)	14.875	9,752	307	393	171	314	874	**11,812**
21PP	Petlovača (R 208a) - Prnjavor (R 210)	7.425	7,486	294	302	143	255	759	**9,239**
22PP	Prnjavor (R 210) - Lešnica	8.200	7,097	285	275	130	237	755	**8,778**
23PP	Lešnica - Lipnički Šor (entry)	9.930	9,233	290	284	136	243	758	**10,943**
24PP	Lipnički Šor (entry) - Loznica (entry)	1.340	13,621	302	305	147	256	770	**15,401**
25PP	Loznica (entry) - Loznica (Šepak)	6.640	5,719	78	92	76	104	539	**6,607**

Average Annual Daily Traffic (AADT) in Target year (2034)

Traffic section		Length	AADT 2034. (vehicles/day)						
Label	Title	(km)	P V	BUS	L V	M V	H V	T T	Total
Traffic sections along the existing M 21 road: Novi Sad-Ruma-Šabac (link to M 19 road)									
01PP	N.Sad (Petrovaradin) - N.Sad (tunnel)	2.970	25,041	536	1332	469	583	2,663	**30,624**
02PP	N.Sad (tunnel) - Sremska Kamenica (entry)	2.875	23,722	512	1281	431	571	2,663	**29,180**
03PP	Sr.Kam. (entry) - Sr.Kamenica (exit)	0.560	18,785	200	1078	309	510	2,098	**22,980**
04PP	Sr.Kam.(izlaz) - Sr.Kam. (end of settlem.)	1.780	21,695	580	1258	368	581	2,737	**27,219**
05PP	Sr.Kam.(end of settlem.) - Fruška G. (ridge)	5.595	18,661	514	1192	284	573	2,767	**23,991**
06PP	Fruška Gora (ridge) - Irig (entry)	5.000	16,991	519	1121	264	586	2,773	**22,254**
07PP	Irig (entry) - Irig (Vrdnik)	2.935	19,785	512	1065	482	576	2,930	**25,350**
08PP	Irig (Vrdnik) - Ruma (entry)	7.150	17,956	502	979	558	561	2,953	**23,509**
09PP	Ruma (entry) - Ruma (Stara Pazova)	2.225	9,191	161	571	419	441	2,892	**13,675**
10PP	Ruma (Stara Pazova) - Ruma (Pećinci)	0.745	11,101	188	408	434	685	3,158	**15,974**
11PP	Ruma (Pećinci) - Ruma (exit)	3.115	12,043	200	517	464	720	3,191	**17,135**
12PP	Ruma (exit) – Link to E 70	2.215	14,742	351	566	594	479	3,287	**20,019**
13PP	Link to E 70 - Jarak (R 103.3)	6.895	15,183	527	568	619	373	2,942	**20,212**
14PP	Jarak (R 103.3) - Hrtkovci	4.095	16,959	553	573	621	386	2,960	**22,052**
15PP	Hrtkovci - Platičevo	6.455	18,806	566	576	611	431	2,950	**23,940**
16PP	Platičevo - Klenak	6.745	20,648	578	578	606	477	2,945	**25,832**
17PP	Klenak - Šabac (bridge)	4.135	21,548	580	624	591	500	3,171	**27,014**
18PP	Šabac (bridge) - Šabac (link to M 19)	2.235	21,548	580	624	591	500	3,171	**27,014**
Traffic sections along the existing M 19 road: Šabac (link to M 19 road) - Loznica									
19PP	Šabac (link to M 19) - Šabac (R 209)	9.730	21,548	580	624	591	500	3,171	**27,014**
20PP	Šabac (R 209) - Petlovača (R 208a)	14.875	16,996	512	670	292	535	1,489	**20,494**
21PP	Petlovača (R 208a) - Prnjavor (R 210)	7.425	13,046	490	515	244	434	1,294	**16,023**
22PP	Prnjavor (R 210) - Lešnica	8.200	12,368	475	469	221	403	1,286	**15,222**
23PP	Lešnica - Lipnički Šor (entry)	9.930	16,091	483	484	231	413	1,291	**18,993**
24PP	Lipnički Šor (entry) - Loznica (entry)	1.340	23,738	502	520	251	436	1,311	**26,758**
25PP	Loznica (entry) - Loznica (Šepak)	6.640	9,966	129	157	129	178	918	**11,477**

3) Expected traffic flows on the optimal alternative of the new road in the first year and target year

Road stretch I: Novi Sad (Petrovaradin) – Fruška gora (foot)
[Two alternatives were designed: Blue and Pink]

Average Annual Daily Traffic (AADT) along the designed new road for the alternative Blue (NEW ROAD ALIGNMENT COINCIDES WITH THE EXISTING ROAD ALIGNMENT)

Traffic sections of the new road		Length (km)	year	**AADT 2015.** (vehicles/day)						
Label	Title			P V	BUS	L V	M V	H V	T T	**Total**
11NP(V1)	N.Sad (Petrovaradin) - Petrovaradin (exit)	1.000	2015	14,369	322	782	275	342	1,564	**17,654**
			2034	25,041	536	1,332	469	583	2,663	**30,624**
12NP(V1)	Petrovaradin (exit) -N.Sad (tunnel)	1.970	2015	14,369	322	782	275	342	1,564	**17,654**
			2034	25,041	536	1,332	469	583	2,663	**30,624**
13NP(V1)	N.Sad (tunnel) - Sr.Kamenica (entry)	2.875	2015	13,612	307	752	253	335	1,564	**16,823**
			2034	23,722	512	1281	431	571	2,663	**29,180**
14NP(V1)	Sr.Kamenica (entry) - Sr.Kamenica (exit)	0.560	2015	10,779	120	633	182	299	1,231	**13,244**
			2034	18,785	200	1,078	309	510	2,098	**22,980**
15NP(V1)	Sr.Kamenica (exit) -Sr.Kamenica (end of settl.)	1.780	2015	12,449	348	739	216	341	1,607	**15,700**
			2034	21,695	580	1,258	368	581	2,737	**27,219**
16NP(V1)	Sr.Kamenica (end of settlem.) -Fr.gora (foot)	1.055	2015	10,708	309	700	167	337	1,625	**13,846**
			2034	18,661	514	1,192	284	573	2,767	**23,991**

