

# GUIDELINES FOR COST-BENEFIT-ANALYSIS OF INFRASTRUCTURE PROJECTS

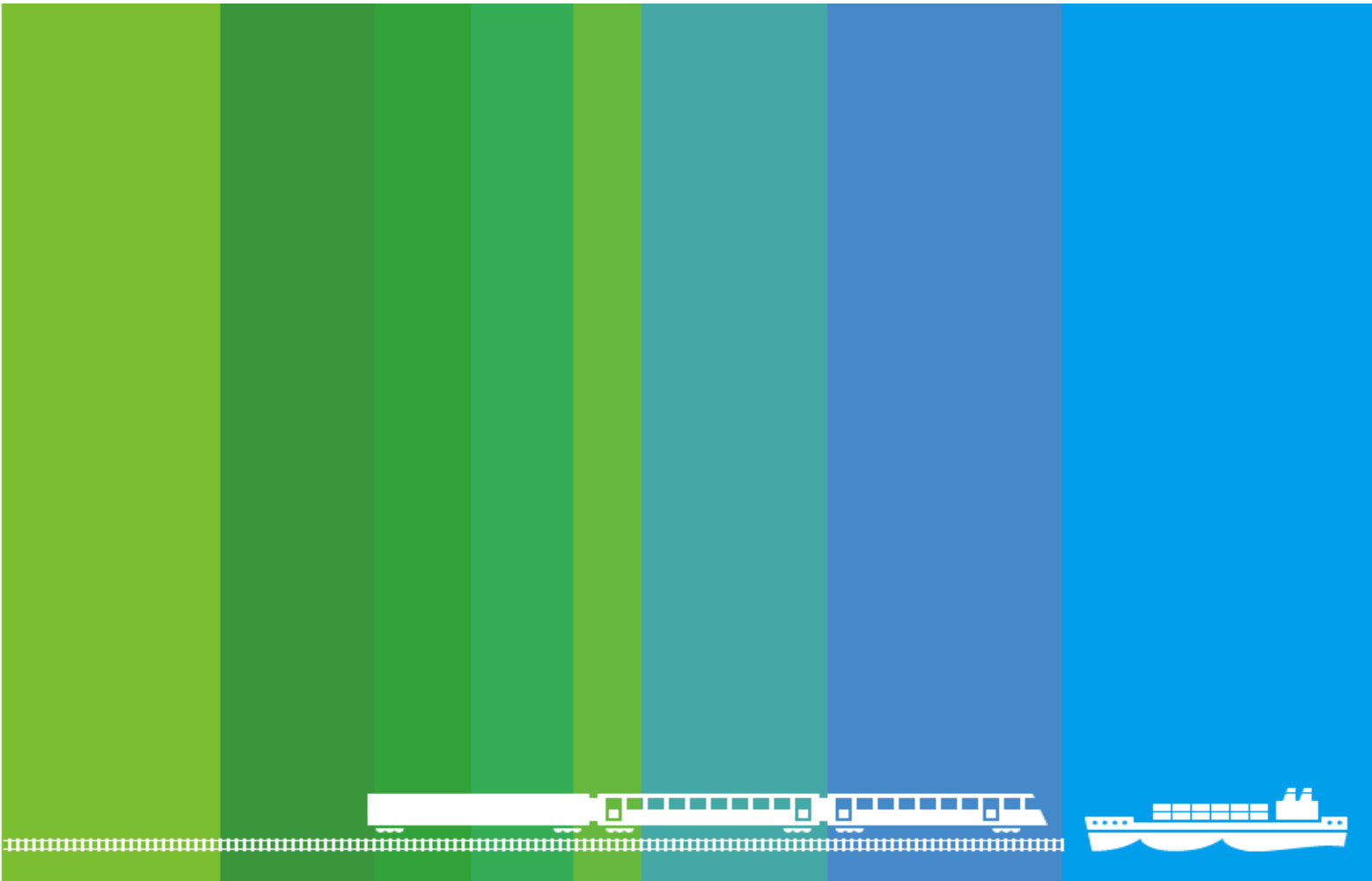
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## 1 Introduction

The following section describes the guidelines for Cost-Benefit Analyses of Investment Projects published by the European Commission (EC) in 2008. However, the EU will release a new “Guide to Cost-Benefit Analysis of Investment Projects”, probably by the end of 2014; all the guidelines published before the final version are only preliminary and not yet valid. Therefore, the guidelines presented in this document will be valid for project applications until the publication of the new guidelines, presumably in the beginning of 2015.

Due to the already published preliminary guidelines it can be inferred that special emphasis will be placed on the first step of a project appraisal, context analysis and project objectives in the new version of the guidelines for 2014 to 2020 (section 2.1). Furthermore, the consistency with national as well as EU objectives and regulatory framework will be especially important (section 2.1.3). In the future, strategy planning will be separated from the programming stage. The strategy will be developed by the European Union (JASPERS and DG MOVE). However, it is still possible for national, regional and communal authorities to plan their own strategies which may be approved by the EU. Based on the formulated strategy of the EU, corresponding measures will be developed. Applicants can develop projects for these measures. It is essential for the projects to contain the measure to 100% (making it a “green project”) - otherwise, no grants will be provided. In addition it is possible to influence the EU’s definition of strategies by conducting studies (e.g. SETA) including analyses that go beyond the required CBA-methods in order to build further arguments.

