

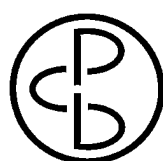
**EVALUATION OF
INFRASTRUCTURAL PROJECTS;**
GUIDE FOR COST-BENEFIT ANALYSIS

Section I: Main Report

Research Programme on the economic Effects of Infrastructure

Carel J.J. Eijgenraam*
Carl C. Koopmans*
Paul J.G. Tang*
A.C.P. (Nol) Verster**

CPB Netherlands Bureau for Economic Policy Analysis*
Netherlands Economic Institute**



A copy of this report can be ordered from
AVV Transport Research Centre
T.a.v. Louise van der Pol
P.O. Box 1031
3000 BA ROTTERDAM
The Netherlands
fax: +31 10 282 5642
L.vdPol@avv.rws.minvenw.nl

On the initiative of the Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs, a large-scale research programme entitled 'Economic Effects of Infrastructure' (OEEI) was carried out. The results of OEEI were published in a guide and eight underlying reports.

A guide for the evaluation of infrastructural projects.

OEEI offers a guide for the evaluation of proposed infrastructural projects. In this respect, a broad range of effects is described, including methods to determine the effects. The guide makes it possible to present the impacts of infrastructural projects in a more structured and transparent way in order to facilitate decision-making.

This publication, titled 'Evaluation of infrastructural projects: guide for cost-benefit analysis' forms the main report of OEEI and is, to a large extent, based on the results of eight studies performed within OEEI. The guide consists of section 1, the main report. Section 2, selected topics, looking at specific subjects in more detail such as the valuation of indirect effects and external effects is only available in Dutch. The eight underlying studies contain information which, in part, complements the guide and which is useful when carrying out a cost-benefit analysis.

Overview of the studies within OEEI

- A1: Economic evaluation of major infrastructural projects: makes an inventory of internationally prescribed evaluation methods in order to extract lessons to improve Dutch practice
- A2-1: International benchmarks for performance comparison of infrastructure: highlights performance indicators for infrastructure in a number of West-European regions.
- A2-2: Markets for infrastructure: provides insight into the relationship between institutional factors such as privatisation and decentralisation and the performance of infrastructure.
- A3: Spill-over effects of main port projects: provides insight into the economic spill-over effects of major investment projects in European seaports and airports.
- A4: A regional data file for the analysis of the economic effects of infrastructure: offers an overview of a regional (panel) data set and an initial test of the limitations thereof.
- B1: Welfare effects related to the evaluation of large infrastructural projects: provides a basis for the valuation of external effects and possible solutions for compensation measures.
- B2: Distributive aspects of large infrastructural projects: provides insight into the problem of distributive effects and gives recommendations for dealing with these.
- C: Essentially forward: making practical suggestions for the meticulous evaluation of forward effects and the development of a spatial general equilibrium model.

Commissioned by:

Ministry of Transport, Public Works and Water Management
Ministry of Economic Affairs

Contact persons on behalf of both Ministries:

P.W.L. Gerbrands, MA (Ministry of Transport, Public Works and Water Management, directorate Strategy & Coordination)
A.L. 't Hoen, MA (Ministry of Transport, Public Works and Water Management, directorate Strategy & Coordination)
J. Prij, MA (Ministry of Transport, Public Works and Water Management, AVV Transport Research Centre)
F.A. Rosenberg, MA (Ministry of Transport, Public Works and Water Management, AVV, Transport Research Centre)
A. Westerhuis, Eng (Ministry of Economic Affairs, directorate Spatial Economic Policy)

OEI research group:

P.M. Blok, MA Eng (KPMG Bureau for Economic Argumentation, chairman)
M. van Beveren, MA (Buck Consultants International)
A.N. Bleijenberg, Ir (Centre for Energy Saving and Clean Technology)
P.M.H. Bleumink, MA (Buck Consultants International)
L. de Boer, MA (KPMG Bureau for Economic Argumentation)
Prof. E.J. Bomhoff (NYFER)
M.A. van den Bossche, MA (NEI)
Dr F.R. Bruinsma (Free University of Amsterdam)
R. Buck, MA (Buck Consultants International)
J.M.W. Dings, Ir (Centre for Energy Saving and Clean Technology)
C.J.J. Eijgenraam, MA (CPB Netherlands Bureau for Economic Policy Analysis)
Prof. C. van Ewijk (CPB Netherlands Bureau for Economic Policy Analysis)
L. van der Geest, MA (NYFER Forum for Economic Research)
W. de Haart, MA (IOO bv)
A.R. Hoen, MA (IOO bv)
T.H. van Hoek, MA (CPB Netherlands Bureau for Economic Policy Analysis)
B.A. Leurs, MA (Centre for Energy Saving and Clean Technology)
M.L.G. Lijesen, MA (IOO bv)
Dr C.C. Koopmans (CPB Netherlands Bureau for Economic Policy Analysis)
Dr H.J. Meurs (MuConsult)
Prof. J. Oosterhaven (University of Groningen)
Dr A.H. Perrels (TNO Inro)
J. Poort, MA (NYFER Forum for Economic Research)
Prof. P. Rietveld (Free University of Amsterdam)
Dr J. Rouwendal (MuConsult)
Dr J.E. Sturm (University of Groningen)
P.J.G. Tang, MA (CPB Netherlands Bureau for Economic Policy Analysis)
O. Teule, MA (NEI)
Dr E. Verhoef (Free University of Amsterdam)
Dr A.C.P. Verster (NEI)
Dr P. Zwaneveld (TNO Inro)

Interdepartmental consultation between the Ministries of Transport, Public Works and Water Management, Economic Affairs, Housing, Spatial Planning and Environment, Finance and Social Affairs and Employment formed a linked with the practical aspects of policy and implementation. The Committee for Economic Structure (ICES) was closely involved in the project.

April 2000

Preface

Over the past few years, economists have held major discussions over the social return of large transport infrastructural projects. The economic effects were often estimated with diverse results. The Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs therefore decided in 1998 to make an inventory of the knowledge of economic effects of infrastructural projects, to promote collaboration between institutions and to try and formulate common starting points, definitions and methodologies. The departments therefore commissioned the Research programme on the economic effects of infrastructure (OEEI).

In total, eight studies were commissioned on which separate reports were published. The results of these studies have been summarised in this guide. The guide was written for the appraisal of all types of transport infrastructural projects. The whole range of effects should be taken into consideration when appraising large projects while, when appraising smaller projects, some effects do not have to be considered, or only need to be considered superficially.

We can conclude that the aims have been met. Leading research institutions have, in close collaboration, agreed on the concepts to be used, the types of effects and the appraisal framework within which all effects should be placed. Applying the guide means that the relevant information is provided in a transparent and objective manner, which forms the basis on which political decisions can be made.

We are convinced that we have made an important step forward to enhance decision-making in respect of infrastructural projects. This does not exclude the need that the guide should prove its worth in practice. In view of this, we will re-evaluate the guide in two years' time (early 2002).

The Secretary-General of the Ministry of Transport, Public Works and Water Management

The Secretary-General of the Ministry of Economic Affairs

Preface /

Summary and Conclusions /

1 Reason and aim /

2 Results //

3 Evaluation of OEEI /X

4 Set-up of OEEI X

1 Introduction 1

2 Research and Decision-making 3

2.1 Why an economic project appraisal? 3

2.2 The results of a cost-benefit analysis 5

2.3 Research during the decision-making process 8

3 Project Effects 13

3.1 Types of project effects 13

3.2 Valuation of project effects 15

4 Structure of the cost-benefit analysis 21

4.1 The core of the research 21

4.2 Sectional studies 24

5 Research aspects 27

5.1 The base case 27

5.2 Scenarios, risks and uncertainty 29

5.3 Direct effects and transport prognoses 32

5.4 Indirect effects 35

5.5 External effects 38

5.6 Distributive issues and employment effects 39

6 Step-by-step plan for economic project appraisal 43

6.1 Nine research steps 43

Literature 51

List of definitions 53

Table of contents Section II
(only in Dutch; not included in this publication)

.....

7 Return and uncertainty

- 7.1 Standards to determine the return of projects
- 7.2 Risk
- 7.3 Flexibility and phasing: real options
- 7.4 Conclusions and recommendations

8 Market and Competition analysis

- 8.1 Transport costs and transport demand
- 8.2 Transport benefits of the project
- 8.3 Generated traffic and locational benefits
- 8.4 Environment and competition

9 Indirect effects

- 9.1 Redistribution of welfare benefits
- 9.2 Welfare changes
- 9.3 Infrastructure and clusters
- 9.4 Employment, unemployment and income
- 9.5 Research methodology
- 9.6 Conclusions

10 External effects

- 10.1 What are external effects?
- 10.2 Method for valuing external effects
- 10.3 Methodological issues
- 10.4 The compensation issue
- 10.5 Conclusions and recommendations

11 Effects on income distribution

- 11.1 What is the relation between CBA and distributive and institutional aspects?
- 11.2 Individual and social valuation
- 11.3 Users and non-users
- 11.4 Negatively affected and not affected groups
- 11.5 Regions in the Netherlands
- 11.6 Public private partnerships (PPP)

Literature

List of definitions

- Appendix A Measuring welfare effects**
- Appendix B Business and Macro-economic profitability**
- Appendix C First year rate of return**
- Appendix D Optimal phasing of investments**
- Appendix E Risk-aversion and welfare maximisation**
- Appendix F Journey time valuation**
- Appendix G Valuation of external effects**

1 Reason and aim

The past few years, a large number of Dutch economic research institutions have, commissioned by the Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs, worked on the Infrastructural Effects Research Programme (OEEI). Discussions on the social return of several large infrastructural projects resulted in this programme being implemented. Differences in approach and definitions explain partially why appraisals of economic effects of projects vary so much. As a result, public confidence in the bases of the projects is undermined, which in turn impedes a reliable social assessment.

Decisions on major infrastructural projects do however have to be made. Such decisions are inevitably associated with great risks which, among other things, relate to uncertainty over future developments and effects. Under such circumstances, a reliable and policy-relevant form of information is needed.

Against this background, the aim of OEEI is twofold:

- 1 to obtain a greater degree of agreement over the methodological framework for social evaluations of major infrastructural projects;
- 2 to provide research instruments for determining the effects and their contribution to welfare.

OEEI led to the recommendation that, in respect of large infrastructural projects, a cost-benefit analysis should be carried out which will serve as a framework within which an integrated and transparent description of effects is possible. This recommendation was widely supported by the research institutions involved in OEEI. The OEEI study looked at all social effects which are directly or indirectly linked to the project and offered a basis for determining the contribution to the national welfare. It provided tools to describe and, wherever possible, to quantify these effects and the uncertainties surrounding them.

These analyses obviously can never replace the considerations made in political decision-making. However, they try to ensure that political decisions are taken on the basis of relevant information, using unequivocal terms and solid foundations for evaluations.

The most important results of OEEI are explained below (section 2) and an evaluation of OEEI is also given (section 3). Finally, a description of the research programme is provided (section 4).

2 Results

The results of OEEI were integrated by CPB and NEI in the report "Evaluation of large infrastructural projects; guide for cost-benefit analysis". A summary of this guide is given in this section. The guide was based to a large extent on the contributions from a number of research institutions which participated in the OEEI project (AVV, BCI, CE, IOO, KPMG, MuConsult, NEI, NYFER, University of Groningen, TNO Inro, Free University Amsterdam).

Cost-benefit analysis

The most important recommendation of the guide is that, in respect of large projects, a broad welfare-economical approach should be used. This implies that social cost-benefit analysis (CBA) must be used as the appraisal method for government investments.

Cost-benefit analysis is firmly based in economic science and is often used in practice. In a cost-benefit analysis, all the effects of an investment project can be systematically evaluated and, where possible, given a monetary value. In addition, CBA provides an overall picture of the distributive effects, alternatives and uncertainties. A comprehensive assessment can only be made on the basis of complete information.

One single figure?

Many effects of large projects can be expressed reliably in monetary terms. Examples are journey time and some environmental effects. However, if distributive issues are involved or an exceptional landscape is affected, it is impossible to determine useful 'prices'. In addition, there are many uncertainties surrounding both the way the project itself works and the environment in which the project is to be implemented. It is therefore neither possible nor desirable to express a large project in one single monetary value.

The result of a cost-benefit analysis is a profitability analysis which incorporates items for which there are no market prices; It also includes as many other effects as possible for which the value can be determined in other useful ways. Effects which cannot be expressed in monetary terms are recorded separately. Although these effects are not included in the profitability calculations, as much quantitative information as possible is provided on these. In this way, a systematic overview of all costs and benefits is created. The outline below is an example of a cost-benefit analysis for a fictional project. The various types of items in this set-up will be explained later in this summary.

Summary of a social cost-benefit analysis for a fictitious project*Amounts in net present values*

	<i>Financial</i>	<i>Relating to</i>
<i>BENEFITS</i>		
<i>Direct effects</i>		
- Operating income	NLG 3 to 4 bn	
- Benefits to travellers	NLG 2.25 to 3 bn	75 to 100 m hours journey time scale and efficiency benefits
<i>Indirect/strategic welfare effects</i>	NLG 0 to 2 bn	
<i>Environment: emissions prevented</i>	NLG 0.25 to 0.5 bn	2 to 4 m ton CO ₂
<i>Total benefits</i>	NLG 5.5 to 9.5 bn	
<i>COSTS</i>		
<i>Direct effects</i>		
- Investment	NLG 4 to 4.5 bn	
- Maintenance	NLG 1 bn	
- Operation	NLG 1 bn	
<i>Total costs</i>	NLG 6 to 6.5 bn	
<i>Balance (benefits minus costs)</i>	NLG -1 to +3.5 bn	
<i>Financial yield</i>	3.5 to 10%	
<i>PM ITEMS</i>		
<i>Distribution effects (between regions)</i>	+PM1	10% smaller income difference
<i>Landscape and nuisance</i>	-PM2	500 ha 1000 people suffering nuisance

Conclusion: in the political appraisal, the balance in guilders must be weighed up against the PM items which cannot easily be expressed in monetary terms.