Road stretch II: Fruška gora (foot) – Jarak
(No alternatives)

Average Annual Daily Traffic (AADT) along the designed new road

Traffic sections of the new road		Length (km)	year	**AADT 2015.** (vehicles/day)						
Label	Title			P V	BUS	L V	M V	H V	T T	**Total**
21NP	Fruška gora (foot) -Irig (Vrdnik)	10.900	2015	9,262	249	615	150	334	1,620	**12,230**
			2034	16,141	414	1048	256	568	2,760	**21,187**
22NP	Irig (Vrdnik) - Ruma (entry)	7.110	2015	10,303	302	575	328	329	1,733	**13,570**
			2034	17,956	502	979	558	561	2,953	**23,509**
23NP	Ruma (entry) - Ruma (Stara Pazova)	2.225	2015	5,274	97	335	246	259	1,698	**7,909**
			2034	9,191	161	571	419	441	2,892	**13,675**
24NP	Ruma (S. Pazova) - Ruma (Pećinci)	0.745	2015	6,370	113	240	255	402	1,854	**9,234**
			2034	11,101	188	408	434	685	3,158	**15,974**
25NP	Ruma (Pećinci) - Ruma (exit)	3.115	2015	6,910	120	304	273	423	1,873	**9,903**
			2034	12,043	200	517	464	720	3,191	**17,135**
26NP	Ruma (exit) – link to M 1 (E 70)	2.215	2015	8,459	211	332	348	281	1,930	**11,561**
			2034	14,742	351	566	594	479	3,287	**20,019**
27NP	link to M 1 (E 70) - Jarak	0.750	2015	8,712	316	334	363	219	1,727	**11,671**
			2034	15,183	527	568	619	373	2,942	**20,212**

Road stretch III: Jarak – Šabac
[Two alternatives were designed: Blue and Pink]

Average Annual Daily Traffic (AADT) along the designed new road for the alternative Blue

Traffic sections of the new road		Length (km)	year	AADT 2015. (vehicles/day)						
Label	Title			P V	BUS	L V	M V	H V	T T	**Total**
31NP(V1)	Jarak - Hrtkovci (exit)	11.600	2015	8,102	310	301	345	214	1,693	**10,965**
			2034	14,120	517	512	588	365	2,884	**18,986**
32NP(V1)	Hrtkovci (exit) - Klenak (entry)	7.350	2015	10,467	322	304	341	250	1,714	**13,398**
			2034	18,241	536	517	581	426	2,920	**23,221**
33NP(V1)	Klenak (entry) - Šabac (R 208)	3.750	2015	8,897	322	228	273	162	1,714	**11,596**
			2034	15,505	536	388	464	276	2,920	**20,089**
34NP(V1)	Šabac (R 208) - Šabac	0.300	2015	8,897	322	228	273	162	1,714	**11,596**
			2034	15,505	536	388	464	276	2,920	**20,089**
35NP(V1)	Šabac - Majur (M 19)	6.300	2015	8,897	322	228	273	162	1,714	**11,596**
			2034	15,505	536	388	464	276	2,920	**20,089**

Road stretch IV: Šabac – Lipnički Šor
[Two alternatives were designed: B1/IV (Blue) and B2/IV (Pink)]

Average Annual Daily Traffic (AADT) along the designed new road for the alternative Pink

Traffic sections of the new road		Length (km)	year	AADT 2015. (vehicles/day)						
Label	Title			P V	BUS	L V	M V	H V	T T	**Total**
41NP(V2)	Štitar (R 209) - Petlovača	11.500	2015	8,550	236	363	156	289	837	**10,431**
			2034	14,901	392	619	266	492	1426	**18,096**
42NP(V2)	Petlovača - Prnjavor	3.000	2015	6,738	236	273	128	229	722	**8,326**
			2034	11,742	392	464	218	391	1230	**14,437**
43NP(V2)	Prnjavor - Straža	17.000	2015	5,678	230	220	104	189	719	**7,140**
			2034	9,895	383	375	178	322	1225	**12,378**
44NP(V2)	Straža - Lipnički Šor	8.515	2015	8,309	233	256	122	219	721	**9,860**
			2034	14,481	388	436	208	373	1228	**17,114**

Road stretch V: Lipnički Šor – Loznica (Šepak)
(No alternatives)

Average Annual Daily Traffic (AADT) along the designed new road (NEW ROAD ALIGNMENT COINCIDES WITH THE EXISTING ROAD ALIGNMENT)

Traffic sections of the new road		Length (km)	year	**AADT 2015.** (vehicles/day)						
Label	Title			P V	BUS	L V	M V	H V	T T	**Total**
51NP	Lipnički Šor - Lipnički Šor	6.68	2015	5,719	78	92	76	104	539	**6,608**
		2	2034	9,966	129	157	129	178	918	**11,477**

4) Basic data on the optimal alternative of the designed new road

Road stretch	Road stretch	Alternative	Length (m)	Construction costs (EUR)
Novi Sad - Šabac	road stretch I	B1/I (Blue)	9.240	36,219,509
	road stretch II	no alternative	27.060	115,402,859
	road stretch III	B1/I (Blue)	29.300	95,190,064
	total 4-lane road		**65.600**	**246.812.432**
Šabac - Loznica	road stretch IV	B2/I (Pink)	40.015	99,148,411
	road stretch V	no alternative	6.682	13,265,401
	total 2-lane road		**46.697**	**112,413,812**

5) Costs of realisation of the optimal alternative for the new road design with dynamics of investments per year

Financial costs of realisation

Road stretch	Varijanta	Finansijski troškovi građenja (EUR)	Dinamika ulaganja (EUR)	
road stretch I	B1/I (Blue)	36,219,509	2012 2013 2014	12,073,170 12,073,170 12,073,170
road stretch II	-	115,402,859	2012 2013 2014	38,467,620 38,467,620 38,467,620
road stretch III	B1/I (Blue)	95,190,064	2012 2013 2014	31,730,021 31,730,021 31,730,021
road stretch IV	B2/I (Pink)	99,148,411	2012 2013 2014	33,049,470 33,049,470 33,049,470
road stretch V	-	13,265,401	2012 2013 2014	4,421,800 4,421,800 4,421,800

6) Expected economic benefits by stretches of the optimal alternative for the new road design in the first and target year