To sum up it should be emphasised that, in order to reach the acceptance of a concrete project, it is essential to follow the exact steps described in the CBA-guidelines with the explained methodology. Nonetheless, it is also possible to suggest and influence strategies. For designing strategy proposals to the European Union (“step zero”), it is explicitly allowed and encouraged to use alternative and further reaching methods as well.

Furthermore, there will be a change in the process of the ex-ante analysis: Instead of conducting the entire analysis as a whole, it should be performed step by step (or milestone by milestone). The first milestone is to show that the project is part of a specific strategy (context and project analysis). Only after the approval of e.g. JASPERS, one should proceed to the second step which might be the “bottleneck analysis” that has to be approved by e.g. JASPERS as well before continuing with the third step, the feasibility analysis. This mechanism has to be followed until the last step of the project appraisal. The project can only be realized if all milestones are approved. This is a major difference to the procedure so far in which JASPERS and other funds receive the complete project appraisal. The purpose of this “decision making tree” is to avoid costly developments in a wrong direction.

Additionally, it will become necessary to conduct accompanying analyses (during the phase of construction) and ex-post analyses. The purpose of ex-post analyses will be to assess the impact of the project and to determine which projects should be funded in the future. Moreover, project developments should cover so-called “functional regions” instead of referring to political regions.

As all versions of the new guidelines are only preliminary, it is still not possible to analyse the definite changes of the guidelines. However, it is most likely that the new guidelines will be published before the end of 2014 and will be valid from the beginning of 2015.

For this reasons, the guidelines presented in this document still refer to the Guidelines for Cost-Benefit Analyses of Investment Projects published by the European Commission (EC) in 2008. They aim to reflect the specific requirements for the EC in order to successfully appraise investment projects, which are at least partly financed by the Structural Funds (SF), the Cohesion Funds (CF) and the Instrument for Pre-Accession Assistance (IPA). In general, a project appraisal document should be structured according to the following six steps, which will be discussed in detail later on:

- a) A presentation and discussion of the socio-economic context and the objectives
- b) The clear identification of the project
- c) The feasibility study of the project and of alternative options
- d) Financial Analysis
- e) Economic Analysis
- f) Risk assessment

Regarding the Economic Analysis it should be stressed that besides calculating economic performance indicators (which take into account both direct and indirect effects as well as monetised externalities) and having applied social discounting, in practice the evaluation mainly focuses on an assessment of travel time reductions and the monetary values created by these reductions.

Furthermore, it is necessary to first define what a “project” is. This definition may vary among available funds. For the structural and cohesion fund, major projects are those with total cost exceeding € 25 million for environmental projects and € 50 million for other sectors. For IPA projects, the financial threshold corresponds to € 10 million. Regarding the financial threshold, it is worth noting that the key economic variable is total cost of investment, which does not only consider the sources of financing but the sum of all expenditures planned to acquire or build the fixed capital good and related lump-sum costs for some intangible assets. In the case of the investment being spread over several years the sum of annual costs has to be considered. Additionally, it is also advisable to include any one-off expenses which are incurred in the start-up phase (such as hiring and training expenses, licenses, preliminary studies etc.). Sometimes, it is better to consider several smaller projects with the same project objective as one large project.

Article 40 of Regulation 1083/2006 stipulates the information that has to be provided in form of a project dossier and submitted to the Commission. It has to contain the results of a feasibility study, a cost-benefit analysis, an assessment of the risk, an environmental impact analysis, a justification of public contribution and a financing plan. Similar information has to be provided for IPA projects.

After submitting the application for the investment project the economic appraisal by the Commission is carried out based on the following three-step approach:

- the project appraisal dossier is complete (all necessary information is available)
- the analysis is of good quality (the analysis is coherent with the Commission's methodology and national CBA guidelines)
- the results provide a basis for a co-financing decision

Moreover, CBA results should provide evidence that the project is:

- desirable from a socio-economic perspective
- consistent with the operational programme and other community policies
- in need for co-financing

## 2 Outline for Project Analyses of Transport

This subsection describes the outline for a project appraisal in the field of transport. The investment for the development of new or existing transport infrastructures may include new transport lines, the completion of already existing networks or the upgrade of existing infrastructure.

### 2.1 Context analysis and Project objectives

#### 2.1.1 Socio-economic context

For decision makers it is of utter importance to understand the social, economic and institutional context of a project. In general, the socio-economic objectives include the improvement in travel conditions for goods as well as for passengers and the improvement in both the quality of the environment and the well-being of the population served.

#### 2.1.2 Definition of project objectives

It is necessary to clearly state project objectives, the benefits should not be just physical indicators but measurable socio-economic variables, and the project objectives should be logically connected to the investment as well as consistent with policy or programme priorities. In order to define project objectives, a forecast of the project's impact is necessary. The present guidelines focus on social cost-benefit-analysis which cannot predict all future impacts but investigates several microeconomic indicators in order to draw conclusions for the whole economy.