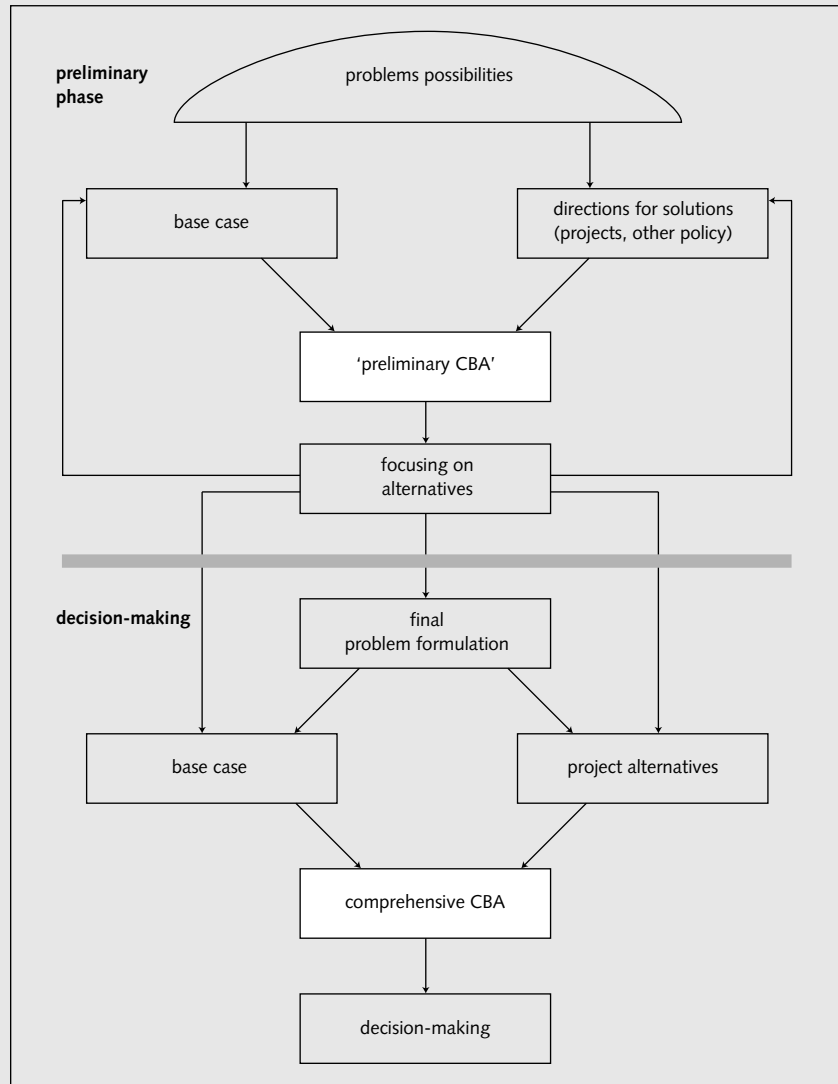
The role of CBA in policy preparation

CBA information is useful in almost every stage of policy preparation because decisions on the more detailed configuration of project alternatives are continually being taken. On the one hand, it is therefore very useful to carry out a CBA in the early stages of appraisal. On the other hand, because so much information is required to set up a comprehensive CBA, it is really only possible to carry out such a CBA in a late stage of the appraisal process.

The solution is to use the blueprint of the CBA as a framework during the phase of problem analysis and the preliminary investigation into various project alternatives, but to derive the information mainly from statistics and overall indicators (pre-feasibility study). This ensures that broad information on all relevant topics is available when making decisions on gearing the research towards promising alternatives. Prior to making final decisions on the project, a comprehensive CBA is carried out. In this way, carrying out

a CBA is an iterative process in terms of which certain items are expanded quantitatively and improved during the course of the research. Figure 1 outlines the role of CBA in the decision-making process.

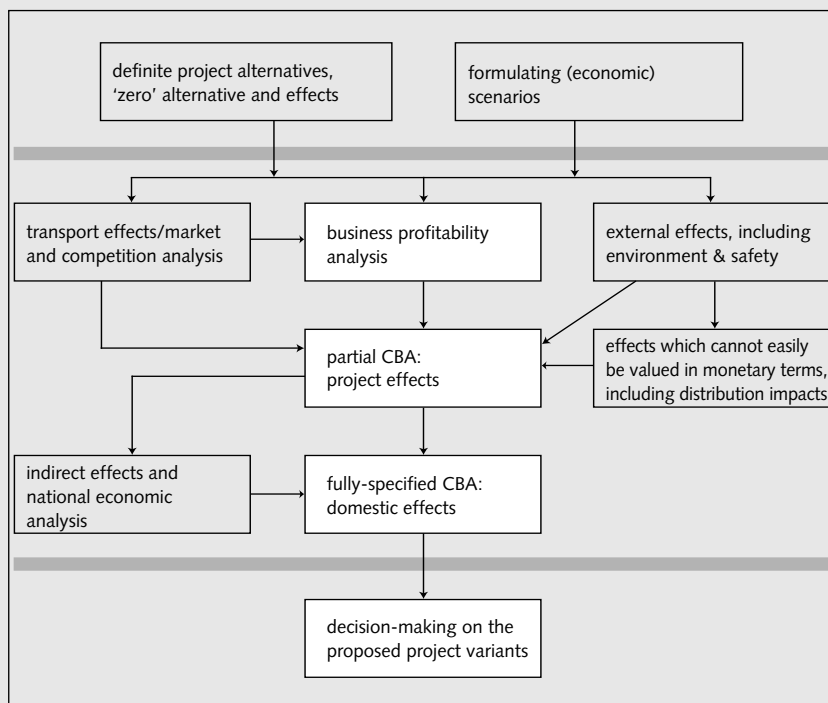
Figure 1
Structure of the decision-making process



Structure of economic project appraisal

Figure 2 is a schematic representation of the various valid forms of project analysis and their mutual relationships. The CBA should be seen as the concluding stage of a large number of analyses. As has already been shown in Figure 1, the steps involved are not taken just once. A CBA is, in many respects, an iterative process. Some parts which have been researched globally at an earlier stage may need to be revised at a later stage as additional information is obtained from other research.

Figure 2
Main structure of economic project appraisal



The most important elements of Figure 2 will be dealt with separately below.

Clear project alternatives and suitable scenarios (top section of Figure 2) are very important. It is evident that an appraisal of the quantitative effects of project variants require that these variants be described very clearly. Otherwise an extra, unnecessary source of uncertainty is introduced. The environment in which the project will function, however, will inevitably be characterised by uncertainty in the long term. Making use of only one forecast would merely give the appearance of certainty. It is important to determine the critical factors for success first and then to consider the various conceivable developments of these factors. In cases where there is a high degree of coincidence between the factors, it is possible to work with scenarios.

The project appraisal (middle of Figure 2) commences with a meticulous market and competition analysis. This involves looking at (transport) effects on operators and users and at effects on other modes of transport (network effects). The market and competition analysis serves as input for a business profitability analysis (BPA). The external effects, including environmental effects (MER), can be calculated on the basis of these analyses. External effects are divided into two groups: those which can be expressed in monetary terms and those which cannot be monetised. Non-monetised distributive effects are also added. These analyses together comprise a 'partial' CBA; the word 'partial' implies that the analysis includes mainly sectors which are directly affected by the project, and not the wider effects of the project on the economy as a whole.

In other countries, the project analysis often ends with the partial CBA; in the Netherlands however it is deemed important to include evaluations of the indirect effects on other sectors of the economy as well when appraising major infrastructural projects. This results in a comprehensive CBA.

Project and base case

Project effects can be defined as the differences between a development with the project (project alternative) and without the project (base case). Because of this, the construction of the base case is just as decisive for the outcome of the CBA as the configuration of the project alternative.

In case the project is not realised, sensible choices must be made. The base case is therefore a combination of the best other application of resources and the best possible other solution for bottlenecks. The base case is therefore something other than 'not doing anything' and is also not the 'existing policy'. For each situation, the best alternative for the project must be determined. Sometimes the implementation of another, much smaller project is the best alternative, and sometimes it is more advantageous not to reduce the bottleneck through infrastructure, but rather through another policy. Postponing the project is also often a relevant alternative; this can be included as a variant.

The difference between the project alternative and the base case is not only determined by the project itself. The construction of the project could, for example, challenge competitors to make efficiency improvements. As a result, the environment in the project alternative could look different from the environment in the base case.

Market and competition analysis

The benefits of an infrastructural project are heavily influenced by the value given by travellers or carriers to the new transport opportunities offered by the project. This valuation usually becomes apparent in a transport valuation study. The extra transport opportunities are not only determined through infrastructure (for example via network effects) but also through the manner in which the project is developed in terms of for example price, frequency and number of intermediate stops. Users react to this by making use of the project services in a particular way. This results in the direct benefits of the project being distributed between operators and users. In a CBA an evaluation must therefore be made – in conjunction with a market and competition analysis – of the behaviour of both the suppliers and those demanding the project services.

When preparing decision-making in respect of infrastructure, an *Inventory of Economic Effects (IEE)* is often carried out. The IEE provides an overview of the different types of effects of the project, such as cost benefits and direct effects on employment. The IEE however does not offer an integrated picture of the direct and indirect effects on national welfare. It is only the CBA which offers a complete overview in terms of which all welfare effects are thoroughly and mutually compared. The IEE should much rather be conceived as a market and competition analysis supplemented by components of a national economic analysis than as a CBA. Against this background, an IEE, at the most, forms a component of the research and not the centrepiece of the study.

Costs

An important element in the analysis are the costs involved in implementing the project. Information on costs is mostly provided by those people responsible for the technical aspects of the project. This involves preparation costs, investment costs during the construction period, development costs during the life span of the project and the costs of removal. Compensating people who suffer disbenefits as a result of the project can lead to additional costs.

In practice, costs often increase during the decision-making process because, at the beginning of the process, the costs of additional provision to limit negative effects are not known. This uncertainty should, as far as possible, be taken into consideration in the project evaluation.

In addition, the social costs can be higher than the direct costs. This relates to the missed extra returns of alternative spending of the money. These could for example be the missed extra benefits of tax reductions.

Indirect effects

Infrastructural projects have specific characteristics which economic research should take into consideration. There could be important benefits which do not accrue to the users and operators of the infrastructure. These *indirect effects* could contribute to an efficient (physical) concentration of economic activities (clusters). As part of the indirect effects, these could also have positive effects on Dutch or regional business development conditions. These latter (*'strategic'*) effects should be included in economic research.

Indirect effects do not occur in isolation: they result from an improvement in the transport system and the use that is made of the system. The use of project services can be divided into two groups: substituting one mode for other modes of transport and generating new traffic. The generation of new traffic is partially connected to indirect effects. A clear, quantified relationship between the generated traffic and indirect effects are often not made evident in project analyses. It is important that the indirect effects are evaluated in connection with the generation of new traffic.

Large infrastructural projects do not only affect users and operators. Since users pass on a part of their benefit to others, the economy as a whole is affected. This redistribution of benefits can also take place across national borders which could be either favourable or unfavourable for the Netherlands. In addition, the redistribution could have a positive impact on welfare if it results in fewer market distortions which could, in turn, result in the improvement of efficiency, for example through network effects or through scale expansion and/or clustering of companies. In order to avoid double-counting, it is important to separate these efficiency effects from the redistributive effects.

Methods for evaluating indirect effects

Various methods are available for evaluating indirect effects. It is advisable to employ an approach which accommodates a number of research forms. This creates a total picture of the possible range of indirect effects based on a variety of research methods. Indirect effects are often evaluated by using the following methods:

- 1 The macro-production function;
- 2 Case studies;
- 3 Targeted fieldwork;
- 4 Models.

By using the *macro-production function*, the effects on the national economy of the total investment in infrastructure of a country can be estimated. A lot of experience has been gained by this, both within and outside the Netherlands. Unfortunately the results vary substantially so that no clear picture emerges. Furthermore, it is not always clear in these analyses to what extent high investments are the cause or (also) the result of economic growth (causality). This method is only suitable for analysing total (macro) investments and not for evaluating a specific project.

Case studies can be used to draw lessons from comparable projects, for example, in other countries. Since situations and projects are not exactly the same in different countries, this does not provide an exact picture of a new Dutch project. Nevertheless, such a study can make a useful contribution when estimating the order of magnitude of effects (by means of statistical indicators).

A third method to determine indirect effects is *targeted fieldwork*: surveys and interviews. This method does not make any comparisons with the past, but looks explicitly at the expectations for the future (which may deviate from the past). A problem with this method is that the statements from respondents in surveys and interviews do not always correspond with their actual behaviour.

Finally, *models* can be used. These can be used to determine the impact of the project on the economy as a whole, including an overall estimate of the indirect welfare effects. CPB's Athena model may, for example, be used. The direct effects and the results of case studies and surveys can be used as input when using models to calculate effects. This could partially solve the problem of a model not being detailed enough to avoid drawing ambiguous conclusions. In order to examine spatial-economical effects, consideration could be given to constructing a spatial general equilibrium model.

Risks and flexibility

The benefits of an infrastructural project can extend over a number of decades. As a result, the exact extent of these benefits is often uncertain. The valuation of projects will normally decrease as the uncertainty over the returns increases. This 'risk-aversion' can be incorporated in the cost-benefit analysis by increasing the discount rate by a risk premium in respect of projects where the benefits are uncertain (a discount rate of 4% is prescribed for risk-free projects). This ensures that benefits which lie far in the future are allocated less weight.

A better approach however is to highlight the risks explicitly and to value them. There are various ways of doing this. Firstly, the impact of the project can be estimated in various scenarios (and possibly in variants of the scenarios). This makes it possible to study the robustness of the project in various possible developments. Secondly, simulations are created on the basis of probability distributions for specific, uncertain factors; this allows valuations to be connected to different possible outcomes as well.

Sometimes implementing the project in phases or postponing the project is a possibility to limit risks; this gives researchers more time to obtain clarity on certain developments. Phasing also offers more flexibility because choice possibilities remain open at later stages. In other cases, the success of the project depends on the question of which country realises such a project first (first-mover advantage) so that – despite the uncertainty – a rapid construction has important advantages.

3 Evaluation of OEEI

If we look at what has been achieved during the past two years, we can draw the following conclusions:

- agreement has been reached on the concepts to be used, the types of effects which can be expected and a systematic and consistent overview of costs and benefits;
- more clarity has been obtained on the use and limitations of the methods;
- collaboration with managing boards of a number of current projects has led to much practical, reciprocal advice;
- consensus was reached on the issue that project appraisals should provide as much insight as possible into all possible costs and benefits, including relevant uncertainties and risks.

It is expected that the description of the social cost-benefit analysis, the possible types of effects and the range of possible calculation methods will lead to the improved preparation of the decision-making process in respect of projects. Further steps will be possible in future years as the calculation methods are tested and developed further.

This guide has been written primarily for large transport infrastructural projects, but is, in principle, also suitable for the analysis of large and small projects. The whole range of effects related to large projects has been covered. The system of cost-benefit analysis can also be used for smaller projects. In respect of small projects however it is not necessary to examine some effects (such as the indirect effects) in great detail, if it is at all necessary to incorporate these.