Road stretch	Alternative	Economic benefits in the first year 2015 (RSD)	Economic benefits in target year 2034 (RSD)
road stretch I	B1/I (Blue)	623,843,564	1,340,036,475
road stretch II	-	1,478,979,225	2,876,215,021
road stretch III	B1/I (Blue)	2,220,069,248	5,638,487,333
road stretch IV	B2/I (Pink)	1,217,870,363	2,104,777,439
road stretch V	-	57,381,236	97,591,421

7) Values of basic indicators of economic evaluation of the optimal alternative for the new road by stretches and for the total length of the new road

Road stretch	Alternative	IRR (%)	NPV (RSD)
road stretch I	B1/I (Blue)	24.75%	4,954,649,270
road stretch II	-	19.19%	8,734,612,746
road stretch III	B1/I (Blue)	31.77%	22,346,419,697
road stretch IV	B2/I (Pink)	17.99%	6,215,876,341
road stretch V	-	5.12%	-378,616,344
Total length		22,93%	41.872.941.709

8) Assessment of economic feasibility of investing into the project realisation of optimal new road alternative in the initial planning period from a social-economic aspect, by stretches and for the total length of the new road

a) Investment into the project realisation on the total length from Novi Sad to Loznica has a high economic feasibility, since EIRR=22.93%, which is higher than OCC=10%-12%.

b) Investment into the project realisation of a four-lane road on the total M-21 route, from Novi Sad to Šabac, has an extremely high economic feasibility on all stretches, since EIRR=25.35%, which is higher than OCC=10%-12%.

c) Investment into the project realisation of a two-lane road on the total M-19 route, from Šabac to Loznica, has a satisfactory economic feasibility, since EIRR=16.77%, which is higher than OCC=10%-12%.

d) The observed isolated investment in the stretch from Lipičin Šor to Loznica (Šepak) does not have a sufficient economic feasibility in the initial planning period, since the EIRR=5.1%, which is lower than OCC=10%-12%.

9) Optimal dynamics of new road project realisation through phases

Based on the values of Internal Rate of Return and the Net Present Value, the relative priorities for the project realisation of the road Novi Sad – Šabac – Loznica, surveyed on M-21 and M-19 routes, and by stretches within the road routes appear.

According to road routes, the priorities are the following:

A. The first priority is the M-21 four-lane road from Novi Sad to Šabac
B. The second priority is the M-19 two-lane road from Šabac to Loznica

According to stretches within road routes, the priorities are the following:

A. Priority by stretches within the M-21 four-lane road from Novi Sad to Šabac
   - The first priority is the stretch from Jarak to Šabac
   - The second priority is the stretch from Novi Sad (Petrovaradin) to Fruška Gora (foot)
   - The third priority is the stretch from Fruška Gora (foot) to Jarak

B. Priority by stretches within the M-19 two-lane road from Šabac to Loznica

   - The first priority is the stretch from Šabac to Lipnički Šor
   - The second priority is the stretch from Lipnički Šor to Loznica

Conclusions and Recommendations of the Pre-Feasibility Study

Conclusions

1) In order to eliminate extremely unfavourable traffic conditions on the existing roads (M-21 and M-19), which are caused by bottlenecks from the aspect of practical capacity and service level, and especially through a significantly low traffic safety level, there are realistic needs for the realisation of the designed road in the initial planning period, in functional phases.

2) According to the indicators of economic evaluation of investing in the optimal alternative of the new road, the following was determined:

a) Investment in the project realisation on the total length from Novi Sad to Loznica has a high economic feasibility, since the EIRR=22.93%, which is higher than the OCC=10%-12%.

b) Investment in the project realisation of a four-lane road on the total M-21 route, from Novi Sad to Šabac has an extremely high economic feasibility on all stretches, since the EIRR=25.35%, which is higher than the OCC=10%-12%.

c) Investment in the project realisation of a two-lane road on the M-19 route, from Šabac to Loznica, has a satisfactory economic feasibility, since the EIRR=16.77%, which is higher than the OCC=10%-12%.

d) The surveyed isolated investment into the stretch from Lipičin Šor to Loznica (Šepak) does not have the sufficient economic feasibility in the initial planning period, as the EIRR=5.1%, which is lower than the OCC=10%-12%.

Recommendations

1) The results of the economic evaluation of the Pre-Feasibility Study reveal that there is a full justification for initiating the preparation of the Preliminary Design and the Feasibility Study for M-21 road, Novi Sad- Ruma – Šabac, and the continuation of the M-19 road, Šabac – Loznica.

2) During the Preliminary Design phase, special attention should be paid to the project improvement, particularly from the aspect of feasibility, taking into account the financing sources.

ANNEX 3 Appraisal periods in EU

Country (in EU)	Appraisal Period (in Years)
Belgium	30
Denmark	50
Finland	30
France	30 – Infinite
Ireland	30
Netherlands	Infinite
Sweden	40-60
Switzerland	40 – Infinite
UK	30
Czech Republic	20
Estonia	30
Hungary	25
Latvia	20 – 30
Poland	20
Slovak Republic	20 – 30
Slovenia	20 – 25
Italy	30
Malta	30
Portugal	20

Source: HEATCO

ANNEX 4 Value of Time in Serbia for the period 2008-2030

Year	Time values	
	Passengers Euro/hr	Freights Euro/hr/ton
2008	3,50	0,02
2009	3,65	0,03
2010	3,75	0,05
2011	4,10	0,08
2012	4,30	0,12
2013	4,60	0,15
2014	5,00	0,18
2015	5,30	0,20
2016	5,90	0,22
2017	6,20	0,26
2018	6,80	0,28
2019	7,10	0,31
2020	7,60	0,36
2021	7,80	0,40
2022	8,30	0,50
2023	8,90	0,60
2024	9,40	0,70
2025	10,00	0,80
2026	11,00	0,90
2027	12,00	1,00
2028	13,00	1,00
2029	15,00	1,20
2030	17,00	1,40

ANNEX 5 Detailed Explanation of Vehicle Operating Costs in Serbia

Vehicle Operating Costs (VOC) are the costs/benefits that the owner of the transport vehicle receives in the form of the increase/reduction of the operating costs of his vehicle. The HEATCO study defines VOC as "comprising the standing costs, which are invariant with distance, and operating costs, which vary with distance, of the transport vehicle". The same study recommends including the following components in the calculation of the VOC:

- Standing (Fixed) Cost Components: depreciation (time-dependent share), interest of capital, repair and maintenance costs, material costs, insurance, overhead, administration.
- Operating (Variable) Cost Components: personnel costs (if not included in travel time savings), depreciation (distance-dependent share), fuel and lubricants, maintenance cost (distance-related).