Typical project objectives in the field of transportation are:

- the reduction of congestion
- the improvement of performance
- the shift of transport demand to specific modes
- the completion of missing links or poorly linked networks
- improvements in accessibility for people in peripheral areas

At first the main direct objectives including environmental objectives should be stated (e.g. reduction of bottlenecks, emission reductions) and then the indirect aims (i.e. regional development) should be addressed. A clear distinction between direct and indirect objectives is recommended.

#### 2.1.3 Consistency with EU and National Frameworks

The project promoter should show how the project, if successful, will contribute to the broad objectives of the EU regional and cohesion policies. From the Commission's perspective it is indeed important to ensure that the project is logically related to the main objectives of the funds involved. The project promoter should show that the proposed project is coherent with these objectives, while the examiner should ascertain that this coherence actually exists and that it is well justified. Furthermore, the project has to be coherent with EU legislation and Community legislation.

After the objectives have been clarified the next step is to check whether the identification of the project is consistent with the defined objectives.

#### Checklist for the context analysis and project objectives:

- Are the social, institutional and economic contexts and aims of the project clearly described?
- Is it realistic to obtain the described socio-economic benefits with implementing the project?
- Have all important socio-economic effects of the project been considered?
- Is the project coherent with EU objectives of the funds and with national strategies and priorities?
- Are the means of measuring the attainment of objectives indicated?

## 2.2 Project Identification

A project is clearly defined if:

- The object is a **self-sufficient unit of analysis** ('half a bridge' is not a project). The project appraisal should focus on the whole project as a self-sufficient unit of analysis and not on project fragments. Partitions of projects are not appropriate for project appraisals.
- **Indirect and network effects** are adequately taken into account. However, if an appropriate shadow price has been given for the benefits and costs, indirect impacts on secondary markets should not be included in the economic appraisal. Regarding network effects, these should be included in the CBA through an appropriate forecasting model. Externalities should be captured in the Economic Analysis.
- All **relevant stakeholders** have been considered properly and a **social perspective** has been adopted. The presence of a number of social stakeholders has to be acknowledged because costs and benefits may be borne by a smaller or larger amount of social or economic actors depending on the geographic level adopted.

### 2.2.1 Type of Project

The best way to identify the investment project is to:

- state its concrete function which should be coherent with its investment objective
- describe the type of investment, possible types are:
  - new infrastructures (road, rail, ports, airports) to satisfy increasing transport demand
  - completion of existing networks (missing links)
  - extension of existing infrastructure
  - renovation of existing infrastructure



- investment in safety measures on existing links or networks
- improved use of the existing networks (i.e. better use of under-utilised network capacity)
- improvement in intermodality (interchange nodes, accessibility to ports and airports)
- improvement in networks interoperability
- improvement in the management of the infrastructure
- describe the functional type of the investment, the characteristics may be:
  - increasing capacity of existing networks
  - reducing congestion
  - reducing externalities
  - improving accessibility to peripheral regions
  - reducing transport-operating costs
- describe the type of service it is offering:
  - infrastructures for densely populated areas
  - infrastructures for long distance travel demand
  - infrastructures for freight transport
  - infrastructures for passengers transport.

### 2.2.2 Territorial Reference Framework

It has to be defined whether the investment is part of a local, regional or national transport project.

The elements to be considered are:

- How to incorporate the designed infrastructure into the existing one in order to account for network effects
- If the planned infrastructure is consistent with national and European transport policies (fiscal policies, pricing schemes, environmental constraints and technological standards)
- If the planned project is consistent with other development projects

#### Checklist for the project identification:

- Is the project a self-sufficient unit of analysis?
- Are indirect and networks effects properly taken into account?
- Has a proper social perspective been adopted and all potentially affected parties considered?

## 2.3 Feasibility Study

The basic approach of any investment appraisal aims to compare the situations with and without the project. Therefore, in conducting a feasibility study the following steps should be taken:

1. Define a “business as usual” option (BAU): To select the best option, it is helpful to describe a baseline scenario. This will usually be a forecast of the future without the project, i.e. the ‘business as usual’ (BAU) forecast. Hence, BAU is the no-investment forecast, which is usually not without costs as it incurs operational and maintenance costs.
2. Define a “do-minimum”-option, which will be compared to the BAU.
3. Define other possible alternatives (“do-something” - options).

An experienced project analyst will typically focus on the BAU scenario, the ‘do-minimum’ option and a small number of “do-something”-options.

### 2.3.1 Analysis of Demand

Regarding the reference scenario (the BAU), the following aspects should be clarified:

- The area of influence of the project (the demand without the project and the impact of the new infrastructure)
- The method to estimate existing and future demand
- Competing modes and alternative routes
- Deviations from past trends and comparisons with large-sale prospects on a regional, national and European level

In case of uncertainty regarding future trends, it is advisable to consider two scenarios, an optimistic and a pessimistic one.

