General guidelines for the appraisal of transport network projects in Finland – Executive summary of the benefit-cost analysis

1 Introduction

These general guidelines for the appraisal of transport network projects lay down the principles for the appraisal of the socio-economic benefits and costs of the state's transport network investments. The general guidelines are issued by the Finnish Transport Agency and adopted by the Ministry of Transport and Communications. The principles provided in the general guidelines must be adhered to in the project appraisal of all transport network investments specified in the state budget.

The appraisal of transport network projects comprises the description of the object's input data, the description of the project's impacts, a plan for subsequent follow-up and post-implementation assessment, as well as reporting and documentation (Figure 1). The input data, methodology and process of the appraisal are documented with a degree of accuracy that enables the repeatability of the appraisal, quality assurance and any post-implementation assessment that may be conducted after the project's completion.

This executive summary discusses only the benefit-cost analysis (hereinafter also the 'BCA') component of the appraisal framework. A number of key elements of the BCA, such as the project budget, estimation of traffic volumes, the unit values in monetary terms of the costs and benefits included in the analysis, or the determination of the reference scenario, are excluded from the scope of this executive summary.

Figure 1. Project appraisal framework of transport network investments

2 Benefit-cost analysis (BCA)

2.1 General principles

The BCA is used to determine the key money-value effects of a transport network investment. In project appraisal, the BCA is based on the principles of socio-economic benefit-cost analysis.

The BCA studies the difference between the proposed project and the alternative reference scenario. The analysis can include all effects that can be appraised by means of a valid methodology and clear valuation criteria.

For the purposes of the BCA, the base year (year zero) is the year in which the project is completed and opened for traffic (project opening year). Investment costs and impact on transport during construction period are included from the start of project implementation (project start year) up to year zero. The effects of the investment are included in the analysis for a period of 30 full years after the opening year. The effects are adjusted in the analysis to present value by using a discount rate of 4%.

The benefits of the project are usually cost savings, such as a reduction in transport operating costs or journey time. Similarly, the costs are an increase in costs, such as increased maintenance or emissions costs. Each cost and benefit item is included in the analysis only once.

2.2 Treatment of taxes in the analysis

Project appraisal analysis is based on a (simplified) welfare analysis model, in which taxes are taken into account as follows:

• investment, maintenance and transport operating costs are shown without VAT.

• special taxes (non-deductible taxes) are taken into account in the determination of transport operating costs and freight transport benefits (heavy vehicles)

• in the determination of consumer user benefits, special taxes (fuel tax) and VAT are taken into account

• changes in the revenue from taxes, charges and fares are itemised both at payer and recipient level, so that the net effect is zero.

• changes in journey time, accident, emissions and noise costs are priced using tax-free unit prices.

The taxes and charges included in user prices are taken into account both at payer and recipient level (net effect=0).

2.3 Increasing certain unit values during appraisal period

The unit values of journey time, accident, emissions and noise are increased during the appraisal period by 1.5% annually in line with the growth of income level. No such increase is made in other costs.

2.4 Calculation of indicators

In years 1 to 30, the investment produces benefits H_t (cost savings) and costs K_t (cost increases). The present values of the benefits and costs in year zero (H_P, K_P) are determined as follows:

(1) $$H_P, K_p = \sum_{t=1}^{30} \frac{1}{1{,}04^t} (H_t, K_t)$$

During construction time (from year n to year zero) investments costs I_t and construction-time costs K_{rt} are incurred. The present values of such costs in year zero (I_P, K_{rp}) are determined as follows:

(2) $$I_P, Kr_P = \sum_{t=-n}^{0} \frac{1}{1{,}04^t} (I_t, Kr_t)$$

Some of the investment costs and construction-time costs may be incurred in years 1 to 30. Such costs are associated with supplementary measures undertaken after opening to transport and replacement investments made during the appraisal period. These costs are discounted to the base-year level as shown in the formula above (1).