In the road transport sector VOC usually include the cost of fuel, lubricating oil, spare parts, maintenance (labour hours), tyres, depreciation and crew. These costs varies on a number of variables:

- Category of vehicle – standard categories of vehicles include: passenger cars, light goods vehicles (LGV), heavy goods vehicles (HGV), buses;
- 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.).

In Western Europe HDM-4 computer software developed by the World Bank is often used to estimate these savings.

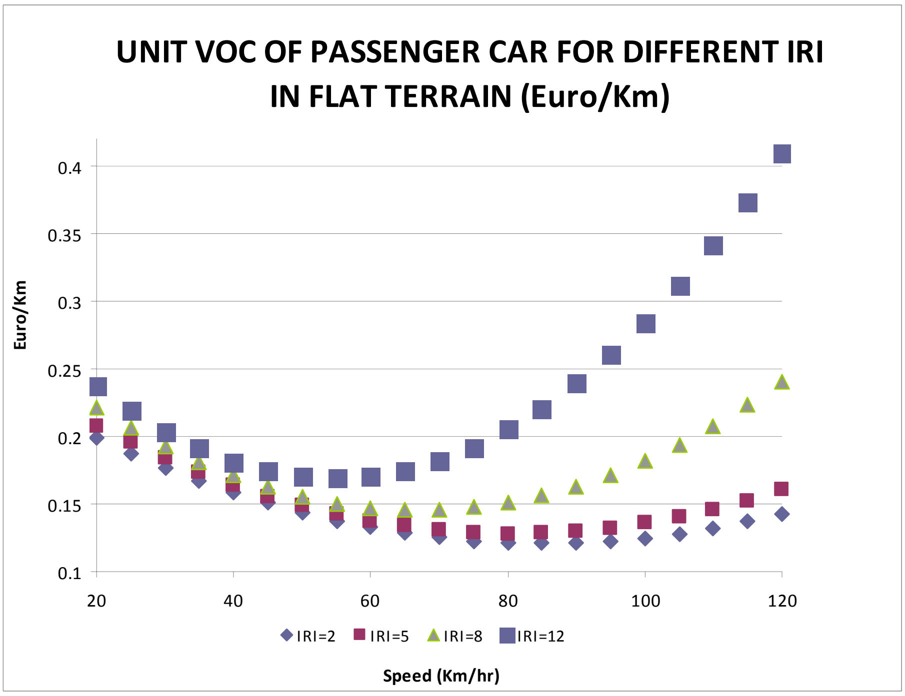
Proposed Value for Serbia

As an improvement of the roads in Serbia can have a positive effect on the operating costs as a result of:

a) shorter routes which will lead lower operating costs and

b) improved quality of roads that will lead to reduced wear and tear of the vehicle.

A reduction in the IRI (International Roughness Index) gives an idea as to how far this will lead to reduced wear and tear of the vehicle. This aspect of IRI is a specific element in CBA analyses for countries where the infrastructure is in a bad condition. The figure below shows how the IRI influences the VOC of a passenger car. So an improvement of the IRI will lead to a lower VOC.



As can be observed in the figure above a quadratic function has been applied to determine the VOC:

VOC = a+b*speed +c*speed^2

The values for the parameters are listed in the table below. The speed is obtained from the GTMP. So the VOC is calculated for each link. A change in IRI and a change in speed will lead to a new value of VOC. An improvement in infrastructure will lead to a lower IRI, resulting in a lower VOC. A lower VOC is a benefit to society.

Passenger Car Medium

Type of terrain	Flat				Rolling				Mountain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	0.25427	0.26845	0.29948	0.33829	0.26100	0.27162	0.29968	0.33828	0.27033	0.27951	0.30294	0.34194
b	-0.00313	-0.00347	-0.00458	-0.00619	-0.00340	-0.00361	-0.00459	-0.00619	-0.00384	-0.00395	-0.00472	-0.00635
c	0.00002	0.00002	0.00003	0.00006	0.00002	0.00002	0.00003	0.00006	0.00002	0.00003	0.00004	0.00006

Bus

Type of terrain	Flat				Rolling				Mountain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	1.51983	1.65630	1.87637	2.19782	1.54920	1.67934	1.88024	2.20082	1.60672	1.72776	1.91412	2.20794
b	-0.02371	-0.02479	-0.02913	-0.03861	-0.02485	-0.02566	-0.02902	-0.03836	-0.02610	-0.02652	-0.02910	-0.03690
c	0.00016	0.00017	0.00022	0.00036	0.00017	0.00018	0.00022	0.00036	0.00019	0.00019	0.00023	0.00034

Light Truck

Type of terrain	Flat				Rolling				Montain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	0.80922	0.85844	0.95042	1.08814	0.82347	0.86666	0.95308	1.09052	0.84432	0.88545	0.96247	1.09960
b	-0.01322	-0.01396	-0.01647	-0.02156	-0.01395	-0.01440	-0.01663	-0.02172	-0.01499	-0.01534	-0.01708	-0.02217
c	0.00009	0.00010	0.00013	0.00020	0.00010	0.00010	0.00013	0.00020	0.00011	0.00011	0.00014	0.00021

Medium Truck

Type of terrain	Flat				Rolling				Mountain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	0.96672	1.01700	1.13035	1.29658	0.98547	1.03118	1.13437	1.29363	1.00945	1.05325	1.14070	1.30389
b	-0.01513	-0.01569	-0.01893	-0.02533	-0.01599	-0.01633	-0.01906	-0.02493	-0.01704	-0.01729	-0.01922	-0.02530
c	0.00010	0.00011	0.00014	0.00024	0.00011	0.00011	0.00015	0.00023	0.00012	0.00012	0.00015	0.00023