The OEEI project has led to a broad consensus between research institutions on the importance of cost-benefit analysis when appraising large infrastructural projects and on the main features of the method according to which such analyses should be carried out. The organisations involved in OEEI are of the opinion that this consensus has paved the way for the better preparation of the decision-making process in respect of projects.

4 Set-up of OEEI

Introduction

A large conference, initiated by the then secretary-general of the Ministry of Transport, Public Works and Water Management, Van der Plas, was held at the onset of the research programme. The conference gave the many researchers another opportunity to set out their various points of view. As a direct result of the conference, the Ministries of Transport, Public Works and Water Management (V&W) and Economic Affairs (EZ) took the initiative to meet the most important panel members on a regular basis for a period of one year in order to obtain clarity on which matters there was and was not agreement and to determine in what areas more knowledge should be acquired.

At the end of that year, the directorate Strategy and Coordination of the Ministry of Transport, Public Works and Water Management and the directorate Spatial Economic Policy of the Ministry of Economic Affairs decided to commission the implementation of the Infrastructural Effects Research Programme. The Transport Research Centre (AVV) of the Ministry of Transport, Public Works and Water Management was asked to set up and conduct the research. In order to maintain contact with policy-makers, a steering committee was set up in which representatives of the Ministries of Transport, Public Works and Water Management (V&W), Economic Affairs (EZ) and co-workers of the Ministries of Housing, Spatial Planning and Environment (VROM), Finance and Social Affairs and Employment (SZW) participated. In addition, regular consultations took place with the directors of the various ministries who are involved in setting up large infrastructural projects. The Committee for Economic Structure (ICES), which was faced with the choice of a large number of investment options, was kept directly informed of the progress of the research. Finally, the organisations of the large infrastructural projects were also involved in the OEEI project.

The AVV invited approximately twenty Dutch research institutions to stipulate their interests in one or more components of the programme. On the basis of this, tenders were invited and, in collaboration with representatives of the various ministries, a selection was made between the various institutions. Because collaboration is so important, the parties were asked to work together as much as possible.

Results of the various studies

A total of nine studies were commissioned which were categorised in four clusters, namely: International comparison, Welfare aspects, Forward effects and Analysis and coherence.

A Within the cluster "International comparison", five research questions were addressed:

- Evaluation methods. Institute responsible: Centre for Energy Saving and Clean Technology (CE).

This research showed that CBA (cost-benefit analysis) is central to research carried out in our neighbouring countries (a practice not currently followed in the Netherlands). All prescribed methods which were considered, have a partial character. This implies that the aim is not to make a complete inventory of the indirect welfare effects. The effects are limited to effects in the transport market. In some cases, the partial analysis is expanded to include effects on other modes of transport.

- Performance characteristics: Institute responsible: TNO INRO in collaboration with the Free University of Amsterdam.
On the basis of information on more than forty European regions, benchmarks were drawn up which were used to determine on which infrastructure sub-sections the Netherlands scored well or badly. Such an analysis is useful (if carried out regularly) when drawing up the Dutch policy and stipulating accents in the investment portfolio for infrastructure.
 - Institutional factors. Institute responsible: NYFER
This research looked at the initially attractive statement that institutional factors, such as privatisation and decentralisation can influence the profitability of an infrastructural project. The statement seems to be partially supported in practice. The research highlights the conditions under which this is the case. The study relates to two stages in the evaluation procedure; the phase of project definition and the phase of implementing the CBA in respect of still incompletely defined organisational options.
 - Indirect effects of main ports. Institute responsible: Buck Consultants International (BCI)
Within this research, a number of selected main port investments were used to determine to what extent indirect impacts of the investments can be shown abroad. The research showed that hardly any ex post effect studies were carried out. It also showed that the Netherlands, in contrast to neighbouring countries, spend a lot of attention on determining the relevance of indirect impacts.
 - Cross section study. Institute responsible: (IOO bv)
In respect of this study, a theoretically radical attempt was made to try to establish the connection between regional economic developments and various types of infrastructure investments. The quality of the statistical materials unfortunately seems insufficient to conclude this study effectively within OEEI.
- B The cluster “Welfare effects” contains two research areas:
- External effects. Institutes responsible: MuConsult and the Free University of Amsterdam
This research provides a basis for the valuation of external effects. In addition, solutions were offered for the best way in which compensation can be made.
 - Distributive aspects. Institute responsible: NYFER
This is one of the theoretically more difficult areas and still represents a gap in our knowledge. It is clear that infrastructure causes welfare effects. Policy makers are however also interested in the division of income and employment between regions and those parties involved in the project (users, local companies, residents in the area and tax payers). The report provided more clarity on the complexity of this issue. It was recommended that an inventory be made of the distributive effects and to bring the costs and benefits of large projects closer together, for example, by letting beneficiaries contribute as much as possible to the project.
- C The cluster “Forward effects” consists of one research task and looked at the most complex subject of all the clusters. For this task, the Netherlands Economic Institute (NEI), the University of Groningen and TNO Inro joined forces. The report, among other things, showed that the results of many practical studies carried out in the past are based on ad hoc hypotheses and global analyses in terms of which the characteristics of the specific project were not expressed.

Moreover, these studies are often prone to double-counting. In order to prevent this undesired situation, the report made a number of recommendations for improvement. Two possible solutions were offered: one for the short term (conducting interviews, surveys and targeted fieldwork in a structured way) and one for the long term (Spatial General Equilibrium Model).

- D The last cluster relates to “Analysis and inter-connection” and was carried out by a group of researchers from NEI, the Netherlands Economic Institute and CPB Netherlands Bureau for Economic Policy Analysis. This involved the complicated task of drawing up a well-founded guide on the evaluation of infrastructural projects. The analyses and information carried out and collected by the parties who participated in OEEI were used. The most important OEEI results were briefly discussed in the preceding paragraphs.

1 Introduction¹

This report was compiled at the request of the Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs within the framework of the Research programme on the Economic effects of Infrastructure (OEEI). The most important aim of OEEI is to achieve greater uniformity in the economic assessment of infrastructural projects in order to provide project managers and project leaders with a better base from which to conduct such research.

During the last few years, the situation surrounding the economic assessment of large infrastructural projects has been very loosely structured. This was one of the main reasons for setting up the Research Programme. Not only was the assessment characterised by diverse research methodologies, but many intense, and not always very lucid, discussions about the appropriateness and applicability of these methodologies arised. Within the Research Programme, however, consensus has been reached on a number of crucial points, for example, the importance of implementing cost-benefit analyses. The agreements reached within the 'OEEI community' have been set out in this guide. Although much has been achieved, there will obviously always be scope for further discussion.

The guide concentrates on the economic assessment of infrastructural projects in the Netherlands, which means that it is not a general manual or reference work for cost-benefit analysis. Some topics are only mentioned in passing or are not discussed at all, while other topics, in particular those which are specifically relevant to infrastructural projects or which focus on the Netherlands in particular, are discussed in great detail. This study is specifically aimed at transport infrastructure in the form of rail connections and (transport) hubs.

Is OEEI aimed only at large projects?

This guide has been primarily written for large transport infrastructural projects, but can, in principle, be used for the analysis of large and small projects. The difference between large and small projects lies in the extent of the research into the project effects. For small projects, it is relatively easy to show the benefits of the project for a limited number of directly involved, and the effects which it has on others are often considered to be less relevant. The effects of large projects are more extensive and often diffuse as a result of their affecting the rest of the economy or the environment as well. This implies that the parts of the guide dealing with direct effects are also relevant to small projects while the parts dealing with indirect effects and environmental effects are, in many cases, of less importance to small projects.

Notes

¹⁾ Peter van den Berg, Sjeff Ederveen, Casper van Ewijk, Taco van Hoek, Herman Stolwijk and Nico van der Windt all contributed to the guide in a variety of ways. The authors are very grateful for their contribution.

Connection with other OEEI studies

The guide is largely based on contributions to the OEEI project made by a number of research institutions (AVV, BCI, CE, IOO, KPMG, MuConsult, NEI, NYFER, University of Groningen, TNO Inro, Free University). These individual studies have been included in the bibliography and reference is made to them throughout the text.

Structure of the report

The first section of the book, up to chapter 6, is mainly aimed at those people who are more broadly involved in the process (for example policy makers and project managers). In chapter 2, the place of economic assessment in the whole preparation and decision-making process for infrastructural projects is explained. The subsequent chapters deal with the content of a cost-benefit analysis. In chapter 3, the types of project effects are described. Chapter 4 concentrates on the different parts of a project assessment. Chapter 5 describes the various aspects of measuring project effects. Chapter 6 offers a step-by-step plan for project assessments.

The second section, chapters 7 to 11, is published in a separate volume (not included in this publication, only available in Dutch). Section 2 is aimed at (economic) researchers and supervisors of research projects. A number of diverse topics are explored in more detail. In so far as a more detailed explanation seems appropriate for professionals and specialists, this will be given in separate appendixes.

2 Research and Decision-making

Decision-making on infrastructural projects is a political-administrative process. Section 2.1 outlines why economic research is of the utmost importance within the decision-making process. Section 2.2 describes what type of information emerges from the research. Finally, section 2.3 shows how the research can be used in the preparation and decision-making process.

2.1 Why economic project assessment?

The nature of large infrastructural projects, necessitates active involvement by the government. Economic project assessment contributes to a meaningful consideration of often dissimilar and unequally distributed effects of these projects. Cost-benefit analysis is a very suitable instrument for conducting this type of assessment. This guide provides recommendations on how a cost-benefit analysis can be implemented.

The government is currently grappling with decisions on large infrastructural projects such as the Betuwe line (freight railway to Germany), High-speed Rail Links, a new area for Rotterdam Port Activities or Amsterdam airport. One reason for this struggle is that many of these projects are spatially difficult to implement. Another reason is that the government is usually called upon to finance large infrastructural projects in particular. In a certain sense, the government then adopts the role of an entrepreneur who is considering making an investment. The government is by nature not very capable to fulfil this role. Furthermore, making decisions is a more complex process for the government than for an entrepreneur. Whereas the entrepreneur primarily looks at business returns, the government has to consider the interests of a number of parties.

The financial returns from a project are, in many cases, insufficient to cover the investment costs, but locational or environmental advantages for example, could justify the investment from a social perspective. This obviously does not simplify a project assessment. Locational advantages are not immediately perceptible, and there is no market, and therefore no market price, for landscapes or noise.

Although indirect effects are perhaps less specific, this does not mean that they are less important. One example is an infrastructural project which is part of a (transport) network. Improving a (transport) hub or a line between two (transport) hubs could offer benefits further up in the network. The project accordingly does not offer benefits to only the direct users. A further important characteristic of transport is that it fulfils an intermediary function in the economic process. This means that the quality of the infrastructure has a bearing on many sectors in our economy. Investments in transport also relate well to trade and distribution, an area in which the Netherlands has specialised for a long time.

These general considerations nevertheless have little to offer as a basis for an analysis of concrete projects. It is clear that without electricity, for example, the Dutch economy would grind to a halt. This does not imply however that the Netherlands build an extra power station tomorrow.

Implementing a specific project can have both positive and negative influences on the economy. It is only if the benefits outweigh the costs that we are, on balance, better off in terms of national welfare. Economic project assessment endeavours to assess this. To achieve this, all effects are recorded and made comparable as far as possible, even if these effects cover very diverse areas such as the environment or locational advantages.

When economic assessments are made on infrastructural projects, the following questions have to be considered:

- Does the project contribute to improving national welfare?
- Which configuration of the project should be given preference?
- To what extent is a financial contribution by the government reasonable?

Certain important elements of these questions also apply to two other types of assessment: administrative and technical assessments. In the administrative assessment procedure, a social problem is identified for which an infrastructural project could offer a solution. In addition, it is recognised that many different interests are at stake and therefore an attempt is made to find a solution to the problem which takes into account all interests and which is acceptable to as many people involved as possible.

The technical assessment procedure tries to find the best possible way of shaping the chosen administrative solution. Although economic factors are already taken into consideration when choosing between the various planning and implementation options, these are confined to options relating to parts of the project. It is often a matter of finding the cheapest solution for a clearly defined problem.

Economic project assessment includes all aspects of national welfare

Economic project assessment poses a number of fundamental questions overlooked by administrative or technical assessment. In the same way as an entrepreneur carries out a profitability analysis when assessing an investment project, the government (or society) requires an instrument for comparing and evaluating various investment opportunities which would lead to an acceptable government contribution. Economic project assessment meets this need. It is important to note that the word 'economic' should not be interpreted in the strict meaning of 'financial'. 'Economic project assessment' looks at the systematic, rational basis of social choice between relevant alternatives. In addition, all social aspects must be taken into consideration, including non-financial aspects, such as safety or environmental effects. Cost-benefit analysis also provides insight into the distribution of costs and benefits among relevant groups in a society. Cost-benefit analysis is therefore by definition always 'social' in nature and, in principle, includes all types of effects.

Why cost-benefit analysis?

Cost-benefit analysis (CBA) is firmly based in economic science and is often used in practice. In a cost-benefit analysis, all the impacts of an investment project can be evaluated and, where possible, given a monetary value. In addition, CBA provides an overall picture of the distributive impacts, alternatives and uncertainties. A comprehensive assessment can only be made on the basis of complete information; a CBA offers this information.

A number of policy documents published by the Ministry of Finance (1993, 1995 and 1998b) accordingly stipulate that state policy should always be evaluated first and that cost-benefit analysis is the perfect instrument for this.

Cost-benefit analysis also forms the basis of the various methods developed by the public-private partnership knowledge resource centre for portraying and assessing the advantages and disadvantages of public-private partnerships, see section 11.6.

Why a guide?

Given the fundamental questions raised by a CBA, it is of the utmost importance that there is agreement on the nature of the CBA. This relates specifically to the aim, methodology and results. This does not only apply to economists. Other social parties interested or involved who assess projects from their own perspectives and persons from other disciplines, such as engineers and managers, need to know what a CBA involves. This guide – in particular section I – endeavours to serve all these various groups.

The guide contains clear recommendations for the design and implementation of a CBA geared towards large (transport) infrastructural projects, but, in principle, the recommendations can be applied equally well to small projects. These recommendations will not always be immediately applicable and will often have to be adapted when putting a CBA into practice. In this respect, the guide differs from the Handbook for Economic Infrastructural Effects (AVV, 1996) which provides rules of thumb which are especially applicable to small projects.

2.2 The results of a cost-benefit analysis

In a cost-benefit analysis, all effects of an investment project are recorded and, wherever possible, given a monetary value. In this way, a cost-benefit analysis promotes a comprehensive assessment of diverse aspects. In addition, a CBA provides an overall picture of the distribution effects, (project) alternatives and uncertainties.