Estimates of future demand should be disaggregated by the source of traffic:

- Existing traffic
- Diverted traffic from other modes
- Generated or induced traffic (only results due to the new infrastructure or capacity increase)

However, it is necessary to pay attention to the sensitivity of expected traffic flows to critical variables such as:

- The elasticity with respect to time and costs, here traffic caused by the investment project can be estimated based on the elasticity of demand with respect to generalised transport costs. Furthermore, the changes in the accessibility have to be analysed. This can be done using a regional development transport model.
- Capacity constraints on competing modes and strategies in place (e.g. in terms of fares)

### 2.3.2 Option Identification

The construction of a reference solution and the identification of promising alternatives are two aspects that will influence all the results of the following evaluations. Typical examples of options are: different routes, or different construction timing, or different technologies considered for transport projects.

The starting point is identify the reference option (BAU), which should not be a “catastrophic scenario” but include interventions such as management, maintenance etc. After defining the BAU scenario and analysing critical aspects in terms of demand/capacity ratios, all possible alternatives should be identified. For all alternatives, it is necessary to estimate all investment costs as well as costs for maintenance (ordinary and extraordinary) and renewals. Furthermore, it is required to allocate these costs over the time horizon.

### 2.3.3 Feasibility Analysis

The feasibility analysis aims to identify the potential constraints and related solutions with respect to technical, economic, regulatory and managerial aspects. A project is considered feasible if its design conform to technical, legal, financial and other constraints relevant to the geographic area. It is recommended to point out the difference between binding constraints (e.g. lack of human capital, geographical features) and soft constraints (e.g. tariff regulations) because soft constraints may be removed by suitable policy reforms.

Typical feasibility reports for major infrastructures should include information on:

- demand analysis
- available technology
- the production plan (including the utilisation rate of the infrastructure)
- personnel requirements
- the project’s scale, location, physical inputs, timing and implementation, phases of expansion and
- financial planning
- environmental aspects

### 2.3.4 Option Selection

EU Regulations require that the proposer provides the results of feasibility and option analysis. The main task of such an analysis is to identify the most promising options on which detailed cost-benefit analysis (CBA) should be carried out.

One possible selection approach could be as follows:

- establish a long list of alternative actions to achieve the intended objectives
- screen the identified long list against some qualitative criteria (e.g. a set of scores to be established in light of overall policy orientations and/or technical considerations - to be duly justified in the analysis) and establish a short list of suitable alternatives

- establish option rankings and select preferred options based on their net present values in financial and economic terms.

The calculation of the financial and economic performance indicators must be made with the incremental net benefits technique, which considers the differences in the costs and benefits between the “do-something” alternative(s) and the BAU scenario (“do-nothing”).

#### Checklist for the feasibility study:

- Does the application dossier contain sufficient evidence of the project’s feasibility (from an engineering, institutional, management, implementation, and environmental etc. point of view)?
- Has the do-nothing scenario (‘business as usual’) been identified to compare the situations with and without the project?
- Was it demonstrated that other alternative feasible options have been adequately considered (in terms of do-minimum and a small number of do-something options)?

## 2.4 Financial Analysis

The main purpose of the Financial Analysis is to use the project cash flow forecasts to calculate suitable net return indicators; special emphasis will be placed on the Financial Net Present Value (FNPV) and the Financial Internal Rate of Return (FRR).

In order to determine financial returns, the Discounted Cash Flow (DCF) approach is used in the EU guidelines. The implied assumptions of this methodology are.

- Only cash inflows and outflows are considered
- The incremental approach should be used to determine project cash flows
- An appropriate financial discount rate has to be applied to aggregate cash flows of a period stretching across several years.

Generally, the Financial Analysis should be conducted from the point of view of the infrastructure manager. It can first be carried out for the owners and the operators and then be consolidated. The Financial Analysis contrasts the financial inflows with the financial outflows.

Financial inflows can be:

- any possible revenues for the sale of goods and services (Tolls, fares and charges)
- the net cash from the management of financial resources (Government Transfers)

Financial Outflows are:

- Investment Costs
  - Expenses for renewals
  - Extraordinary maintenance operations
- Operation costs (road)
  - ordinary maintenance costs of planned works

- costs related to tolling
- Operation costs (rail)
  - ordinary maintenance costs of planned works
  - costs related to charging
- reimbursement of loans and interest paid,
- taxes
- other disbursements (e.g. dividends, retirement bonus, etc.).

The investment costs are obtained as a result of the technical analysis and should be disaggregated by the type of works the intervention may be broken down into and allocated over the construction period. Furthermore, the cost analysis should be split up into main cost components - such as labour force, materials, carriage and freight -, in order to allow the use of conversion factors that enable the conversion of financial into economic costs.

Additionally, the Financial Analysis of non-revenue-generating infrastructure should show the net-present cost for the public sector.

#### 2.4.1 Total Investment Costs

The first step in a Financial Analysis is to estimate the total cost of investment and the time horizon for the investment, which is the number of years for which forecasts are provided. The reference time horizon for the years 2007 to 2013 was for railway projects 30 years and for roads, ports and airports 25 years.

#### 2.4.2 Total Operating Costs and revenues

The calculation of total operating costs and revenues is the second step of a Financial Analysis.

These costs do not take the form of an investment and are consumed within each accounting period; the operating costs comprise all the data on the disbursements foreseen for the purchase of goods and services.