Heavy Truck

Type of terrain	Flat				Rolling				Mountain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	1.37266	1.45989	1.64208	1.90532	1.40985	1.48466	1.64397	1.90898	1.45866	1.52785	1.66036	1.90459
b	-0.02145	-0.02246	-0.02803	-0.03836	-0.02305	-0.02352	-0.02788	-0.03833	-0.02427	-0.02446	-0.02739	-0.03660
c	0.00014	0.00015	0.00022	0.00038	0.00016	0.00016	0.00022	0.00038	0.00017	0.00018	0.00021	0.00035

Artic Truck

Type of terrain	Flat				Rolling				Mountain			
IRI	2	5	8	12	2	5	8	12	2	5	8	12
a	1.83202	1.93189	2.09199	2.38623	1.71524	1.82037	2.01209	2.33421	1.83202	1.93189	2.09199	2.38623
b	-0.02991	-0.03016	-0.03325	-0.04374	-0.02645	-0.02700	-0.03207	-0.04443	-0.02991	-0.03016	-0.03325	-0.04374
c	0.00024	0.00024	0.00028	0.00045	0.00019	0.00020	0.00027	0.00046	0.00024	0.00024	0.00028	0.00045

For rail traffic a fixed VoC is used so benefits are obtained if the speed of the link is obtained.

ANNEX 6 Benefit Estimation in Transport CBA and Rule of half

A transport CBA involves the application of the basic principles of CBA to **networks**. However, the analysis can begin at the level of a single connection in the network, between origin i and destination j by mode m.

Consumer surplus for the individual is the difference between willingness-to-pay and price (generalised cost). Total consumer surplus (CS^0) for a particular ijm market within the network, is shown diagrammatically in Figure 4(i). User benefit, ΔCS_{ijm}, as a result of a change in supply conditions (due to a transport initiative) is shown by the shaded area in Figure 4(ii).

Generalised cost GC_{ijm} is made up of any aspects of the inconvenience of travelling (for passengers), but is typically defined to include:

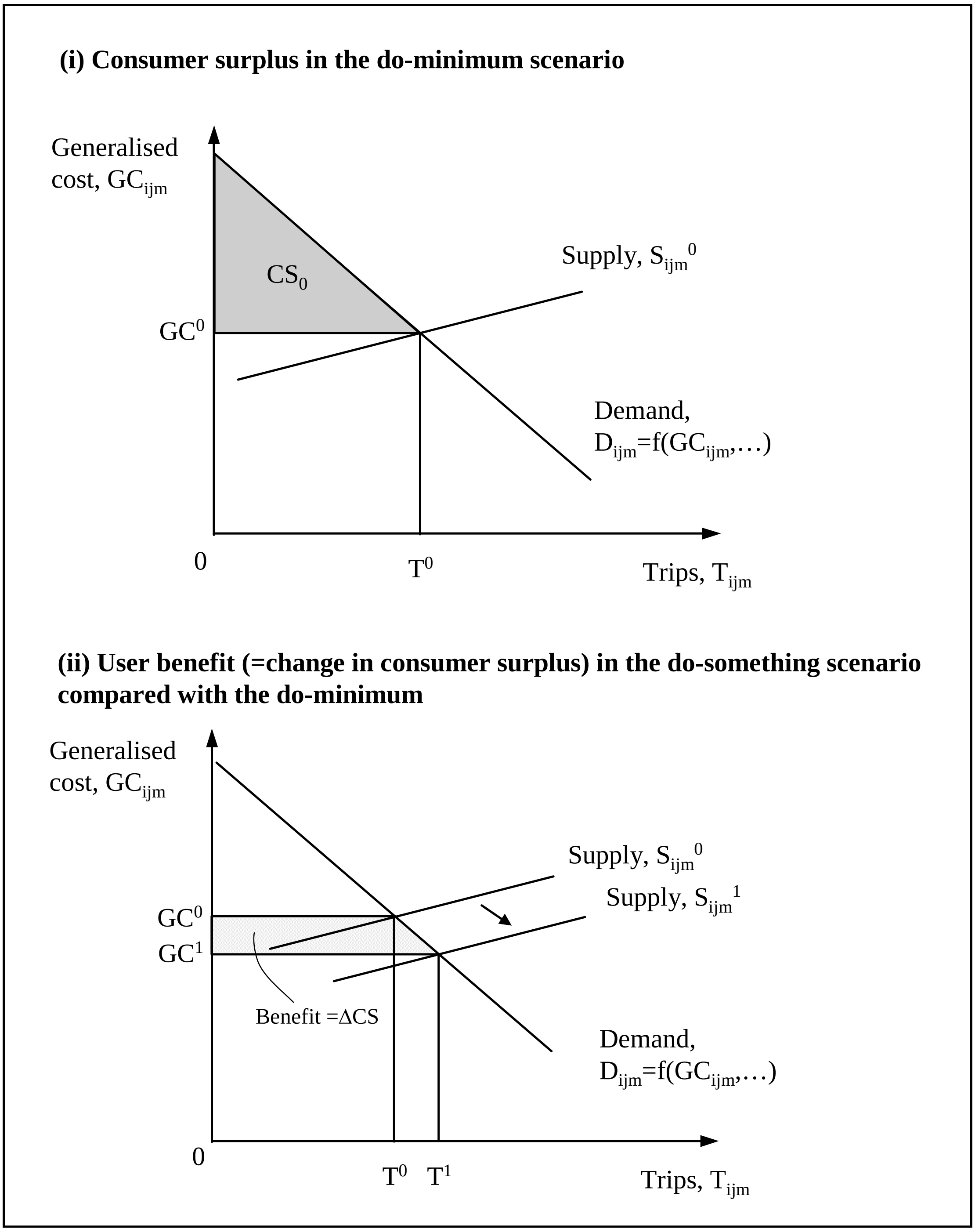
- travel time; and
- money costs of travel (including user charges (fares, tolls, etc) and the cost of private transport inputs such as fuel).

Thus: $GC_{ijm} = T_{ijm}V^{T}_{ijm} + \text{User Charges}_{ijm} + \text{Private transport operating costs}_{ijm}$

where T is travel time in minutes, V^T is a Value of Time in money/minute (note that this is abstracting from variation in VT between individuals, trip purposes and modes).

In a pure form of CBA, the values of time would be based on observed behaviour in the project context, and would be applied consistently throughout the demand modelling and evaluation process. In practice, however, values of time (VoT) are not directly observed but are imported from elsewhere mostly from national studies or are derived from other studies where they have been used.