A CBA describes:

- A. a comprehensive assessment of different effects;
- B. the distribution of costs and benefits;
- C. project alternatives;
- D. risks and uncertainties connected with the project.

A. Comprehensive assessment

The philosophy which underlies cost-benefit analysis is an appealing one. All relevant advantages and disadvantages of an investment project are recorded and quantified in the best possible way. By allocating a suitable monetary value to project effects wherever possible and then adding them up, it is possible to present information in a well-organised manner which facilitates a comprehensive assessment. Cost-benefit analyses limit, wherever possible, the compilation of long lists of diverse advantages and disadvantages which complicate rather than simplify a comprehensive analysis of project effects.

A cost-benefit analysis also has a disciplining effect because it prevents double-counting. It requires an adequate insight into the relationship among the various impacts. A cost-benefit analysis therefore makes demands on the research, not only on the analysis itself, but also on the underlying research projects. This reduces subsequent criticism.

A single figure for returns?

The aim of a CBA is to express all effects in monetary terms and to add them up. This however is not possible in practice. While (almost) all benefits and costs for business investments can be given a value in terms of market prices, this is not the case for social investment projects. Still, non-priced effects can often be reliably expressed in monetary terms. Examples are journey time profits and some environmental effects. How to assess time spent travelling is not immediately apparent, but can be reliably determined by looking at the behaviour of travellers or by conducting surveys. Similarly, although there is no market price for CO₂ emissions, the costs of measures to reduce emissions, serve very well as (shadow) prices.

Other effects cannot be objectively expressed in monetary terms. Distribution aspects are an example. Also allocating a value to non-reproducible, unique goods is a tricky problem: it is not easy to allocate a price to an area of natural beauty. In such cases, other quantitative or qualitative information has to be used. Effects which cannot be expressed in monetary terms must be weighed up in political-administrative terms against the sum of the effects which can be expressed in monetary terms.

Figure 2.1
A fictitious research report

Summary of a social cost-benefit analysis for a fictitious project		
<i>Amounts in net present values</i>		
	<i>Financial</i>	<i>Relating to</i>
<i>BENEFITS</i>		
<i>Direct effects</i>		
- Operating revenue	NLG 3 to 4 bn	
- Benefits to travellers	NLG 2.25 to 3 bn	75 to 100 m hours
<i>Indirect/strategic welfare effects</i>	NLG 0 to 2 bn	journey time scale and efficiency benefits
<i>Environment: prevented emissions</i>	NLG 0.25 to 0.5 bn	2 to 4 m ton CO ₂
<i>Total benefits</i>	NLG 5.5 to 9.5 bn	
<i>COSTS</i>		
<i>Direct effects</i>		
- Investment	NLG 4 to 4.5 bn	
- Maintenance	NLG 1 bn	
- Operation	NLG 1 bn	
<i>Total costs</i>	NLG 6 to 6.5 bn	
<i>Balance (benefits minus costs)</i>	NLG -1 to +3.5 bn	
<i>Return</i>	3.5 to 10%	
<i>PM ITEMS</i>		
<i>Distribution effects (between regions)</i>	+PM1	10% smaller income difference
<i>Landscape and nuisance</i>	-PM2	500 ha 1000 people suffering nuisance
Conclusion: in the political assessment, the balance in guilders must be weighed up against the PM items which cannot easily be expressed in monetary terms.		

Figure 2 is an example of a cost-benefit analysis for a fictitious project. A cost-benefit analysis always provides an overview of project effects for which market prices are available. Effects, the value of which can be reliably determined by other means, are also included in the overview wherever possible. Effects which cannot be reliably expressed in monetary terms are referred to separately. These effects are not included in the financial balance, although as much quantitative information as possible is provided on these.

B. Distribution of costs and benefits

The distribution of costs and benefits is extremely important for at least three reasons, especially for large projects:

- 1 A distinction must be made between effects for the Netherlands and other countries. Because the effects of major infrastructural projects spatially cover a large area, it often means that there are cross-border effects. If Dutch tax payers pay for projects, it is important to determine what benefits these entail for the Netherlands. The division of the benefits between the Netherlands and other countries must be clearly shown. If the project is (also) aimed at specific regional developments, it is also necessary to determine the regional distribution effects.
- 2 It is necessary to understand how the users of the infrastructure will benefit directly from the project. The benefits for users form the basis of the generation of revenue for a private operator. In the case of public-private partnerships, such insight is important for making a reasonable distribution of the contributions between public and private parties.
- 3 Infrastructural projects often entail some inconvenience for people living in the area, while the benefits partly accrue to users of the project. As a result of this disparity, it is important to look at the distribution of benefits and burdens carefully.

C. Project alternatives

The analysis of alternatives lies at the heart of any economic research. This type of analysis entails looking at the returns of a project in comparison with alternative ways of making investment resources work for the community. The notion that the cancellation of a project could result in a loss of income and employment for the Dutch economy is not always correct. This can only be determined after the benefits have been compared to the alternative returns. This is exactly what takes place in a cost-benefit analysis.

The search for alternatives is also very important within the project. In this case, alternatives relate to the timing and scale of the project. The advantages and disadvantages of 'now' versus 'later' and 'small' versus 'large' should be investigated systematically. This also involves looking at building the project in stages. Alternatives could also relate to different locations or competing modes of transport (for example track versus inland waterway transport). Cost-benefit analysis is extremely well suited for comparing various (project) alternatives systematically and for providing information in terms of which the various alternatives can be assessed.

D. Uncertainties and risks

A long-term perspective is inherent in many infrastructural projects. Decisions on the project are made now, but the effects will often only be visible in the long term. This means that the research must be able to deal with a comparable long period. Firstly, it is important to take into account that the future holds many fundamental uncertainties. Using one prognosis provides only the illusion of certainty. The customary approach in this case is, first of all, to determine the critical success factors and then to formulate

various conceivable developments for these factors. If there is a connection between these factors, it is possible to work with scenarios. Various developments are often also plausible within the context of one scenario. A supplementary sensitivity analysis should then be carried out.

Simulation models can also be a useful tool for assessing the consequences of various combinations of success factors. In this case, probabilities should be assigned to these factors. The advantage of such an approach is that a price tag can be put on the risk. It will often be evident from such analysis that flexibility in the implementation of a project is of great value.

In any event, when conducting a thorough cost-benefit analysis, careful attention should always be paid to the uncertainties and risks. In this way, economic research supports a policy decision which will inevitably be based on a calculated risk.

2.3 Research during the decision-making process

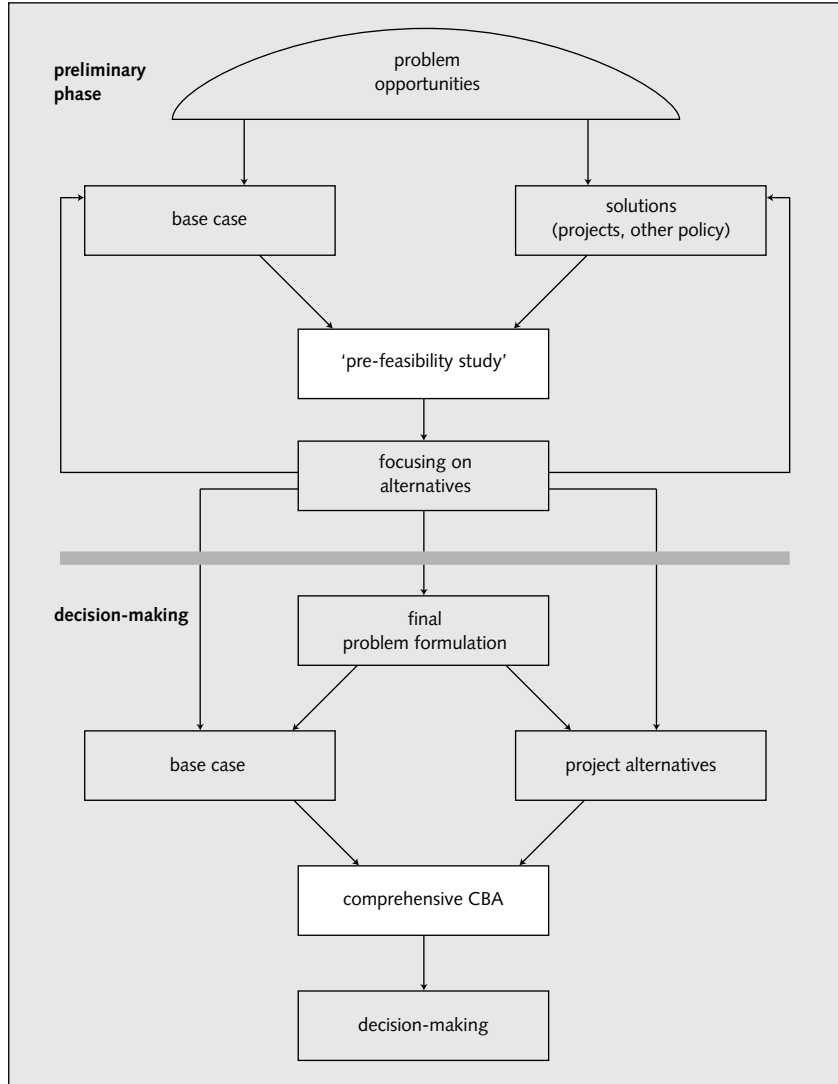
In order to fit in with the decision-making process, the cost-benefit analysis can be carried out in two stages. In the initial phase of the decision-making process, a large number of alternatives can be analysed overall on the basis of 'pre-feasibility studies'. Once clarity has been reached on the alternatives on which the research will be focused, a more in-depth cost-benefit analysis can be carried out. The final decision will be made by politicians, on the basis of clear and relevant information

Between the moments when the idea for a large project is first formulated and a complete "Planologische Kernbeslissing" (Key Planning Decision) is finalised, there are many instances, spread over a number of years, when political choices must be made. The initial ideas are normally based on a notion of a problem or an opportunity. During this stage, investigations will often already be carried out to determine whether there is any connection with existing policy concepts, such as 'main port' or 'modal shift'. Although this leads to a specific positioning, it does not yet afford any insight into the significance of the project itself. Only research will determine to what extent an investment project can be used as a means of achieving certain aims.

Research is important in almost every stage of the policy preparation process because, in each stage, decisions have to be made on how project alternatives are to be configured. On the one hand, it is therefore sensible to carry out a cost-benefit analysis in the early stages. On the other hand, since so much information is required to carry out a comprehensive cost-benefit analysis, it is only really possible to carry out a complete analysis at a later stage.

The solution is to take the principles of the cost-benefit analysis as a point of departure during the problem formulation stage and the preliminary investigation into various project alternatives, but to derive the information mainly from pre-feasibility studies and overall indicators. Overall information on all relevant topics is therefore available when deciding on the most likely alternatives for the research. Moreover, these 'pre-feasibility studies' can provide information on whether a project is indeed large, i.e. whether wide research, including the effects which this will have on (the rest of) the economy and the environment, is desirable.

Figure 2.2
Structure of the decision-making process



Before the final decision is made on the project, a comprehensive cost-benefit analysis is carried out. In this way, doing a cost-benefit analysis becomes an iterative process in which more and more sections can be filled in and improved quantitatively as the research progresses. Obviously, these analyses can never replace the assessments made in political decision-making. On the contrary, the aim of these analyses is to ensure that political decisions are made on the basis of relevant information by using unambiguous concepts and clear bases for assessments.

Figure 2.2 shows the role of cost-benefit analysis in the decision-making process. A distinction is made between two research stages. During the preliminary stage, problem analysis occupies a central position and 'pre-feasibility studies' are carried out. In the second stage, a comprehensive cost-benefit analysis is carried out prior to making a final decision.

The initial research stage: problem analysis and 'pre-feasibility study'

Large infrastructural projects entail a lengthy preparation and decision-making process. At the start there is an abundance of suggestions and ideas. During the course of the process, these are reduced to only a few serious project alternatives. The quality of the interim decisions to be made

in respect of these many suggestions and ideas depends on the quality of the information. The quality is thus determined by the research during the entire preparation and decision-making process. Research must, on the one hand, prevent unrealistic alternatives from remaining under consideration in the later stages and on the other hand, prevent usable project alternatives being rejected during the initial stages.

In addition, a clear *problem analysis* is important for the quality of the interim decisions. Problem analysis should ensure that attention is not shifted from a general problem to a narrowly defined, technical problem. Good problem analysis can also help in identifying the information which is required to make considered decisions.

The following questions are raised in a problem analysis:

- *problems and opportunities*
What are the aims of a project? Improvements of existing infrastructure can be qualitative (speed, reliability, punctuality) or quantitative (capacity) in nature. They may solve existing problems, but may also make it possible to use opportunities which are expected to arise.
- *Solutions*
 - Is the project the only means of solving the problems or making use of the opportunities? A type of policy other than infrastructure investments (regulations, price policy) may also be considered.
 - What is the role of the market and the government? The allocation of tasks between the private and public sectors is closely linked to the nature of the project services. The government may undertake the project itself, but may also assume other roles: a preconditional role (for example within the framework of spatial organisation), a coordinating role (bringing parties together) or a financial role (as investor). In this respect, an investigation may also be carried out on whether a public-private partnership is a feasible option.

In order to get a clear picture of the problems or opportunities, information is required on future developments with or without the project. The project effects become apparent when comparing the two developments. A pre-feasibility study of the (project) alternatives can be carried out on the basis of scenarios. Aspects which will be considered include implications for the spatial organisation, legal issues, transport flows, impact on the environment and costs. It is very important that these effects are shown systematically, in each case as the difference between the (project) alternative and the base case. The initial stage of the research is therefore largely concerned with making an inventory. It is more important that all relevant topics are taken into account than that thorough research is carried out on only a number of sections. In this stage, it is often sufficient to use information derived from pre-feasibility studies which have been carried out during other research projects.²

Notes

² See for example the information in AVV (1996), the OEEI report TNO Inro et al (2000).

This stage also seems to be the appropriate time to conduct discussions on the usefulness and necessity of the project. Problems and opportunities and the significance of various infrastructural and other policy possibilities have already been identified. It is of great importance that the fundamental issues are already discussed at this stage to prevent the initial choices and demarcations still being under discussion at a later stage in the process.

A pre-feasibility study can help to put the correct assessments in perspective and to support the political-administrative decisions in respect of project alternatives. The aim is to prevent irrelevant alternatives from remaining in the foreground and relevant alternatives from disappearing into the background. A thorough broad cost-benefit analysis at the end of the initial research stage prevents a more in-depth, comprehensive profitability analysis during the second research stage from being at right angles to the preparation and decision-making process.