The residual value J of the investment is the benefit existing in year 30 (at the end of the appraisal period), the present value J_p of which is determined as follows:

(3) $$J_P = \frac{1}{1{,}04^{30}} (J)$$

The key indicator of profitability is the benefit-cost ratio, which is calculated as follows:

(4) $$\frac{H}{K} = \frac{H_p - K_p - Kr_p + J_p}{I_p}$$

The value of benefit-cost ratio is 1, when the project's socio-economic benefits equal the investment cost. The project is profitable in socio-economic terms, when the value of benefit-cost value is greater than 1.

2.5 Structure of the analysis

The benefit-cost analysis includes the project's costs and benefits in money-value. There is no definite structure to the analysis, but, in most cases, the analysis contains the following elements:

INVESTMENT COST

1) the project's investment cost

BENEFITS AND COSTS

2) impact on transport network management costs
3) indirect investments
4) user benefits
   - vehicle and journey time costs
   - fare costs
   - taxes and charges
5) change in producer surplus
   - transport operating costs
   - taxes and charges
   - revenue from transport services
6) safety impact
   - accident costs
7) environmental impact
   - emissions impact
   - noise costs
8) impact on public finances
   - revenue from taxes, charges and other similar sources
   - subsidies, procurement and other expenditure
9) residual value of investment

The same general principles must be applied to the benefit-cost analyses of all transport network infrastructure investments. Because of the nature of the different transport modes and the great diversity of projects, the analyses may also contain other elements.

2.6 Determination of the cost and benefit items included in the analysis

Investment cost

The investment cost of the project alternative being analysed includes all the costs that exceed the costs of investments required by the reference scenario. Any structures and equipment replaced through replacement investments during the appraisal period are included in the analysis as investment costs. The investment cost is included in the analysis net of taxes and adjusted to the same price level as the unit values applied in the analysis.

Maintenance costs and other transport network management costs

Any changes in the annual or other costs associated with transport network maintenance are included in the analysis as project impact. In this case, too, the decisive factor is the difference between the proposed project alternative and the reference scenario.

The replacement costs of transport network sections reaching the end of their service life during the appraisal period are entered in the analysis as costs incurred at the end of their service life.

Indirect investments

The project being analysed may also have an impact on investments other than those associated with the project itself or with the reference scenario. Such indirect investments are included in the analysis, if the project itself, or the reference scenario, has a clear and unambiguous relationship to these investments.

Indirect investments associated with the project or the reference scenario can, for example, be investments made by municipalities or port authorities in transport network infrastructure not included in state assets. Any indirect investment cost avoided by implementing the proposed project will be included in the analysis as a benefit incurred in the year when such an investment would have been made under the reference scenario. Similarly, any indirect investment cost arising from the proposed project will be included in the analysis as a cost incurred at the time when such investment is estimated to take place.

User benefits

Change in consumer surplus is measured by means of generalised costs. Generalised costs comprise vehicle, journey time and fare costs, and, potentially, also other service level factors. Vehicle, fare and any other costs valued in terms of money are treated inclusive of taxes. The unit price of time costs will be increased in line with economic growth. The annual growth rate multiplier to be used is 1.015.

As a result of the project, the costs and, thus, the amount of consumer surplus will change. If the proposed project does not affect traffic volume, the change in consumer surplus is obtained by multiplying the change in the generalised costs (per unit) by the traffic volume. If the project affects traffic patterns or the selection of travel or transport modes, the so-called rule of one-half will be used.

If the transfer from one transport mode to another is significant, the reduced congestion of the transport mode losing traffic and the improved service level will change the generalised cost and, thus, also the consumer surplus (for those who do not transfer to another mode). Such changes are determined and taken into account in the analysis.

In the determination of user benefits in public transport, the value of all journey components (walking, waiting, changing bus or similar) for the passenger is taken into account as a service level benefit. The value of the service level factors is determined relative to the journey time cost.

Change in producer surplus

Change in producer surplus is taken into account in all projects which affect the costs and revenues of transport service providers. Producer surplus is obtained by calculating the change in the transport service providers' operating costs and fare revenues.

In investments affecting the costs of freight transport, it is not practically meaningful to differentiate between producer (e.g. a shipping company) and consumer (e.g. a paper mill) surpluses. These items are treated as a single totality.