Figure 4: Consumer surplus and user benefit - a simple illustration



Source: IASON[39].

[39] Deliverable 1: IASON Project Assessment Baseline Version 1.0 IASON, Mackie PJ, Nellthorp J, Kiel J, Schade W, Nokkala M (2001) with contributions from partners Contract: GRD1/2000/25351 S12.316053 Project Coordinator: TNO Inro, Delft, Netherlands. Funded by the European Commission 5th Framework – Transport RTD

Extending the analysis to the network level, user benefits are given by the change in consumer surplus (ΔCS) across the network:

$$\Delta CS = \sum_{ijm} \left[CS_{ijm}^{1} - CS_{ijm}^{0} \right]$$

where i and j are the possible origins and destinations within the network; m are the modes of transport which exist; and superscripts 1 and 0 are the do-something and do-minimum scenarios;

hence CS^1_{ijm} is the total consumer surplus due to trips from i to j by mode m in the do-something scenario.

It can be observed that the little rectangle formed by GC^0 GC^1 T^0 T^1 is what is referred to as the **"rule of half"**. In words the extra generated traffic (T^1 –T^0) gets only the half of the "decrease in price".

Note that these calculations are for the general case of a multi-modal network.

Note also that in order for the CBA to produce a robust result in terms of predicted change in consumer surplus, it is essential that the forecasting model (the first stage in the flow diagram - Fig 3) predicts all relevant types of response to the transport initiative across an appropriate area.

Of course much research has taken place on the specification of V^T, values for accident reduction and values of environmental damage, these form a key part of state of the art transport CBA.

The remaining stages of the CBA process consume a significant amount of resources and have a substantial bearing on the result. Key variables include the choice of social discount rate and the time profile applied to forecast costs and benefits, in the light of modelling outputs and other evidence (Mackie and Nellthorp, 2001).

ANNEX 7 Value of Time used in GTMP

The value of time (VoT) is preferably to be determined within the context of the projects, however this is very costly. Usually these are obtained from studies carried out on national level. In the case of Serbia no study was at hand, the value of time was determined, based on the HEATCO values for different countries. A relationship between the Value of Time and the GDP was estimated and applied in the analysis of the GTMP. A distinction was made between VoT for freight and passenger transport users.

A remark has to be made in case of toll roads, toll bridges or toll tunnels. In case of revenues from tolls in the financial analysis and inclusion of time saving benefits in the economic analysis double counting can occur. In fact, part of the willingness to pay of the users for travel time reductions are passed onto tolls to the operator (supplier). In this sense the toll income can be left out of the economic analysis. Moreover there is, of course, a relation between toll levels and traffic demand. The higher the tolls, the lower the traffic demand will be (depending on the price elasticity of the users). In that sense there can be a trade off between the toll income (financial analysis) and the consumer surplus (time savings benefits) in the economic analysis.

In the Serbian model the VoT's were calculated for different years. As stated, the VoT rises at the same rate as the growth of GDP. In the table below the VoT is used in the GTMP. The values are calculated in Euro's as these form a more stable unit for calculation in the long-term. The growth of GDP is taken in real terms (not in nominal).

Year	Time values	
	Passengers Euro/hr	Freights Euro/hr/ton
2008	3,50	0,02
2009	3,65	0,03
2010	3,75	0,05
2011	4,10	0,08
2012	4,30	0,12
2013	4,60	0,15
2014	5,00	0,18
2015	5,30	0,20
2016	5,90	0,22
2017	6,20	0,26
2018	6,80	0,28
2019	7,10	0,31
2020	7,60	0,36
2021	7,80	0,40
2022	8,30	0,50
2023	8,90	0,60
2024	9,40	0,70
2025	10,00	0,80
2026	11,00	0,90
2027	12,00	1,00
2028	13,00	1,00
2029	15,00	1,20
2030	17,00	1,40

ANNEX 8 Road Safety Values used in GTMP

The cost of accidents is an important socio-economic cost of transport.
The following accident classification is traditionally applied to the CBA of transport projects:

- Fatal accident: Death within 30 days for causes arising out of accident
- Serious injury: Cases which require hospitalisation, hospital treatment and results in the lasting injuries, but do not conduct to the death within 30 days.
- Slight accident: Cases that do not require major hospital treatment, or if they do, the effects of the injuries can be quickly overcome
- Damage-only accidents: accidents without casualties.

The main three categories of the accident costs are: material damage (cost of vehicle damage, cost of lost or damaged goods), personal loss for casualties, costs to society. They can be further detailed into the following items: damage to property, cost of emergency services, legal and court costs, insurance costs, lost economic output, delays to other transport users, welfare loss, human costs including pain and suffering, etc.

Proposed values for Serbia

Besides the effect of improvement of the roads, there is also an autonomous increase in road safety as a result of a safer vehicle park and better driving capabilities over time. So not all increase in traffic safety can be allocated towards the project benefits. Therefore an estimation was made for which increase in traffic safety could be attributed to the projects. This was monetised again with HEATCO adapted values for Serbia.

In the table below the values for the different injuries in accidents are listed in Euros. The values are obtained from HEATCO and are adapted to GDP values for the Serbian situation.

Years	Average value of fatalities Serbia	Average value of severe injuries Serbia	Average value of slight injuries Serbia	Average value of accident Serbia
2007	243,665	32,532	2,464	73,120
2008	259,559	34,654	2,625	77,890
2009	276,491	36,915	2,796	82,971
2010	295,916	39,508	2,992	88,800
2011	316,707	42,284	3,203	95,039
2012	337,366	45,042	3,412	101,239
2013	357,484	47,728	3,615	107,276
2014	377,006	50,335	3,812	113,134
2015	397,595	53,083	4,021	119,312
2016	419,307	55,982	4,240	125,828
2017	442,206	59,039	4,472	132,700
2018	465,974	62,213	4,712	139,832
2019	491,019	65,557	4,965	147,348
2020	517,410	69,080	5,232	155,267
2021	540,028	72,100	5,461	162,054
2022	563,634	75,251	5,700	169,138
2023	588,117	78,520	5,947	176,485
2024	613,664	81,931	6,206	184,152
2025	640,321	85,490	6,475	192,151
2026	668,135	89,204	6,757	200,498
2027	697,158	93,078	7,050	209,207
2028	727,128	97,080	7,353	218,201
2029	758,386	101,253	7,669	227,581
2030	790,988	105,606	7,999	237,364

One benefit from lower accident rates is obtained through an improvement of roads. It should be noted that in the GTMPS only the accidents that occur outside urban areas are evaluated. A method has been defined to make this distinction for the base year. Furthermore, there is an autonomous development towards a safer environment as the vehicle park will improve. In the table below the accidents and persons involved on the main network that is included in GTMP are shown for the base year.