The data can be organised in a table that includes:

- Direct production costs
- Administrative and general expenditures
- Sales and distribution expenditure

All items which do not lead to any expenditure must be excluded. Typical examples are:

- Depreciation
- Reserves for future replacement costs
- Contingency reserves

Moreover, capital, income or other direct taxes are included only in the financial sustainability table (as an outflow) and not considered for the calculation of FNPV and FNPV, which should be calculated before deductions.

Revenues will be determined by the forecasts of the quantities of services provided and by their price. The calculation of revenues does not include:

- Transfers or subsidies
- VAT or other indirect taxes

#### 2.4.3 Financial Return on Investment

After having collected information on investment and operation costs as well as revenues, the financial return on investment has to be evaluated. The used indicators<sup>1</sup> are:

- the financial net present value of the project (FNPV), and
- the financial internal rate of return (FRR)

#### 2.4.4 Sources of Financing

The main financing sources are:

- community assistance (the EU grant)
- national public contribution (grants or capital subsidies at central, regional and local government level)
- national private capital
- other resources (e.g. EIB loans, loans from other lenders).

#### 2.4.5 Financial Sustainability

A project is financially sustainable if it does not incur the risk of running out of cash in the future. The crucial issue here is the timing of cash proceeds and payments. Project promoters should show how sources of financing (including revenues and any kind of cash transfers) will consistently match disbursements year-by-year over the project time horizon. Financial sustainability is ensured if the difference between ingoing and outgoing flow (net flow) of cumulated generated cash flow is positive for all the years considered.

If the rate of return (FRR) shows that the investment will never be profitable from a financial point of view, the proposer should specify what, if any, resources the project will draw on when EU grants are no longer available.

#### 2.4.6 Financial Return on Capital

The last step in the Financial Analysis is the appraisal of the financial return on capital, which aims to look at the project performance from the perspective of the assisted public and possibly private entities in the Member States. The financial net present value of the capital, FNPV(K), is the sum of the net discounted cash flows that accrue to the project promoter due to the implementation of the investment project. The financial rate of return on capital, FRR(K), determines the return for the national beneficiaries (public and private combined).

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<sup>1</sup> A detailed description on these indicators can be found in EU(2008), A Guide to Cost-Benefit Analysis of Investment Projects.

### Checklist for the Financial Analysis:

- Have depreciation, reserves, and other accounting items which do not correspond to actual flows been eliminated in the analysis?
- Has the determination of the cash flows been made in accordance with an incremental approach?
- Is the choice of the discount rate consistent with the Commission's or Member States' own guidance? If not, why?
- Is the choice of the time horizon consistent with the recommended value? If not, why?
- Has the residual value of the investment been calculated?
- In the case of using current prices, has a nominal financial discount rate been applied?
- In the case of revenue generating projects, has the 'amount to which the co-financing rate applies' been identified in accordance with EU regulations (Art. 55 Reg. 1083/2006)?
- Have the main financial performance indicators been calculated (FNPV(C), FRR(C), FNPV(K), FRR(K)) considering the right cash-flow categories?
- If private partners are involved, do they earn "normal" profits (as compared to financial benchmarks)?

## 2.5 Economic Analysis

The Economic Analysis appraises the project's contribution to the economic welfare of the region or country. It is made on behalf of the whole of society instead of just the owners of the infrastructure, as in the Financial Analysis. In the case of an economic evaluation based on a cost-benefit analysis, which takes the perspective of society as a whole, the market pricing of a good is not a good indicator of its true value to society as so-called external effects also play a significant role. Observed prices may not represent their actual social value because markets for these goods are inefficient or non-existent. Yet the valuation of these effects is crucial for Economic Analysis and may be important for the appraisal of the project. In order to internalise these externalities, the external effects have to be identified, quantified and have a realistic monetary value assigned to them. The calculated value for externalities or non-market products is a so-called shadow price.

The methodology consists of five steps:

- conversion of market to accounting prices
- monetisation of non-market impacts
- inclusion of additional indirect effects (if relevant)
- discounting of the estimated costs and benefits
- calculation of the economic performance indicators (economic net present value, economic rate of return and B/C ratio).

Since many benefits and costs are public goods or non-market goods, the Economic Analysis differs substantially from the Financial Analysis. In the case that market prices are deemed to reflect the opportunity costs of resources it is necessary to eliminate transfers from financial costs by applying conversion factors to each cost component and to take tax burdens into account. If market prices are not deemed to reflect the opportunity costs of resources, shadow prices have to be applied.

Benefits result from variations below the demand curve of transport and variations in economic costs. Social benefits are obtained by adding up the following components:

- variations in consumer's surplus (= consumer's willingness to pay minus costs of a trip)
- variations in road user producer's surplus (= price of a good minus producer's willingness to sell)
- variations in infrastructure and service operator producer's surplus
- variations in taxes and subsidies
- variations in external costs

The calculation of consumer's and producer's surplus as well as external costs takes into account non-market goods. A distinction should be made between:

- benefits for existing traffic
- benefits for traffic diverted from other modes
- benefits for generated traffic

Several non-market goods are very important for the Economic Analysis. Examples for non-market goods are: the value of time, environmental effects and avoided accidents.