The second research stage: a comprehensive CBA

The second stage commences with a political decision on the areas of research to which 'the project' will be restricted. These areas may in practice still be interpreted broadly. Examples are the Research into National Airports (ONL) and the Project for the Main Port Development in Rotterdam (PMR). In a broad approach, the comprehensive assessment of diverse solutions is shown to its full advantage in a comprehensive cost-benefit analysis. In addition, social discussion and cost-benefit analysis progress in step with each other. A broad approach prevents the discussion from narrowing to a derived problem with only one technical solution.

The environmental impact assessment MER required by law is carried out simultaneously with the cost-benefit analysis. The aim of the MER is to record the consequences for the environment and nature, but does not weigh this up against other interests. The aim of the CBA is to determine the social-economic return – including effects on the environment and nature. Therefore these studies should be geared to one another. They must be carried out from the same point of view and an exchange of information must be possible. A cost-benefit analysis cannot be carried out properly without knowing what impact the project will have on the environment. In the same way, the MER requires economic impacts in order to accurately forecast the impact on the environment. Both the cost-benefit analysis and the MER also require information derived from, for example, transport studies, landscape studies and cost studies.

The remainder of this report will concentrate on the (comprehensive) cost-benefit analysis carried out during the second stage of the decision-making process. The pre-feasibility study carried out in the initial stage has a similar structure, but will, in general, not be as fully elaborated.

3 Project Effects

Project effects can be defined as the differences between the development with and the development without the implementation of the project. The aim of a cost-benefit analysis is to determine the value which society allocates to an impact. This chapter considers the types of project effects (section 3.1) and the valuation of the effects (section 3.2).

3.1 Types of effects

We can distinguish between project effects by asking five questions: does it have an impact on the Netherlands? Are there market prices for the impact? Does it involve extra welfare or a different distribution of welfare? Does it involve a direct or indirect effect? Does the effect affect operators, users or third parties? Based on these criteria, it is possible to distinguish between types of project effects.

The effects of a national infrastructural project can be characterised on the basis of five criteria:

- 1 Do the effects affect the *Netherlands* or *foreign* parties? This criterion is important when considering the question of whether the Dutch government would have to contribute financially to the investment.
- 2 Is it *possible or impossible to price* the effects according to market prices? This distinction has a practical significance since there are no markets or market prices for many impacts of infrastructure. Think for example of journey time savings made by users and aspects relating to the environment, nuisance and safety.
- 3 Does an effect signify a different size of the national welfare or only a different *distribution* of the existing or new welfare? The first case relates to an *improvement in efficiency*. This criterion distinguishes a cost-benefit analysis from other forms of project appraisal.
- 4 Do the effects on the economy arise directly from the project, or are these effects derived from direct effects? The distinction between *direct* and *indirect* effects is used to show the *causal* effect of a project. In respect of indirect effects, the distinction is often made between forward and backward effects. A forward effect causes a change for the customer; a backward effect leads to a change for a supplier.
- 5 *Which parties* are affected by the benefits and disbenefits of the effects: owners or operators of a project, customers of the project services or third parties? This criterion is important when considering, for example, a government contribution to the development, any public-private partnerships and compensation of non-priced external effects.

Based on these criteria, a diagram (see Figure 3.1) has been drawn up to classify the most important types of economic effects of a project. Horizontally, the cells are arranged on the basis of criteria 1 (domestic/foreign), 2 (priced/non-priced) and 3 (redistribution/efficiency). Vertically, criteria 4 (direct/indirect) and 5 (operators/users/third parties) were used.

Figure 3.1
Typology of project effects^a

welfare estimate causal estimate		The Netherlands		foreign countries
		priced effects	non-priced effects	
		redistribution	efficiency	efficiency
direct effects	operators	<i>operating profits</i>	<i>uninsured risks</i>	<i>journey time</i>
	users	<i>cheaper transport</i>	<i>journey time profits, safety</i>	<i>profits</i>
	third parties		<i>air pollution, noise</i>	<i>air pollution</i>
indirect effects		<i>effects on other modes</i>	<i>congestion</i>	<i>congestion</i>
		<i>strategic effects</i>	<i>regional inequality</i>	<i>exchange rate effect</i>

^a In the cells of the diagram, examples are given in italics.

Many of these effects are explained in the text box 'Examples of project effects: construction of a high-speed rail link'. No attempt was made to be exhaustive, although attempts were made to explain certain concepts.

Examples of project effects: construction of a high-speed rail link

This example relates to the introduction of a high-speed rail link. In this respect, No attempt was made to be exhaustive; not all effects will be discussed. The intention of the example is to explain the concepts behind the division of project effects in Figure 3.1.

operating profits

If the return from the sale of project services (ticket sales, development of stations) exceed the costs of development (personnel, trains etc.), an operator makes a profit. The operator compares this profit to a part of the investment amount. Only if the operator still makes a profit after deducting capital costs – surplus profit to economists – is it possible to talk of a welfare profit in social terms, which in this case, is also called (producer) surplus.

number of journeys and journey time profits

The construction of a high-speed rail link leads to additional sales of project services. For example, the number of train journeys increases. The additional sales are a direct consequence of increased efficiency in production and consumption times and are therefore a welfare effect. In addition, the high-speed train journeys will be faster than journeys with ordinary trains. The benefit of the high-speed rail link consists therefore (mainly) of journey time profits. While journeys are a priced good, a market price for the time (of the journeys) is not immediately apparent. It is therefore a non-priced welfare effect.

safety and uninsured risks

Let us assume that a high-speed rail link is riskier than an ordinary railroad. The risk of an accident and the consequences thereof are not insured separately and are insured only to a limited extent. A market price for this risk is therefore not known. Not only do the users carry an extra risk, but -- if the users are able to recover the consequences financially from the operator -- the shareholders too run an extra risk. A cost-benefit analysis should take the extra risk in respect of accidents into consideration and should, where possible, give it a value.

air and noise pollution

Directly involved parties also include those people living in the area who experience nuisance from the railway (think of noise pollution and also the consequences for accessibility and the visual damage to the environment). In addition, the project will also have a more general impact on the environment (consider, for example, changes in energy consumption and CO₂ emissions). These are all examples of welfare effects.

effects on other modes of transport and congestion

As a result of the high-speed rail link, a number of travellers will choose to take the train and to leave their cars at home. The shift between modes has a (positive) social value if the high-speed rail link reduces tailbacks on motorways or if cars cause more damage to the environment than the train. Only a part of all the consequences of car use is therefore a welfare effect. In respect of the remaining consequences, a change in efficiency is lacking.

strategic effects and regional inequalities

The high-speed rail link will have an influence on where companies decide to locate their premises and, in this respect, it can have strategic effects. It is conceivable that a (further) clustering of activities will take place around the high-speed rail link station. This could have a positive social value if companies benefit from each other's proximity, for example, by lower communication costs, or if proximity leads to more mutual competition. Although it is difficult to determine the extent of the welfare profit, this should nevertheless be included in a CBA.

The high-speed rail link could also have consequences for the distribution of production and income between countries and regions. It could, for example, increase productivity in a relatively underdeveloped region at the cost of another region which would, in turn, reduce inequality.

Although this redistributive impact will not be valued in a cost-benefit analysis, it will be determined.

3.2 Valuation of project effects

According to a CBA, a project is socially profitable if the beneficiaries can, in principle, compensate the non-beneficiaries financially.

This compensation does not however actually have to take place.

The annual benefits and disbenefits are expressed in a CBA in monetary terms and are added up over time to form the net present value. The scope of a CBA is not unlimited; some project effects either cannot be expressed in monetary terms or it is very difficult to do so.

An infrastructural project is normally proposed in order to achieve specific aims. In order to assess whether a project fulfils the aims, it is crucially important to draw up a meticulous inventory and description of the project effects. Considered from a social-economic point of view, an infrastructural project should only be carried out if all returns counterbalance all investment costs and the broadly defined social welfare increases as a result of the implementation of the project.

One of the reasons for building a high-speed rail link is, for example, to present an alternative for medium range travel which will eventually absorb some of the growth in air and motor traffic over this distance. The intended effects are time-saving for motorists, cost-saving for air travellers and a reduction in environmental damage. Appraising such a project according to a list of operational aims is not a simple matter because the aims could be mutually contradictory. Furthermore, the aims should not be achieved at the cost of everything else. A compromise between the (partial) realisation of the aims and the costs associated with this is often desirable.

A CBA offers a framework within which such an appraisal can be made. A great advantage of appraisal method is that it allows a comparison to be made between the various benefits and disbenefits of the project (cost savings, time savings, environmental effects and investment costs) by reducing them, wherever possible, to the same denominator, namely money.

The idea behind this is simple. The economic agents (households and companies) which are directly or indirectly affected by a project can reveal their preferences clearly in terms of money or income. They are willing to pay an amount of money if a project is carried out because they will benefit from the project (willingness to pay)³. A comparable situation arises in respect of non-beneficiaries (willingness to accept). This implies an individual trade-off between the benefits or disbenefits of a project and a sum of money.

If the sum total of such amounts of money – the positive of gainers and the negative of losers – is positive, then the customary requirement has been met in order to appraise the project as being socially profitable. This requirement entails that the gainers must be able to compensate the losers – in monetary terms – fully⁴. The compensation does not actually have to take place.

One profitability criterion?

Practice is more complicated than theory. The text box 'Valuation of effects in practice' explains further how impacts can be expressed in monetary terms. Individual effects are mostly determined and valued per year. All individual effects expressed in monetary terms must therefore first of all be balanced per year. This results in the cash flow over the relevant time horizon⁵. The cash flow is, in principle, initially negative on account of the investment costs. At some time after the project had been implemented, the returns should exceed the expenses so that a positive cash flow can be achieved. Subsequently, the cash flow must be discounted and added up. This gives the net present value.

Notes

³ Or the opposite: they are, in exchange for an amount of money, willing to accept that the project will not be carried out and that they will not enjoy the benefits (willingness to accept).

⁴ In economic literature, this criterion is known as the Hicks-Kaldor criterion and is often indicated as a 'potential Pareto improvement' (see the text box below).

⁵ The cash flow only includes actual income and expenditure. Write-offs therefore are not included.

The risk related to a project often complicates matters. Officially, the risk-free actual discount rate is 4% per annum (Ministry of Finance, 1995). A current effect therefore is weighted approximately three times more than an effect 25 years later. The difference is not so great that the impact can be disregarded after 25 years, in particular not if, at a continued economic growth, the future impact is significantly greater than the current impact. The uncertainty in respect of the effects after 25 years however is great. This problem will be examined in section 5.2. For the time being however the conclusions drawn from chapter 5 will be sufficient. According to these, a cost-benefit analysis must identify the risks and uncertainties and, wherever possible, value them. Furthermore, there are measures other than the net present value which can be used when appraising the risks and uncertainties related to a project.

One criterion?

In chapter 2, we mentioned that not all project effects can, in practice, be expressed in monetary terms. The criterion that gainers should be able to compensate losers, for example, does not take *distributive issues* into consideration. People living in the area often experience nuisance from the project while they do not actually benefit, or benefit only slightly, from the project. An infrastructural project could also specifically aim at redistributing the welfare, for example, to improve the economic position of underdeveloped regions. A cost-benefit analysis obviously has to take such an aim into consideration and must stipulate the possible consequences for the welfare distribution. It is however seldom possible, if at all, to express such an impact in monetary terms⁶.

Another objection to the criterion of financial compensation relates to the *individual valuation of non-tradable goods and services*, such as noise or an exceptional landscape. This is not always easy to estimate. The customary method is to derive the valuation from the behaviour of the users. Market transactions say a lot about the willingness to pay or accept. This method does not work very well, or does not work at all, if markets function badly or if markets do not exist. An amount is then not naturally derived from behaviour.

Inadequate or non-existing markets impede the valuation of environmental effects. The issue is how, for example, to express extra nuisance from noise or increased air pollution in monetary terms. This issue is also raised when valuing leisure time, risks for tax payers, cluster benefits etc. The problems are even greater when valuing a unique area of natural beauty. There are also other things which cannot be expressed in monetary terms, or which are monetised with great difficulty. Legal security is an example of these.

The comments relating to the criterion of financial compensation make it clear that the possibilities of quantifying and monetising in a cost-benefit analysis are not limitless. Limitation refer in particular to distributive issues and the valuation of some non-tradable goods (environment, nature, risks). These impacts are indicated (quantitatively as far as possible) in a social cost-benefit analysis, but are not expressed in monetary terms. The appraisal of a project therefore often has to be made according to several different criteria.

Notes

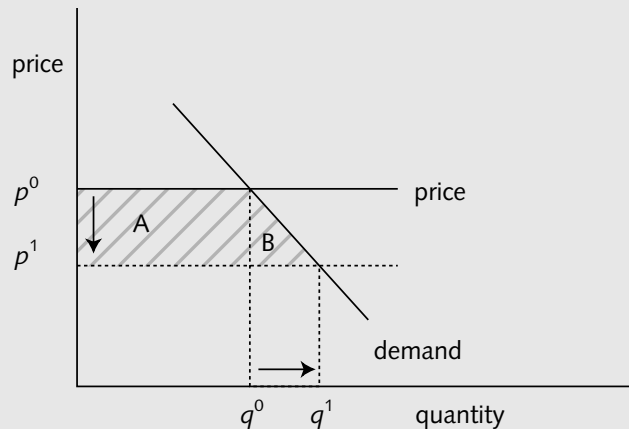
⁶ A cost-benefit analysis can only express the redistribution in monetary terms if the principle of individual valuation is abandoned and if different weights are allocated to the benefits or disbenefits for various parties.

Valuation of effects in practice: consumer surplus

One of the welfare theory criteria for social profitability is that a project must signify a Pareto improvement, i.e. a situation where some people are better off as a result of the project and no-one is worse off. This is generally regarded as too demanding a criterion which few or no projects can fulfil. The Hicks-Kaldor criterion says that, by compensating for the disbenefits, a situation could arise in which a project benefits some people while at the same time not disbenefiting anybody. This criterion has more scope than the Pareto improvement; it could be seen as a potential Pareto improvement.

Establishing whether or not a project signifies a potential Pareto improvement is, in principle, a scientific exercise. In practice, it is not always easy to calculate a potential Pareto improvement. In order to establish whether a project signifies such an improvement, the concepts 'willingness to pay' and 'consumer surplus' have to be considered. It is easy to calculate the change in consumer surplus for products for which a price exists. This is represented by the shaded area in Figure 3.2.