	Accidents	Persons
Total	1,811	2,962
Fatalities	189	226
Injured	1,622	2,736

ANNEX 9 Guidelines on Preparing a Terms of Reference for a CBA study

Definition of a Terms of Reference:

A TOR should:

- Make clear to all involved parties what is expected from the Cost Benefit Analysis
- Be as explicit as possible
- Leave nothing open to interpretation
- Also include tender instructions

Chapters of a TOR

As a general rule, a Terms of Reference should contain the following chapters:

A. Introduction
B. Objectives of the study
C. Background of the project
D. Issues to be studied
E. Plan of work
F. Expertise required
G. Reporting requirements
H. Time schedule
I. Tender instructions

Issues to be studied:

- Ask specific questions, based on preliminary research
- Make clear which issues should be more or less emphasised
- Ask for clear conclusions, not only facts and figures
  - Focus on an overall conclusion on the feasibility of the project
  - Focus on assumptions and risks

Checklist TOR – content

- Did you make a short but solid introduction, including a reading guide?
- Is it clear what your objectives of the study are?
- Is the background of the project clearly defined: did you introduce all relevant preliminary studies
- Did you specify all issues to be studied, including your expectations of the risk analysis and options?

Checklist TOR – procedures

- Does your ToR include a proposal for a plan of work, including the tasks you expect the consultant will execute
- Is it clear what kind of expertise is required form the consultant
- Did you make clear what the reporting requirements are, including drafts?
  - The use of tables & figures?
  - Summary and annexes?
- Is a time schedule included, including deadlines and milestones?
- Does the ToR end with the tender instructions: how and when to submit a proposal?

ANNEX 10 List of Participants to G2G PP

No	Name, Organisation /Function (UK)	Name, Organisation /Function (Serbia)
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14	Michiel Modiefski Ecorys Senior Consultant	
15	Elizabeth van Groll NEA Transport research and training Editor CBA Manual Coordinator Study Tours	

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Annex 12 Glossary – CBA key words

The main source of this glossary is the Guide to Cost-benefit Analysis of Investment Projects (EC-DG REGIO). A selection of CBA key words has been made and selected key words were added.

Accounting period: the interval between successive entries in an account. In project analysis, the accounting period is generally one year, but it could be any other convenient time period.

Accounting prices: the opportunity cost of goods, sometimes different from actual market prices and from 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: the ex-ante analysis of a proposed investment project to determine its merit and acceptability in accordance with established decision-making criteria.

Appraisal period: the period over which all costs and benefits are assessed.

Average Daily Traffic: the number of vehicles travelling through a given section of roads within 24 consecutive hours – annual average, Average Daily Traffic is expressed in the terms of actual number of vehicles per day.

Base year: the time period from which relative levels are measured and which is usually allocated the value of 100 in an index.

Benefit-cost ratio: the net present value of project benefits divided by the net present value of project costs. A project is accepted if the benefit-cost ratio is equal to or greater than one. It is used to accept independent projects, but it may give incorrect rankings and often cannot be used for choosing among mutually exclusive alternatives.

Business as usual scenario: a reference scenario which assumes that future evolution is an extension of the current trends. See also 'do nothing scenario'.

Constant prices: Prices that have been deflated by an appropriate price index based on prices prevailing in a given base year. They should be distinguished from current or nominal prices.

Consumer's surplus: the value consumers receive over and above what they actually have to pay.

Conversion factor: the factor that converts the domestic market price or value of a good or production factor to an accounting price.

Cost-Benefit analysis: conceptual framework applied to any systematic, quantitative appraisal of a public or private project to determine whether, or to what extent, that project is worthwhile from a social perspective. Cost-benefit analysis differs from a straightforward financial appraisal in that it considers all gains (benefits) and losses (costs) to social agents. CBA usually implies the use of accounting prices.

Cost/effectiveness analysis: CEA is an appraisal and monitoring technique used when benefits cannot be reasonably measured in money terms. It is usually carried out by calculating the cost per unit of 'non monetised' benefit and is required to quantify benefits but not to attach a monetary price or economic value to the benefits.

Current prices: (Nominal prices) prices as actually observed at a given time. They refer to prices that include the effects of general inflation and should be contrasted with constant prices.

Discount rate: the rate at which future values are discounted to the present. The financial discount rate and economic discount rate may differ, in the same way that market prices may differ from accounting prices.

Discounting: the process of adjusting the future values of project inflows and outflows to present values using a discount rate, i.e. by multiplying the future value by a coefficient that decreases with time.

Do-minimum: the project option that includes all the necessary realistic level of maintenance costs and a minimum amount of investment costs or necessary improvements, in order to avoid or delay serious deterioration or to comply with safety standards.

Do nothing: the baseline scenario, 'business as usual', against which the additional benefits and costs of the 'with project scenario' can be measured (often a synonym for the 'without project' scenario).

Do-something: the scenario(s) in which investment projects are considered, different from 'do nothing' and 'do-minimum', see above.

Economic analysis: analysis that is undertaken using economic values, reflecting the values that society would be willing to pay for a good or service. In general, economic analysis values all items at their value in use or their opportunity cost to society (often a border price for tradable items). It has the same meaning as social cost-benefit analysis.

Economic rate of return: ERR, the internal rate of return (see definition below) calculated using the economic values and expressing the socio-economic profitability of a project.

Environmental impact analysis: the statement of the environmental impact of a project that identifies its physical or biological effects on the environment in a broad sense. This would include the forecasting of potential pollution emissions, loss of visual amenity, and so on.

Externality: an externality is said to exist when the production or consumption of a good in one market affects the welfare of a third party without any payment or compensation being made. In project analysis, an externality is an effect of a project not reflected in its financial accounts and consequently not included in the valuation. Externalities may be positive or negative.