All non-deductible taxes (i.e. other than VAT) are taken into account in producer surplus. The portion of the tax is itemised.

Safety impact

Accident costs are taken into account in projects which have a bearing on road or rail traffic. In road transport, pedestrian and cycling accidents are taken into account in addition to accidents occurring in motor vehicle traffic.

The value of accidents in monetary terms is calculated by using average unit values exclusive of tax, adjusted to the same price level as the investment costs. The unit value in increased during the appraisal period in line with economic growth. The annual growth rate multiplier to be used for the total accident cost is 1.015.

Environmental impact

The benefit-cost analysis takes into account the project's impact on emissions and noise costs. Emissions costs are usually taken into account in projects which have a bearing on road, rail or waterborne traffic. The costs of emissions are calculated by using average unit values exclusive of tax, adjusted to the same price level as the investment costs. The unit values of emissions costs are increased in the same way as the unit values of accident costs. The annual growth rate multiplier to be used is 1.015.

Noise costs are taken into account in projects which have a bearing on road or rail traffic. The calculation of costs is based on unit prices set for noise exposure, exclusive of tax and adjusted to the same price level as the investment costs. The unit values of noise costs are increased by the annual growth rate multiplier of 1.015 in line with economic growth.

Impact on public finances

User benefits are evaluated on the basis of market prices, which include taxes, fees, charges, dues and subsidies, such as fuel tax, fare price including VAT, the subsidised portion of fare price, rail infrastructure charge, pilotage fee and fairway dues.

Taxes, fees, charges, subsidies and other similar items will change, if the project affects their respective amounts (prices) or the project affects the demand side of transport (volume, mode). The taxes, fees, charges, subsidies and other similar items included in the market prices are taken into account as negative items for the payer (consumer, transport service provider) and as positive items for the recipient (the state).

Residual value of the investment

The investment's residual value is determined case-specifically, taking into account the lifetimes specified in the project budget. For the purposes of the benefit-cost analysis, the residual value is a benefit incurred in year 30. Any dismantling costs are taken into account in the analysis as negative residual value

2.7 Sensitivity analysis

A sensitivity analysis to be conducted on the benefit-cost analysis provides information on the uncertainties involved in the set calculation parameters. Both the number and nature of the uncertainty factors vary in accordance with the project's nature, as well as with the methodology and tools applied, for example.

The sensitivity analysis is performed by comparing the impact of the factors critical to the BCA with the key indicators set for project appraisal. In most cases, it is justified to identify the needs of the subsequent sensitivity analysis before the actual project appraisal so as to make it possible to include an adequate number of optional alternatives in the demand-side prognosis, for example.

As a rule, the uncertainty of all factors which have a significant bearing on the conclusions must be analysed. In connection with the sensitivity analysis, justification must be provided for including any given factor in the analysis. Usually, at least the following factors can be justifiably included in the sensitivity analysis:

- investment cost
- traffic volume prognoses
- assumptions concerning future land use and the development of the transport system
- savings in journey time.

3 Links to the General Guidelines and the detailed transport mode-specific guidelines

More detailed appraisal guidelines for each transport mode are provided in the transport mode-specific guidelines (available in Finnish only) issued by the Finnish Transport Agency on the basis of the General Guidelines. The unit values used in the benefit-cost analyses are also determined for each transport mode separately in further documents, and the unit values will be revised at five-year intervals.

Liikenneväylien hankearvioinnin yleisohje (Liikenneviraston ohjeita 14/2011)

Tiehankkeiden arviointiohje (Liikenneviraston ohjeita 13/2013)

Vesiväylähankkeiden arviointiohje (Liikenneviraston ohjeita 14/2013)

Ratahankkeiden arviointiohje (Liikenneviraston ohjeita 15/2013)

Tieliikenteen ajokustannusten yksikköarvot 2010 (Liikenneviraston ohjeita 21/2010)

Rautatieliikenteen kustannusmallit (Liikenneviraston tutkimuksia ja selvityksiä 15/2013)

Alusliikenteen yksikkökustannukset 2013 (Liikenneviraston tutkimuksia ja selvityksiä 41/2014)