Figure 3.2
Change in the consumer surplus



The demand curve in the figure indicates what consumers are willing to pay for various quantities. If, as a result of the project, the price changes from p^0 to p^1 and the demand increases from q^0 to q^1 , then consumer surplus increases. Consumers who have already agreed to pay price p^0 (namely q^0), are willing to pay more than what is necessary after the implementation of the project. For them, this implies an expense or cost saving represented by the rectangle A. The combination of the drop in price and the rise in consumption is part of the total change in welfare (the triangle B). A formula for the shaded area is:

$$(p^0 - p^1)q^0 + \frac{1}{2} (p^0 - p^1)(q^1 - q^0) = \frac{1}{2} (p^0 - p^1)(q^1 + q^0).$$

The second expression for the area is often called 'the rule of half'. This formula is often used in practice, for example, in transport research. The expression indicates the change in the consumer surplus. The sum of all the surpluses gives an approximate indication of whether a potential Pareto improvement has taken place and therefore of whether the project is socially profitable.

relation between consumer surplus and compensating variation

Consumer surplus is an estimate of two other, much used welfare measures: compensating variation and equivalent variation. Both cases relate to the determination of income changes which are offset against the negative and positive effects of a project. The change in the consumer surplus is approximately equal to both income measures, provided that the changes in the prices are small. To compute the welfare change with priced products, the change in the consumer surplus is often used because it can be very easily measured.

relation between consumer surplus and national income

When carrying out a cost-benefit analysis for a large infrastructural project, it is often recommended to carry out a national-economic analysis using a model which encompasses the entire economy. The welfare changes which can be measured in such models are mostly confined to variables which are found in the national accounts. The national accounts could be interpreted as a consolidated profit and loss account for the Netherlands. Non-priced goods are not included in this account. The models could however measure the differences between incomes, such as the change in the actual national income and the volume change of private consumption. The change in the net present value of consumption is a good measure for the priced section of the welfare effects.

4 Structure of the cost-benefit analyses

In the previous chapter, an overview of the various types of project effects was given and the (individual) valuation of the effects was also discussed. That partially answered the question 'What is a cost-benefit analysis?'. This chapter describes the structure of the social cost-benefit analysis. Section 4.1 looks at the core of the CBA: the integration of the results. Section 4.2 discusses the role played by sectional research projects that underlie the integrated analysis.

4.1 The core of the research

A business profitability analysis gives an indication of the total financial effects of the project on the operator(s). A partial cost-benefit analysis indicates the direct welfare effects of the project on the Netherlands, including non-priced effects. A comprehensive cost-benefit analysis adds welfare effects resulting from the impact on the Dutch economy as a whole to this analysis.

Business profitability analysis

A business profitability analysis is sufficient if an infrastructural project is a normal investment, without any special characteristics. This type of analysis answers the question of whether the project, taking its entire life span into consideration, will result in adequate returns to justify the costs incurred by the operator. In other words: is it not possible for the operator to use the money to be invested for another, more profitable project?

In order to carry out a business profitability analysis, information is required on investment and development costs and on the number of users of an investment project at various combinations of prices and other factors which determine demand (for example convenience, frequency etc.). This information is also essential when carrying out a social cost-benefit analysis. In this respect, a business analysis forms part of the social analysis. Furthermore, a business analysis is essential when distributing the costs and benefits between the private and public sectors in the case of a public-private partnership.

Social cost-benefit analysis

In addition to appraising the project from a company's point of view (the project contractor), it is also possible to appraise the project from a social point of view. This means not only looking at the profit for the operator, but also considering the profit for the national society as a whole. This profit can be defined as the sum of the benefits and disbenefits for all parties arising from the project. Benefits for one party can thereby be set off against the disbenefits for another party.

Figure 4.1
The research core, drawn up according to project effects

Business profitability analysis

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators	operating profits				
	users					
	third parties					
indirect effects						

Partial cost-benefit analysis

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators					
	users					
	third parties					
indirect effects						

Comprehensive cost-benefit analysis

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators					
	users					
	third parties					
indirect effects						

The difference between a business and a social profitability analysis is shown graphically in Figure 4.1. This graphic depiction shows clearly that a business analysis is more restricted than a social analysis, in particular because the former makes no distinction between the redistributive impact and the efficiency effect. The diagrams also show the difference between a partial and comprehensive cost-benefit analysis. This distinction will be explained in more detail below.

Partial or comprehensive cost-benefit analysis?

The national economy is a complex system of actors who are connected with one another by numerous goods and services markets. Policy intervention in one market can, via changed levels of scarcity and price adjustments arising from these, lead to a series of adjustments in other markets. The impact of an infrastructural project can, in a certain sense, be compared to a stone which is thrown into a pond: the direct effect of the stone's impact leads to the indirect effect of waves which eventually lead to a new situation of equilibrium with a (slightly) higher water level.

When carrying out a CBA, the question has to be asked whether the assessment of the total welfare effect on the national economy requires that the impact of the project on all derived markets should be taken into consideration. Is the meticulous measurement of the direct economic effects – as in the example of the impact of the stone on the eventual water level of the pond – not sufficient? This method is indeed very often applied in practice. In cases where the analysis is limited to the direct effects of the project, it is said that a *partial CBA* is carried out. A *comprehensive CBA* however also endeavours to analyse comprehensively the indirect impact on other sectors⁷.

A partial analysis does not imply an underestimation of the total national welfare effect of a project by definition. A comprehensive analysis however does look at the further effects within the economy, but these effects lead partially to a *redistribution of welfare* among population groups, sectors or regions and not necessarily to a *net welfare increase*. A good example are indirect effects on employment in a small labour market. A project can directly and indirectly – in related sectors – lead to the creation of new jobs. However, in situations of labour shortage, employees are scarce and there could be no more jobs than employees. In other words, activities are crowded out. This effect has to be adjusted for which may mean that the national welfare increase with a comprehensive CBA would hardly differ from the increase with the partial analysis.

In chapter 9, it will be argued that priced indirect effects together with market distortions can imply a change in the total welfare. The indirect effects must then be included explicitly and a fully-specified CBA is therefore advisable. In order to trace such arguments, specific market analyses are required.

It is also possible that a redistribution between the Netherlands and other countries, as a result of an infrastructural project, may have a positive influence on the *national* welfare. International locational effects are often the explicit aim of the project (strategic effects). In this case too, a comprehensive analysis is advisable.

Notes

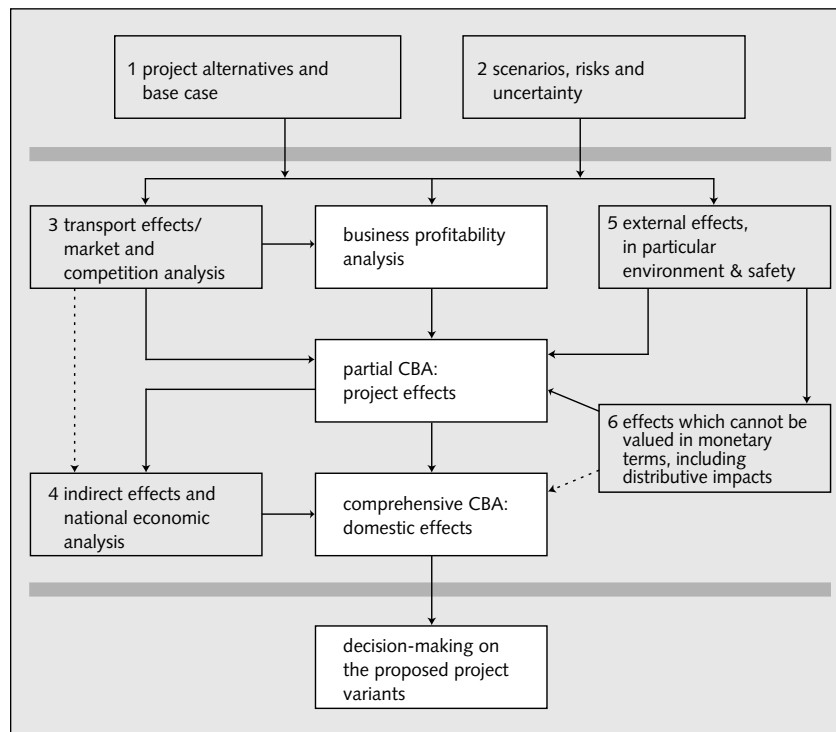
⁷⁾ The difference between 'partial' and 'comprehensive' lies here in indirect effects. This definition differs from that of the Ministry of Finance (1986b). According to the latter, if research is carried out on one aspect (environment or safety or costs) it is 'partial', while 'comprehensive' refers to research into more than one aspect.

4.2 Sectional research projects

Cost-benefit analyses are based on research into project alternatives, environmental scenarios, transport effects, external effects indirect effects and distributive effects. The combination of these studies provides the overall picture of the comprehensive social cost-benefit analysis.

Cost-benefit analyses are central to an economic project evaluation. They are however not unrelated to other studies. On the contrary, CBA's rely heavily on information derived from other, less broadly targeted studies. Figure 4.2 shows the relationship between profitability analyses (see previous paragraph) and sectional studies.

Figure 4.2
Structure of a cost-benefit analysis



The various forms of profitability analyses form the centre of Figure 4.2: the business profitability analysis, the partial cost-benefit analysis and the comprehensive cost-benefit analysis. They lead to decisions being made on whether or not a project (variant) will be carried out. In Figure 4.2, six types of 'supporting' studies are distinguished:

- 1 First of all, it is necessary to describe the *base case and the project alternatives* very meticulously in order to highlight the project impacts.
- 2 The nature and significance of the effects also depend on external developments. *Scenarios* describe these developments systematically and conveniently. They also form the basis from which an analysis of the risks and uncertainties related to the factors which determine the success of a project, is carried out.

-
- 3 The research continues with a *market and competition analysis*. From this analysis, factors emerge which provide important information on the demand for project services. Aspects to consider are the relevant size of the market, market shares and the shifts which can be expected in the market as a result of changes in the price and quality of the project services, the plans of competitors etc. Figure 4.3 portrays a market and competition analysis according to project effects. The top part shows that the perspective of this analysis is very broad.⁸
 - 4 Large infrastructural projects cannot really be appraised without looking at their impact on the rest of the economy. There are a number of ways to determine *indirect effects*. Examples are surveys with companies which may be involved in the project or looking at the effects of comparable projects elsewhere. Another possibility is applying a quantitative model which describes the operation of the entire economy. We call the application of such a model – for want of a better description – a *national-economic analysis* of the project. The middle section of Figure 4.3 shows that only the priced section of the welfare effects is included in such an analysis.
 - 5 Research into *non-priced effects* (for example the environment, nuisance and safety) forms an important part of the cost-benefit analysis. There is even a legal obligation to carry out an environmental impact assessment MER. The bottom section of Figure 4.3 shows that this report involves the effects on third parties.
 - 6 Not all effects of a project can be expressed in monetary terms. Furthermore, some effects cannot be balanced without experiencing difficulties, because information on the separate effects could be important when making decisions on the project. For this reason, the outcome of a cost-benefit analysis will not be one figure, but rather a summary of the most important research results. All effects relevant to the decision-making, such as *distributive issues*, will be reported even if these are sometimes in the form of PM-items.

In the following chapter, we will look at the economic content of the cost-benefit analysis and the sectional studies.

Notes

- ⁸⁾ The perspective becomes even wider if the effects on other sectors (indirect effects) are also taken into consideration in the analysis. The analysis then becomes so wide that it can be called an Inventory of Economic Effects, abbreviated as IEE. This term is used very often, but the content is not always clear. It is important that such an inventory does not make a distinction between the redistribution of and a change in the total welfare and that it furthermore does not make a clear distinction between the benefits and detriments for the Netherlands and those for other countries.

Figure 4.3
Sectional studies, drawn up according to project effects

Market and competition analysis

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators					
	users					
	third parties					
indirect effects		<i>other modes</i>		<i>congestion</i>		<i>congestion</i>

National-economic analysis

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators					
	users					
	third parties					
indirect effects						

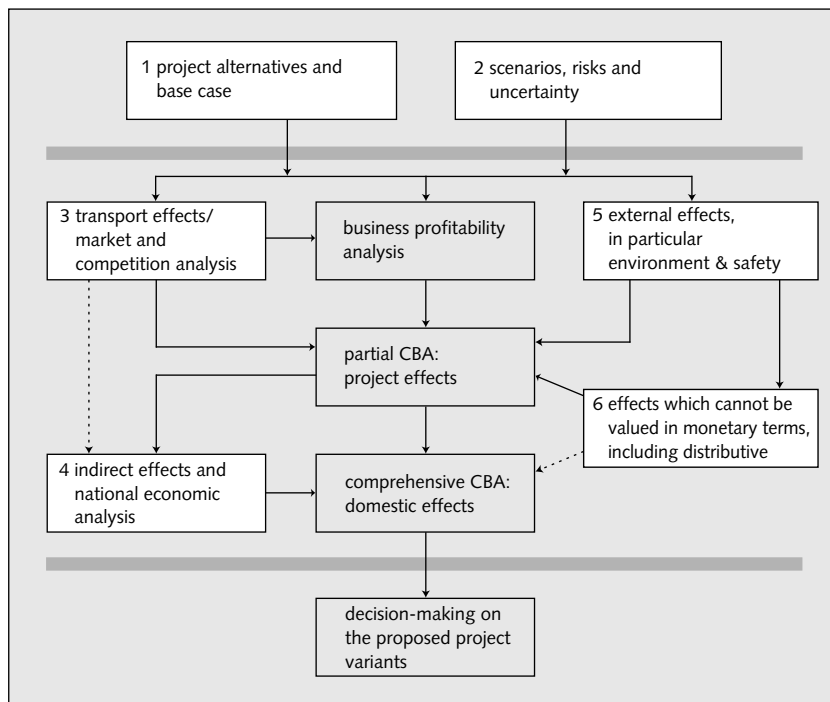
Environmental impact assessment, MER

welfare estimate causal estimate		The Netherlands				foreign countries
		priced effects		non-priced effects		
		redistribution	efficiency	efficiency	redistribution	
direct effects	operators					
	users					
	third parties					
indirect effects						

5 Research Aspects

This chapter provides an overall picture of those aspects relating to content which are generally referred to when carrying out a cost-benefit analysis. The chapter is divided into sections based on the numbers of the boxes in Figure 5.1 and corresponds to the chapter division of Section II of this study. Section II looks more closely and extensively at the aspects relating to content than this chapter. Aspects will be examined in the following order: the base case, scenarios and uncertainty, direct project effects (in particular transport prognoses), indirect effects (including employment), external effects (environment, nuisance, safety) and distributive issues (including regional effects).