Factor costs: factor costs are those that are net of indirect taxation. Factor costs are referred to as 'resource' costs throughout this document.

Feasibility study: a study of a proposed project to indicate whether the proposal is attractive enough to justify more detailed preparation. It contains the detailed technical information necessary for the financial and economic evaluation.

Financial analysis: the analysis carried out from the point of view of the project operator. It allows one to 1) verify and guarantee cash balance (verify the financial sustainability), 2) calculate the indices of financial return on the investment project based on the net time-discounted cash flows, related exclusively to the economic entity that activates the project (firm, managing agency).

Financial rate of return: the FRR measures the financial profitability of a project with a pure number. In some cases it cannot be calculated in a meaningful way and can be misleading.

Financial sustainability analysis: analysis carried out in order to verify that financial resources are sufficient to cover all financial outflows, year after year, for the whole time horizon of the project. Financial sustainability is verified if the cumulated net cash flow is never negative during all the years considered.

Gross Domestic Product (GDP): GDP measures the total output of the economy in a period, i.e. the value of work done by employees, companies and self-employed persons. This work generates incomes but not all of the incomes earned in the economy remain the property of residents (and residents may earn some income abroad). The total income remaining with Serbian residents is the Gross National Product (GNP) and it differs from GDP by the net amount of incomes sent to or received from abroad.

Impact: a generic term for describing the changes or the long term effects on society that can be attributed to the project. Impacts should be expressed in the units of measurement adopted to deal with the objectives to be addressed by the project.

Internal rate of return: the discount rate at which a stream of costs and benefits has a net present value of zero. The internal rate of return is compared with a benchmark in order to evaluate the performance of the proposed project. Financial Rate of Return is calculated using financial values, Economic rate of Return is calculated using economic values.

Long run: the time period in the production process during which all factors of production can be varied, except the basic technological processes being used.

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.

Monitoring: the systematic examination of the state of advancement of an activity according to a pre-determined calendar and on the basis of significant and representative indicators.

Multi-criteria analysis: MCA is an evaluation methodology that considers many objectives by the attribution of a weight to each measurable objective. In contrast to CBA, that focuses on a unique criterion (the maximisation of social welfare), Multi Criteria Analysis is a tool for dealing with a set of different objectives that cannot be aggregated through shadow prices and welfare weights, as in standard CBA.

Net Present Value (NPV): 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. Financial net present value (FNPV). Economic net present value (ENPV).

Net revenues: the amount remaining after all outflows have been subtracted from all inflows. Discounting the incremental net revenues before financing gives a measure of the project worth of all resources engaged; discounting the incremental net revenues after financing gives a measure of the project worth of the entity's own resources or equity.

Non-tradable goods: goods that cannot be exported or imported, e.g. local services, unskilled labour and land. In economic analysis, non-traded items are often valued at their long-run marginal cost if they are intermediate goods or services, or according to the willingness-to-pay criterion if they are final goods or services.

Operating costs (of road section): operation and maintenance costs of defined road or road section; depending of their changes to change of road traffic these are variable or
fixed operating costs.

Opportunity cost: 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.

Producer's surplus: the value a producer receives over and above his actual costs of production.

Project: a discrete on-off form of expenditure. Used in this Guide to define an investment activity upon which resources (costs) are expended to create capital assets that will produce benefits over an extended period of time. A project is thus a specific activity, with a specific starting point and a specific ending point, that is intended to accomplish a specific objective. It can also be thought of as the smallest operational element prepared and implemented as a separate entity in a national plan or program.

Project cycle: a sequence of the series of necessary and pre-defined activities carried out for each project. Typically it is separated into the following phases:

programming, identification, formulation, ex-ante evaluation, financing, implementation and ex-post evaluation.

Project evaluation: the last phase of the project cycle. It is carried out to identify the success factors and the critical areas in order to understand and diffuse the lessons learnt for the future.

Public Private Partnership: a partnership between the public sector and the private sector for the purpose of delivering a project or a service traditionally provided by the public sector.

Risk analysis: a study of the odds of the project's earning a satisfactory rate of return and the most likely degree of variability from the best estimate of the rate of return. Although risk analysis provides a better basis than sensitivity analysis for judging the riskiness of an individual project or the relative riskiness of alternative projects, it does nothing to diminish the risks themselves. It helps, however to identify risk prevention and management measures.

Real rates: rates deflated to exclude the change in the general or consumption price level (for example real interest rates are nominal rates less the rate of inflation).

Relative prices: the exchange value of two goods, given by the ratio between the quantity exchanged and their nominal prices.

Residual value: the net present value of assets at the end of the final year of the period selected for evaluation analysis (project horizon).

Rule of half: in the case where demand is elastic and where prices fall as a result of an overall increase in supply, the consumer surplus associated with the increase in demand is calculated as half the change in price multiplied by the increase in demand.

Sensitivity analysis: the analytical technique to test systematically what happens to a project's earning capacity if events differ from the estimates made in planning. It is a rather crude means of dealing with uncertainty about future events and values. It is carried out by varying one item and then determining the impact of that change on the outcome.

Shadow prices see accounting prices.

Short-run: the time period in the production process during which certain factors of production cannot be changed, although the level of utilisation of variable factors can be altered.

Social discount rate: to be contrasted with the financial discount rate. It attempts to reflect the social view on how the future should be valued against the present.

Socio-economic costs and benefits: opportunity costs or benefits for the economy as a whole. They may differ from private costs and benefits to the extent that actual prices differ from accounting prices.

Tradable goods: goods that can be traded internationally in the absence of restrictive trade policies.

Traffic Model : mathematical expression of the behaviours of individual and/or public transport users.

Traffic Flow: the greatest number of units (vehicles or pedestrians) that can pass through a section of a road (street, intersection entry, pedestrian crossing, bicycle route, etc.) during a given unit of time. Traffic flow is expressed in the terms of actual vehicles per hour [P/h].

Willingness-to-pay: the amount consumers are prepared to pay for a final good or service. If a consumer's willingness-to-pay for a good exceeds its price, the consumer enjoys a rent (consumer's surplus).

Without project scenario: the baseline scenario against which the additional benefits and costs of the with project scenario can be measured (e.g. business as usual).

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