Generally, the most important economic benefit for transport projects is the value of time. For goods transport, the time value usually is quite low and a distinction between trip purposes has to be made in case of estimating passenger's value of time. Leisure travel time is usually 10% to 42% of the working time value.

In order to monetise environmental externalities shadow prices inferred from scientific literature can be applied. In general, environmental externalities depend on the travel distance and exposure of polluting emissions.

Avoided accidents are monetised by calculating average cost by vehicle-km or by passenger-km on the basis of the costs of all road accidents.

An infrastructure project may have an impact on the economic structure of a region (e.g. increased accessibility). However, as market distortions may be present, these kinds of benefits should be excluded from the calculation of profitability indicators.

In the absence of major distortions the use of transport costs and benefits can be considered an acceptable approximation of the final economic impact of the transport project.

### 2.5.1 Conversion of market to accounting prices

Observed prices can differ from social opportunity costs for reasons such as:



- Prices of inputs and outputs are distorted due to market inefficiencies
- Tariffs of public services are not cost reflective

If such distortions are present, the proposer has to address this issue in the project appraisal and use shadow prices to reflect social opportunity costs. Shadow prices may be:

- The shadow exchange rate (SER), which is the economic price of foreign currency. This price may diverge from the official exchange rate.
- The standard conversion factor (SCF) is sometimes preferred to the SER because it captures the same distortions but is more consistent.
- Shadow wages should be used in the case of existing labour market imperfections. In a region with high unemployment, for example, the opportunity cost of labour may be less than the actual wage. However, due to the limited mobility of labour, the shadow wage is region-specific.

Furthermore, the following aspects should be taken into account:

- Check for employment losses in other sectors due to project gross employment benefits
- The preservation of jobs that otherwise would be lost is especially relevant for the renovation and modernisation of existing infrastructure
- The impacts on different target groups have to be considered (youth, women, long-term unemployed)

In order to correct for fiscal distortions, these rules have to be considered:

- All prices of inputs and outputs considered for the cost-benefit analysis should be net of VAT and other indirect taxes
- prices of inputs, including labour, are to be considered in the CBA should be gross of direct taxes
- subsidies granted by a public entity to the project promoter are pure transfer payments and should be omitted from revenues under Economic Analysis

### 2.5.2 Monetisation of non-market impacts

The second step of the Economic Analysis is to include those impacts for which no market value is available. Within the project appraisal the effects should be:

- identified
- quantified
- realistically monetised

The most relevant non-market effects should be covered by conversion factors; however, an alternative approach is the willingness-to-pay (WTP), which allows the estimation of monetary values via revealed preferences of users. In case the WTP-approach is not possible, the long-run marginal cost approach (LRMC) can be applied.

### 2.5.3 Inclusion of indirect effects

Indirect effects are defined as quantity or price changes occurring in secondary markets. These effects have to be included under the existence of market distortions (in case of taxes, subsidies, monopoly power and externalities) because they may represent important costs or benefits to society.

### 2.5.4 Social Discounting

As the implementation of an investment project usually takes several years and costs as well as benefits occur at different points in times they need to be discounted. The discount rate represents the view on how future benefits and costs should be valued against present ones. For the 2007-2013 period the European Commission has suggested using two benchmark social discount rates: 5.5% for the Cohesion countries and 3.5% for the others.

### 2.5.5 Calculation of economic performance indicators

After having corrected for possible distortions and having applied social discounting, economic performance indicators can be calculated. Two performance indicators are of particular importance in a cost-benefit analysis, namely financial net present value (FNPV) and economic net present value (ENPV).

Whereas the FNPV represents the railway operator or railway infrastructure company perspective, the ENPV of a project includes not only economic effects but also social and environmental impacts. Both values represent a discounted monetary value of costs and benefits. In the case of the SETA project the evaluation and information supplied for decision makers are condensed into the ENPV.

Only a few infrastructure projects have a positive FNPV, and in most cases of infrastructure projects this value stays negative.

The ENPV, however, might still be positive since it includes the external effects of infrastructure projects such as travel time reduction,<sup>2</sup> reduced number of accidents and a reduction in pollutant emissions. This, in turn, means that even though a project might not be profitable for an operator, it can be beneficial for society and should therefore still be implemented since the societal benefits (which in this case need to be monetized for comparison reasons) exceed the investment costs.

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<sup>2</sup> A wider reaching approach would include increased accessibility effects (see section 0), but this is not part of “Guide to Cost Benefit Analysis of Investment Projects” from EU DG Regional Policy (2008).

### Checklist for the Economic Analysis:

- Have prices of inputs and outputs been considered net of VAT and of other indirect taxes?
- Have prices of inputs, including labour, been considered gross of direct taxes?
- Have subsidies and pure transfer payments been excluded?
- Have externalities been included in the analysis?
- Have shadow prices been used to better reflect the social opportunity cost of the resources employed?
- In the case of major non-traded items, have sector-specific conversion factors been applied?
- Has the appropriate shadow wage been chosen in accordance with the nature of the local labour market?
- Is the choice of the social discount rate consistent with the Commission's or Member States' guidance? If not, why?
- Have the main economic performance indicators been calculated (ENPV, ERR and B/C ratio)?
- Is the economic net present value positive? If not, are there important non-monetised benefits to be considered?