Figure 5.1
Structure of chapter 5



5.1 The base case

The base case is the best alternative for the project. This therefore does not mean 'doing nothing' and, per definition, also does not constitute 'current policy'. A risk-free investment at 4% actual interest is often used as the best alternative way of spending investment resources. The best alternative policy implementation can, for example, consist of utilisation measures or of smaller investments.

The significance of the base case

The implementation of a project usually leads to a development in society which does not occur without the implementation of the project. Social decision-making means choosing from one of these development paths: one of the project alternatives or the base case.

Project effects can be defined as the differences between a project alternative and the base case. When measuring these effects, the base case is therefore just as important as a project alternative.

We have to make the best of a situation, also without the project. The base case is therefore a combination of the best, alternative application of the available investment resources and the best possible other solution for the problem which we want to solve with the project. The base case is therefore usually something other than 'doing nothing' and also does not constitute 'current policy'. There is a danger of serious overestimation of the profitability if the base case is not developed extensively enough.

It can be difficult to describe the base case for large projects. Without the project, some bottlenecks will probably develop, so that the developments in the base case, will probably not be an extrapolation of historical trends. The people preparing the project will probably also deem the base case to be not interesting enough to pay a lot of attention to it; they may even find – from a technical point of view – that spending much time on it is illogical: *'The task is to find a solution to a problem by designing the best project. Why should we therefore spend a lot of time and energy on a situation which we aim to avoid?'* If they think along these lines, they take as a certainty that the problem, for which the project can offer a solution, must be solved whatever happens. It seems as if it is already clear in advance that the social benefits will be greater than the social costs. The project preparation must then be reduced to setting out priorities based on a cost-effectiveness analysis (CEA). One form of CEA is examining only the implementation variants of, on the whole, the same project with therefore also almost the same social benefits. It is then unnecessary to quantify the benefits.

Alternative application of available investment resources

One aspect of the base case is the alternative return of the investment resources available for the project. An obvious alternative is one or more other investments. In theory, the best must be chosen from all the alternative investments. In practice, it is normal to choose a standard return in the form of a discount rate. From this point of view, the cabinet, in respect of government investments, prescribed an actual discount rate of 4% as the norm for the return of an alternative investment (Ministry of Finance, 1995). The *net present value* of a project is positive if the project achieves an actual return of, on average, more than 4% per annum.

This prescribed discount rate is confined to risk-free investments. Risk and uncertainty in respect of a project must however be explicitly and project-specifically taken into consideration. We will return to this in the next section.

Alternative policy solutions

We have to make the best of a situation, also without the project. Sometimes the implementation of another, smaller project is the best action; sometimes a policy other than a physical solution of the bottleneck provides solace. For example, implementing a noise nuisance tax for aeroplanes will help to reduce noise pollution for people who live around Amsterdam Airport. Furthermore, bottlenecks will, in the base case, displace a part of the potential demand to other places or points in time. A type of base case which is often found with large projects, is the implementation of smaller projects which perform similarly as the project, at least partially or temporarily.

The base case can therefore include other investment projects. An example is the upgrading of a conventional railway line without actually constructing a high-speed rail link.

5.2 Scenarios, risks and uncertainty

The benefits of infrastructural projects are often uncertain because they lie in the far future. This uncertainty has to be identified in a project analysis, for example, by carrying out scenario-analyses. These risks should, in principle, be expressed explicitly in monetary terms. Since this is very difficult in practice, it is possible to work with a risk premium on the discount rate, with payback periods or with a limited time horizon. The internal rate of return indicates at which risk premium the project is still profitable.

Economic research into infrastructural projects should not only be aimed at profitability calculations, but also at risk analysis. This is necessary because an economic analysis has to take uncertainty into account in virtually all areas. The interval between drawing up a preparatory research study and actually implementing the project alone often spans 10 to 15 years for large projects. The benefits relate to even more distant periods.

Scenarios and variants

Scenarios and variant analyses for more specific issues may assist in uncovering project-critical factors and the uncertainties connected with these. Scenarios are a convenient method of ordering large amounts of information relevant to the project in a coherent manner. It is often however also evident that various implementations within the context of a scenario are possible. If this is the case, a variant analysis can be carried out.

It is not sensible to choose a 'desired' scenario. The policy maker can, after all, only influence the (economic) environment to a limited extent, if this is at all possible. In practice, there are unfortunately examples where only one favourable scenario is considered. The decision-maker then does not receive any information on the robustness of the profitability in case of other possible developments.

Quantifying risks

Scenarios indicate to what extent the return of a project depends on specific and general external factors. They can help to distinguish robust projects or project variants which will achieve a positive return not only in good, but also in bad circumstances. Scenarios give a qualitative picture of the risks, but do not provide a quantitative measure for the risks.

Allocating a monetary value to risks would fit in very well with the methodology of a cost-benefit analysis. In general, the value of projects will decrease as the uncertainty of the returns increases. An individual can allocate an equal valuation to a high, but uncertain return and a low, but certain return. The difference between the high and low return is a premium which the individual is prepared to pay in order to buy off the uncertainty related to a project. This insurance premium can be used as the basis for the valuation of risks and uncertainty.

Risk-aversion may affect the discount rate. The prescribed real discount rate of 4% relates specifically to risk-free projects. Risk may be portrayed in the form of a higher, project-specific mark-up on the discount rate. In accordance with the idea that the risk increases as the future is further away, the weight of benefits will, as a result of a higher discounting, decrease (exponentially) in future.

From this point of view, it is perhaps not surprising that various countries and international organisations prescribe discount rates which are significantly higher than the 4% applicable in the Netherlands⁹.

Quantifying project-specific risks is quite a task. It not only requires a picture of possible relevant developments, such as shown in scenarios, but also of the risks involved in the developments. It is therefore not surprising that quantifying specific risks, even in the business world, is (almost) never carried out. Rules of thumb are often used when appraising investment projects. An example of a simple rule of thumb is a fixed risk premium on the (risk-free) discount rate.

Time horizon

Given the high risk premiums customary in the business world, the choice of the time horizon is not very important: what lies far in the future hardly counts. Furthermore, the life span of business projects is generally shorter than those of infrastructural projects¹⁰. However, the combination of a low (risk-free) discount rate and a long life span plays a role in the economic appraisal of infrastructural projects.

It is often difficult to conceive how the developments with or without a project will proceed in the long term. That is the reason why certain devices are sometimes used in profitability calculations, such as repeating the benefits in the last year calculated in the analysis for the following decades. Another device is a fixed time horizon which is shorter than the life span. This has, as far as infrastructural projects are concerned, a considerable disadvantage: the profitability can become sensitive to the time horizon. In particular when the growth of the benefits have remained on the level of the discount rate for a long time, or even if this exceeds this level, it seems as if each infrastructural project can be made profitable by merely taking a sufficient number of years into consideration¹¹. The practical significance of the time horizon depends strongly on the discount rate in combination with the growth of the benefits which a project generates.

The problem of a long life span is less significant if the project appraisal takes place according to pay-back periods. This measure is often used in respect of business investments. The pay-back period is the period from the moment when the project is ready to the moment when the totalled benefits of the project exceed the investment expenditure. This can serve as a supplementary criterion for prioritising projects¹². Shorter pay-back periods limit the degree of uncertainty. Shorter periods also say a lot about the robustness of the profitability of the project if the return, for whatever reason, would fall short afterwards. For this reason, when having to choose between two projects with equal net cash values, the project with the shortest recover period is preferable.

Notes

⁹ See the OEEI report: Economic appraisal of large infrastructural projects; Learning from international experience (CE,2000).

¹⁰ It is generally assumed in the business world that, at the end of the project, the developments in the base case and the project alternative will coincide. Because of this assumption, the profitability calculation does not to exceed the life span of the project itself.

¹¹ In respect to this view, see: Commissie Betuweroute (Co. Hermans, 1995), par. 3.7.

¹² See for example CPB (1995), figure 1.

As a general conclusion, it is worth trying to map the project-specific risks systematically and valuing them. Allocating an exact monetary value to project-specific risks would probably appear to be impossible in respect of complex projects. This leads to the more specific conclusion that the pitfall of a risk-free discount rate in combination with a long time horizon must be avoided. When appraising a project, it is only possible to choose a long time horizon if the risks and the (social) costs of the risks are explicitly considered as well.

An alternative method could consist of a combination of indicators for project-specific risks and the use of other criteria. The following – in order of importance – are examples of such criteria: using a general fixed risk premium on the discount rate, taking into consideration (not too long) pay-back periods and shortening the time horizon. Calculating the internal rate of return can also be convenient, because this makes clear at which risk premium a project is still profitable.

Phasing and flexibility

Apart from the fact that risk must be a central point in the research set-up and the research results, it also has consequences for the character and the content of the decision. This refers to the timing of construction and to flexibility and phasing. These are answers to two crucial questions in respect of constructing infrastructural projects: 'when?' and 'how much?'¹³.

Postponing a project could be advisable if it results in a better utilisation of capacity. An important cost item with almost all projects is underutilisation at the beginning of the life cycle: the temporary surplus capacity takes up investment resources which could have been better utilised (namely an actual return of at least 4% per annum).

Planning a project in phases can have two advantages. Firstly, partial postponement of investments saves interest costs. Secondly, it gives the researchers more time to get clarity on uncertainties. The significance of phasing is even greater if it becomes evident that the design promotes flexibility for adjustment in later phases.

The expected, average size of costs and benefits is not central in a risk analysis. Rather the variance and diverging of possible, future outcomes is the core. Proposing a project or a series of separate projects can be compared to a (call) option: the possibility exists to carry out the (separate) project, but there is, as yet, no obligation to do so. A separate project which has been carried out, can often not, or only partially, be reversed so that, when exercising the option, the option disappears through carrying out the proposal. The value of the option is vested in the possibility to invest if the circumstances are favourable and not to invest when the circumstances are unfavourable. This possibility prevents expensive setbacks, for example protracted over-capacity or – seen retrospectively – incorrectly set up infrastructure (viaducts in the fields).

Notes

¹³ Risk analysis can also relate to the question 'where?', but there are no generally accepted methods for answering this question.

After late construction, the situation in the alternative of early construction does not always follow immediately. Depending on the project, various reactions to a late construction are possible: from a fast, almost abrupt changeover to a growth path with an early construction to growth percentages which never achieve the values in the growth path with early construction. In cases where the success of the project depends on who makes the first offer (*first-mover advantage*), 'constructing later' practically means the same as 'constructing never'.

5.3 Direct effects and transport prognoses

The benefits of an infrastructural project depend heavily on the effects of the project on transport flows. These effects are determined by looking at the individual behaviour of users and operators. A behaviour model is therefore necessary to forecast the project effects. The transport prognosis does only not form the basis for the calculation of the direct effects; the indirect effects of the project are closely connected to the direct transport effects.

The financial valuation of the benefits of a project depends heavily on the physical effects, such as the number of travellers. When setting up a research project, these aspects are often separated. In order to quantify the effects and to express them in monetary terms, various successive studies are allocated to departments which specialise in sectional areas: transport prognosis for the various alternatives, business calculations of the operator, CBA's with journey time valuation, indirect effects etc.

Many physical effects are however the result of the valuation which the users of the infrastructure allocate to the features of the project, such as a faster journey time with a high-speed raillink. The changes in the number of travellers are therefore a *consequence* of the valuation. This assessment leads to the more general conclusion that the transport prognosis and the drawing up of the benefit-side of a CBA are, or should be, to a large extent the same activity.

Behavioral models of transport, supply as well as demand

The connection between prognoses and individual behaviour has important consequences for the design and execution of the various studies. The application of simple, mechanical rules is not adequate when it comes to large projects. Behavioral models must be used to highlight the reactions of transport users.

When carrying out a transport prognosis, the consequences of the project for travel expenses, journey time and frequency play a role. These variables must be included in the causal relationships which describe the behaviour of the users. These variables dependent partially on decisions of the operator. In turn, the operator, when assessing benefits and costs in order to determine prices and quality, depends on the changes in transport volume caused by this decisions. This is a simultaneous process which researchers have to predict.

An integrated description of the transport flows according to the behavioral model furthermore offers the opportunity to carry out a systematic variant analysis. This can relate to the uncertainty over the extent of behaviour parameters or various environmental factors. The competition analysis is a very important part. Competitors never rest on their laurels. On the contrary, the construction of the project challenges competitors to improve efficiency even more.

After the construction of the Channel tunnel, for example, the boats on the Hook of Holland-Harwich route were replaced by a catamaran which is twice as fast. This also contributed to the unofficial bankruptcy of the Channel company. It is important to draw up a transport model very carefully.

Valuation of transport changes: two pitfalls

Assume a report has been drawn up on the expected transport flows and the corresponding prices, journey times and frequencies. What can go wrong?

- Firstly, it is not possible to derive figures for user benefits simply by adding a time valuation and/or the costs of other modes of transport. The (supposed) assessment of costs and benefits by the travellers had, after all, already been made when the prognosis of the transport flows was drawn up. The valuation of the journey time differences was therefore already an element of the behavioral model used to carry out the transport prognosis. The monetary value for changes in the journey time or frequency can therefore be recalculated from the model by comparing the effects of these variables on the transport volume with the effects of a price change.
- Secondly, the journey time benefits for the users and the business results of the operator cannot merely be added together. The danger of double-counting is not an imaginary one. In most cases, the quality of the project services will be different to the quality of those in the existing infrastructure. It is in the best interest of the operator to attract the benefits of the users as much as possible to himself by calculating a higher price than that of existing services of poorer quality. The operator will obviously not succeed entirely, because without benefits the users will not buy the project services. This is therefore the start of the redistribution of the users' benefits to the operator. The valuation of the journey time benefits must therefore be reduced by the price difference with the existing infrastructure which goes to the developer. For users therefore changes in the so-called generalised travel expenses are important. All costs and efforts involved in making the journey are taken into account in these costs. The new infrastructure can also lead to higher costs for the operator. Think for example of the costs of a high-speed rail link compared to those of a conventional railway. Only if the operator, after having deducted all (capital) costs, makes above-average profits – surplus profits in economic terms – does this imply a welfare gain, in this case a producer surplus. Only the surplus profit must be added to the benefits for the users in order to determine the welfare gains for both groups together.

Information for a partial cost-benefit analysis

When a cost-benefit analysis is carried out in the transport sector, only the changes in the transport volume, the related price changes and the changes in other features which have been converted to prices, such as journey and waiting times or frequencies, are required¹⁴. It does not matter which transport alternative is chosen by the potential traveller in the reference scenario. All relevant information on the transport alternatives has already been processed in the assessments of travellers – for example their price sensitivity – as these emerged from the transport prognosis. In short, a large part of carrying out the partial cost-benefit analysis (the operating part and the surpluses) is essentially the same activity as implementing the transport prognosis.