## 2.6 Risk Assessment

Because several critical variables are considered, it is best to carry out a sensitivity analysis of the monetary values assigned to the goods without any markets. Critical factors are:

- Investment and operating cost overruns
- Implementation time
- Transport demand
- Competition with other existing infrastructure

And the main variables to consider are:

- Assumptions on GDP and
- Other economic variables trend
- Rate of increase of traffic over time
- Value of time
- Number of years necessary for the realization of the infrastructure
- Number of years necessary for the full efficiency of the infrastructure

- Investment costs (disaggregate)
- Maintenance costs
- Pricing policies
- Regulatory policies

The recommended steps for assessing the risk of a project are:

### 2.6.1 Sensitivity Analysis

This first step aims to identify the critical variables, which are variables that exhibit the greatest impact on a project's financial or economic performance. The sensitivity analysis is conducted by varying one variable at a time and determining its effect on IRR and NPV.

The procedure that should be followed to conduct a sensitivity analysis includes the following steps:

- i) identification of variables
- ii) elimination of deterministically dependent variables
- iii) elasticity analysis
- iv) choice of critical variables.

### 2.6.2 Probability Distributions for critical variables

The next step is to assign a probability distribution to each of the critical variables, defined in a precise range of values around the best estimate, used as the base case, in order to calculate the expected values of financial and economic performance indicators. The sources of the probability distributions may be experimental data or related literature. However, the correct specification of the probability distribution is a prerequisite for a correct risk assessment.

### 2.6.3 Risk analysis

After having obtained the probability distributions for the critical variables it is possible to calculate the probability distribution of the FRR and NPV of the project. The Monte Carlo method, in which a set of values for the critical values will be extracted randomly and repeatedly, can be used for this purpose.

### 2.6.4 Assessment of acceptable level of risk

The criterion for project acceptability should be that of the expected value or mean of the critical variables, calculated from the underlying probability distribution. Furthermore, a risk-neutral attitude should be assumed.

### 2.6.5 Risk prevention

A typical cause of forecasting errors may be that the project appraisal is too optimistic regarding the project's key variables (investment costs, works duration, operation costs and benefits). To minimise the level of optimism bias, specific adjustments in the form of

increased cost estimates and decreased, or delayed, benefit estimates should be made. Such adjustments should be empirically based, for example using data from past or similar comparable projects, whilst experts' consultancy may also be useful.

**Checklist the risk assessment:**

- Is the choice of the critical variables consistent with the elasticity threshold proposed?
- Has the sensitivity analysis been carried out variable by variable and possibly using switching values?
- Has the expected value criterion been used to evaluate the project performance?
- Have ways to minimise the level of optimism bias been considered?
- Have risk mitigation measures been identified?

### 3 Other project evaluation approaches

Although the method required by the Funds regulation is the for investment projects in the public sector commonly used Cost-Benefit analysis, a variety of other project evaluation approaches exist. These cannot be seen as substitutes to the CBA, but rather as complements and approximations in the case when CBA is not possible to conduct. The CBA guide lists the following three approaches as possible complements to CBA: Cost-Effectiveness Analysis, Multi-Criteria Analysis and the Economic Impact Analysis.

#### 3.1 Cost-effectiveness analysis (CEA)

Cost-Effectiveness Analysis is a tool to compare projects when only a single dimension of outcome matters. The aim of this approach is to identify the project that minimises the net present value of costs for a given level of output, or, alternatively, maximises the output level for a given level of costs. The Cost-effectiveness analysis is often used in cases where benefits are difficult or even impossible to evaluate. Therefore, this analysis can only measure the technical efficiency but does not cover the allocative efficiency. The methodology solves a problem of resource optimization:

- Given a fixed budget and  $n$  alternative projects, decision-makers try to maximise the level of outcome in terms of effectiveness (E).
- Given a fixed level of E, decision-makers aim to minimise costs, C.

In order to compare costs and effectiveness, the ratios of incremental costs and incremental outcomes are used. According to this incremental analysis, projects are ranked and the most cost-effective project is selected. The cost-effectiveness ratios are calculated as follows:

$$R = \frac{C_a - C_b}{E_a - E_b} = \Delta C / \Delta E$$

The measurement of costs should be done as in the Financial Analysis, but the measurement of effectiveness depends on the specific type of outcome.

If there exists a strategy A which is both more effective and less costly than another strategy B, it is said that A dominates B. CEA therefore allows to exclude technically non-efficient options (those are dominated), while for the remaining projects, the choice will depend on the budget size. It is advisable to first implement the project with lowest costs and then add other measures until the budget is exhausted.

#### 3.2 Multi-criteria analysis (MCA)

This approach is a tool for dealing with a set of objectives for which the use of shadow prices and welfare weights as in standard CBA is impossible. One possible approach to design a MCA is the following:

- Express objectives in measurable variables
- Find a technique to aggregate information and to make a choice, assign weights to the objectives
- Define criteria for appraisal

- Describe for each of the chosen criteria the effect it causes (impact analysis)
- Forecast the effects of the selected criteria
- Identify the typology of the subjects involved in the intervention and determine the respective preference functions (weights)
- Aggregate the scores under each criterion and compare the results for other similar interventions.

Then, the project examiner should verify the following aspects:

- Have forecasts for non-monetary aspects been quantified in a realistic way in the ex-ante evaluation?
- Is there in any case a CBA for the standard objectives (Financial and Economic Analysis)?
- Do the additional criteria in the MCA have reasonable political weight?

In the case that benefits are just non-monetary but physically not measurable, a qualitative analysis should be conducted. For this purpose, a matrix containing a set of relevant criteria together with the impacts should be constructed. In another matrix weights should be assigned to each criterion. The selection of the best alternatives should be made by multiplying scores and weights.

### 3.3 Economic Impact Analysis

The Economic Impact Analysis aims to assess the impact of a given project on its socio-economic environment by focusing on macroeconomic indicators and by forecasting the project's influence on these indicators. The results often determine whether public support to a given area should be provided on the ground of economic benefits. The results should cover the sector level in order to identify critical areas and to define policy actions as well as the macroeconomic level by defining relative contributions (e.g. employment, GDP growth etc.).

Because the economic impact analysis provides information which cannot be obtained by CBA, this approach should be seen as a complementary tool rather than an alternative to CBA.

**Checklist the other evaluation approaches:**

- If the project has been shown to have important effects that are difficult to assess in monetary terms, has the opportunity to carry out an additional analysis, such as CEA or MCA, been considered?
- Is the choice of the additional analysis suitable with the fields of application of CEA, MCA and EIA?
- If performing a CEA, have incremental cost-effectiveness ratios been calculated to exclude “dominated” alternatives?
- If performing an MCA, are the applied weights consistent with the relative importance of the effects on society?
- If the project is likely to have a significant macroeconomic impact, has the opportunity to carry out an Economic Impact Analysis been considered?



## 4 The consolidated Economic Analysis (IHS approach)

The IHS approach to consolidated economic evaluation used for the evaluation of SETA measures was designed in accordance with the 2008 EU Cost-Benefit Analysis (CBA) guidelines, while at the same time offering a more differentiated picture as a result of the four specific economic models applied.

The four parts of the consolidated Economic Analysis are as follows:

1. **Financial Analysis:** The Financial Analysis concentrates on analysing effects from the point of view of a railway operator or railway infrastructure company. It takes account of investment costs, maintenance and operating costs as well as operating revenues. The Financial Analysis does not include any external effects.
2. **Short term Economic Analysis:** The assessment of short and medium term effects is based on multiregional input-output analysis methods. The IHS model concentrates on detailed regionalised input-output tables, which are compiled as appendices to national accounts and show the links between the individual production sectors in an economy and between its various regions. Input-output analysis allows for the computation of direct and indirect value creation effects, purchasing power effects and employment effects caused by demand for particular services (e.g. education or investment goods). It also allows the calculation of the effects on both overall economic tax revenues and social security contributions - separated by public authorities.
3. **Long term Economic Analysis:** The economic benefits of infrastructure projects only become apparent with time. To estimate these effects, IHS has developed an accessibility-dependent regional model (EAR), which follows a Bayesian spatial econometric approach. Since improvements in accessibility facilitate a higher degree of economic interaction, the emphasis of this model lies on the evaluation on a NUTS<sup>3</sup> level- of improved infrastructure in terms of additionally generated gross domestic product (GDP) or gross value added (GVA).
4. **Environmental and social analysis:** New or upgraded infrastructure does more than just improve accessibility between regions and nations in many cases. It also reduces the overall level of negative externalities, such as accidents, air pollution, noise and global warming. The IHS ESA model takes these external effects into account and supplies information on environmental and social effects on a local, national and international level.

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<sup>3</sup> NUTS (Nomenclature of Territorial Units for Statistics) is a geocode standard for referencing the subdivisions of countries for statistical purposes used in the European Union.

In order to correctly identify the overall costs and benefits of investments, the IHS approach focuses on the economic net present value (ENPV) of a project, i.e. the value which includes not only its economic effects but also its social and environmental impacts.

#### The IHS approach fulfils the EU guidelines because:

- The Short term Economic Analysis (multiregional IOA) properly accounts for indirect effects as well
- Externalities are taken into account via the IHS ESA model for the environmental and social analysis. The monetised external effects in the analysis are e.g. air pollution and global warming and are calculated using the willingness-to-pay (WTP) approach proposed by the Guide to Cost-Benefit analysis (2008).
- Prices and inputs are considered net of VAT and other indirect taxes which is one requirement
- Prices of inputs including labour have been considered gross of direct taxes
- Subsidies and pure transfers are excluded
- Adequate economic performance indicators are calculated. The IHS approach mainly focuses on the economic net present value (ENPV) which includes environmental and social impacts besides the economic effects.
- The chosen social discount rate (SDR) is in line with EU guidelines and member states. For member states which joined the EU before 2004, a SDR of 3.5 % was chosen, for those member states which joined after 2004, the SDR is 5.5 %.
- Regional-specific average wages were employed of which possible subsidies were subtracted.

For the evaluation of SETA-measures the IHS approach has been applied. The results of this approach provide more detailed information regarding the Financial and Economic Analysis. For further information on the IHS approach, see Work-package (WP) 5.3.