It has to be emphasised once again that the entire direct benefit achieved by the new transport, i.e. the transport which does not take place in the base case, must be included in a partial cost-benefit analysis. This prevents a part of the direct cost benefits or international competition benefits of the construction of a project from being omitted. It is only if extra efficiency profit is expected as a result of the restructuring of production processes, for example by exploiting economies of scale, that there would be cause for separate research into the indirect welfare effects and that the results of a partial and a comprehensive cost-benefit analysis will not correspond.

Information for a comprehensive CBA

More information is often needed for a comprehensive analysis which also takes into consideration indirect effects. A mere distinction between the travellers who stick to the same mode of transport and the travellers who 'will do something else' is not sufficient. We must specify 'do something else' because this could involve different indirect effects.

If the transport prognoses are carried out extensively, the different alternative possibilities are already distinguished in these. A rough distinction can be made between persons who will find an alternative mode of travel and those persons who will not travel without the project. For the first group, the resulting cost increase without the project is evidently so limited that the journey will continue. Further adjustments in their behaviour related to these changes are therefore quite restricted and consequently the same will most likely also apply to the impacts on the rest of the economy. For the second group, the alternative is evidently so unappealing that the journey will no longer continue without the project. Significant indirect effects are not impossible in respect of this group.

The consequences could be restricted for a group of the new travellers. Business travellers could often achieve the same results with an increase in telephone and fax services and tourists could choose another holiday. However, to some extent the new business travellers correspond to new productive activities which are the reasons for the journey. In a macro or industry model, displacement of activities (to the Netherlands) are observed as a result of the reaction to the drop in costs in the industry sectors that, for example, use a high-speed rail link. Their competitive position improves as a result of the high-speed rail link resulting in an increase in their sales. Section 5.4 looks more closely at the nature of indirect effects and their significance for a cost-benefit analysis.

Notes

¹⁴ See the formula in the box at the end of chapter 3. This gives the figures with and without the project and the sum of the price differences of all features of the journey without and with the project.

Changes in transport flows therefore play a central role in the planning, identification and size of direct and indirect effects. The reason for this is that the differences in transport flows reflect the assessments made by all economic actors in reaction to the project. A number of interrelated calculations should therefore be made. This also makes it possible to carry out a systematic variant analysis. If, for example, there is no coherence in the initial stages, the person setting up the cost-benefit analysis must ensure afterwards that all effects attributed to the project be eventually traced back to differences in transport costs or transport flows¹⁵.

5.4 Indirect effects

Infrastructural projects do not only affect users and operators. Since users pass a part of their benefits on to others, it has an impact on the entire economy. This redistribution of benefits can even cross national borders which could have a favourable or unfavourable impact on the Netherlands. Furthermore, the redistribution could have a positive welfare effect if it results in reduced distortions in the market. Such indirect effects can be estimated by a macro-production function approach, case studies, targeted fieldwork or models.

Investments in infrastructure help Dutch companies to maintain and improve their position on foreign markets and may be reasons for foreign companies to carry out activities in the Netherlands. Investments can contribute to an efficient (spatial) concentration of economic activities within our national borders. These considerations are often heard in discussions over infrastructural projects. Not only direct effects, but also strategic, forward and backward effects are then mentioned.

These effects fall under the group called indirect effects. In this report, indirect effects refer to the consequences of an infrastructural project which are not directly related to the project but which arise from the direct effects of the project. Although this is a broad definition, a clear, demonstrable and causal link between a direct and an indirect effect is nonetheless required.

To a certain extent, indirect effects imply a redistribution of welfare¹⁶. Improving infrastructure offers companies (users) benefits. Users however cannot always hold on to this benefit. By being put under pressure by competitors, they are forced to share the benefit with others. Property prices in the neighbourhood around the railway station could serve as an example. Train travellers profit from investments in rail infrastructure. However, if some travellers attempt to move to the neighbourhood where the station is located, house prices will rise. These travellers see a part of the benefit disappear in the form of higher house prices straight into the purses of homeowners.

Notes

¹⁵ Sometimes it is necessary to relate effects to other concrete differences between the project and the reference situation. So, for example, is it possible that the mere construction of new infrastructure, even without any use, could involve changes in the use of land with the resulting consequences for both the economy and the environment.

¹⁶ For the impact of indirect effects on welfare, see chapter 9 and the OEEI report "Fundamenteel Voorwaarts" of NEI, TNO and RUG (2000).

Indirect effects could often be carried-over direct effects. This (re)distribution of benefits however is not necessarily neutral for national welfare, for two reasons:

- A Redistribution can cross *economic-geographic borders*. In terms of a redistribution within the Netherlands, the profit and loss items in a national CBA cancel each other out, while in respect of a redistribution between the Netherlands and foreign countries, it results in a national net profit or loss item.
- B Redistribution can stimulate activities of which, from a social point of view, not enough (or too much) are generated. Central to this then are markets which either do not exist or which function badly. *Market failure* is the classical argument for government intervention and also an important argument in respect of infrastructural projects which are carried out by the government¹⁷.

Market failure can have many shapes. Think for example of imperfect competition, external local economies of scale, but also of taxes which distort decisions on, for example, investments, education and employment¹⁸. Decisions regarding location can also be susceptible to market distortions. In such circumstances, government could play an active and positive role by promoting physical, economic clusters of activities in some sectors and by coordinating decisions related to location in some form or another. Clusters can also arise spontaneously and without government involvement. Firms do realise that the proximity of specialised businesses or employees can work to their advantage. When deciding on the location of their activities, firms will no doubt include this advantage in their considerations. It is only if the choice of one party unintentionally influences the choices and opportunities of another party, that government can play an active, positive role in the choice. Government can then embark upon coordinating the choices. This can be achieved in a number of ways. Government can engage parties in discussions or can change choices through subsidies (on building land). An infrastructural project could be used as a tool.

Another condition for an active, positive role in cluster forming is that government must be able to choose between different projects and clusters. This however is not that simple, because the Netherlands cannot or must not always choose to produce rather than import. It does not necessarily mean that the Netherlands will be the poorer if a group of activities are taken out of the Netherlands or is not introduced into the Netherlands. Cars, for example, are not (significantly) more expensive in the car-importing Netherlands than in car-manufacturing countries.

Although it is clear that economic-geographic borders and market failure (including cluster benefits) are important when translating indirect effects into indirect welfare effects, the translation in practice is far from simple. There is, for example, no fixed, systematic relationship between direct and indirect effects or between direct and indirect net welfare effect. In order to avoid double-counting it is, in any case, important to separate the effects on national welfare from all redistributive effects.

Notes

¹⁷ In the United Kingdom too it has been pointed out that the effect on imperfect markets is important when estimating the welfare effects of indirect effects of infrastructure. See SACTRA (1999).

¹⁸ A scale benefit in respect of an infrastructural project itself is important when determining the direct effects. This should only be included when determining indirect effects if the directly affected parties of a project do not know how to internalise or exploit fully this scale benefit.

Methods

Research can be used to try to determine under which conditions cluster benefits will occur, to what extent a specific project has fulfilled these conditions and to what extent a project actually affects the choice of location. It is also possible that tentative estimates of (business-external) economies of scale can give an indication of the extent of indirect welfare effects. Various methods are available for estimating indirect effects. In practice, an approach can be followed which allows for more than one research form. In this way, an overall picture is created of the possible range of indirect effects. Indirect impacts are often studied by using the following methods:

- 1 macro-production approach;
- 3 case studies;
- 5 targeted fieldwork;
- 7 models.

By using the *macro-production approach*, the effects of the total investment in infrastructure of one country on the national economy can be estimated. A lot of experience has been gained by this, both within and outside the Netherlands. Unfortunately the results vary substantially so that no clear picture emerges. Furthermore, it is not always clear in these analyses to what extent high investments are the cause or (also) the result of economic growth (causality). This method is only suitable for analysing total (macro) investments and not for evaluating a specific project.

Case studies can be used to learn draw lessons from comparable projects, for example, in other countries. Since situations and projects are not exactly the same in different countries, this does not provide an exact picture of a new Dutch project. Nevertheless, such a study can make a useful contribution when estimating the order of size of effects (pre-feasibility studies).

A third method to determine indirect effects is *targeted fieldwork*: surveys and interviews. This method does not make comparisons with the past, but looks explicitly at the expectations for the future (which may deviate from the past). A problem with this method is that the statements from respondents in surveys and interviews do not always correspond to their actual behaviour.

It is not always possible to separate the distributive effects from the efficiency effects when conducting case studies or surveys. This requires additional research.

Finally, *models* can be used to determine the impact of the project on the economy as a whole, including an overall estimate of the indirect welfare effects. The Athena model of the CPB may, for example, be used. The direct effects and the results of case studies and surveys could be used as input when using models to calculate impacts. This could partially solve the problem of a model not being detailed enough to avoid drawing ambiguous conclusions.

In order to examine spatial-economical effects consideration could be given to constructing a spatial general equilibrium model. (see NEI, TNO and RUG, 2000).

All four methods have advantages and disadvantages. In practice, appraising a project is best carried out by combining a number of research methods. It is always necessary however to justify the use of a method.

5.5 External effects

It is difficult to express the effects of projects on the environment, nature and safety in monetary terms, because there are no markets, and therefore also no prices, for these goods. The value of these effects can be estimated by doing surveys with those people who are affected or by measuring the avoidance costs which are common in existing government policy. As these effects relate to people who are not involved in the project, it can be sensible to compensate non-beneficiaries.

Valuation

Individual valuations underlie the cost-benefit analysis. These valuations are often derived from the choices made by private households and companies. They reveal their preferences on markets by choosing one thing and ignoring another. This valuation method cannot always be applied. In markets which do not function well or are absent, information on willingness to pay is unreliable or even not available. This is especially the problem when valuing the effects on the environment and nature. The problem crops up in numerous areas, varying from air pollution to the chances of disasters.

There are two ways of dealing with the problem of the (individual) valuation of non-tradable goods¹⁹. The first tries to find out (by using for example surveys) what the preferences of those individuals who are involved are. The second way is based on the (collective) costs of avoidance or compensation. These are derived from rules and regulations issued by government, or from the aims to which government aspires. Think for example of standards for noise pollution or international agreements on CO₂ emissions. In addition to a collective 'agreement', it is also essential to look at the costs of policy to realise this 'agreement'. Project effects are valued according to these costs. If a project appears to lead to, for example, an increase in noise pollution or extra CO₂ emissions, the value of this impact will then correspond to the costs required for reducing the noise or CO₂ to a level determined in the collective 'agreement'.

Compensation

It is no coincidence that the distributive issue plays a prominent role in respect of the side effects of infrastructural projects on the environment and nature. Individuals cannot, after all, reveal their preferences for these goods via the economic system, only via the political-administrative system. The political-administrative solution of the distributive issue often consists of compensating people suffering disbenefits from the project.

Compensation is mostly in the form of investments to limit nuisance, such as tunnels, baffle boards or insulation. If these investments relate to private goods (for example double glazing), collectively organised investments are less obvious.

Notes

¹⁹ Chapter 10 and the OEEI report "Welvaartsaspecten bij de Evaluatie van Infrastructuurprojecten" [Welfare aspects in the evaluation of infrastructural projects] of MuConsult and Vrije Universiteit (2000) look more closely at external effects and compensation.

In this case, it looks more efficient to offer non-beneficiaries the opportunity to take measures via a subsidy regulation. If, however, these investments relate to public goods (for example a baffle board), collective actions would be more appropriate. The advantage of direct, physical compensation is that it strikes at the heart of the (distribution) problem.

5.6 Distributive issues and employment effects

When estimating distributive effects, a distinction can be made between operators, users and residents living in the area, between regions and between the public and private sectors. When analysing employment effects of a project, the functioning of the labour market must be taken into consideration. Because of this, it is more often a matter of a displacement of employment than an increase in overall employment.

Each infrastructural project involves gainers and losers. As a result, a cost-benefit analysis must deal with distributive issues²⁰. This often highlights the limits of a cost-benefit analysis. Firstly, it is impossible to highlight all distributive effects on an individual level. Secondly, the individual valuation – the basis of the cost-benefit analysis – of redistributive impacts is impossible to determine. As a result, the project appraisal must provide insight into distributive issues independently from the total financial profitability analysis.

In practice, when appraising a project, a division into groups and an estimate of the consequences for the groups would have to be sufficient. A division into four groups takes place:

1. *users;*
3. *residents in the area;*
5. *regions;*
7. *the public versus private sector.*

Users will be the first to profit, and will profit the most, from investments in infrastructure. It therefore seems reasonable that they should at least cover a part of the costs. Only if the infrastructure is a purely public good, will it be impossible or not advisable to charge costs to users. It can be argued that many major infrastructural projects are private goods.

The distributive issue is most pertinent for *residents living in the area*. Although they need not always benefit from the project, they will very often be inconvenienced by the project. The valuation of effects such as noise or landscape pollution often varies a lot from one individual to the next. This is a result of the fact that there are no markets for these: an individual cannot buy off the detrimental effects or simply be compensated for them. There is therefore the danger that a project will be given the go-ahead even though the beneficiaries could not compensate the non-beneficiaries (see section 3.2). It is conceivable that a small group may have a strong preference, but is unable to indicate this preference via markets and would therefore do without the political-administrative means to prevent the project from going ahead.

Notes

²⁰ In chapter 11 and in the OEEI report "Verdelingsaspecten van grote infrastructuurprojecten" [Distribution aspects of major infrastructural projects] NYFER (2000) distributive issues are discussed in detail.

Infrastructural projects will benefit some regions more than others. The effects often concern a rearrangement of production in the Netherlands. Extra jobs in a region also often rather mean a redistribution among regions than an increase in employment in the Netherlands. Furthermore, such a redistribution may even be intended, for example to relieve densely populated areas.

Public-private partnerships (PPP) aim at improving performance in setting about and implementing infrastructural projects. Government intervention could hamper the optimal development of infrastructure: this distorts the efforts and investments by private parties aimed at cost management, service provision and innovations. In addition, PPP must ensure that business risks are passed on from the public sector to the private sector and that these do not remain with government. This may also be prompted, in any case, by the desire for some of the investment costs to be borne by users.

Employment

Infrastructural projects are often embraced not only because they lead to a rise in production and income, but also because they create extra jobs. Sometimes it seems as if employment is the main reason for undertaking a project. Employment effects are however difficult to trace. Jobs which are directly or indirectly connected to a project are clearly conceivable and demonstrable. Effects elsewhere on the Dutch economy however remain invisible. More jobs in one place often mean fewer jobs in another place. This *crowding out* is often ignored. Crowding out can best be argued by taking a *scarce production* factor as point of departure, such as highly skilled employees. They can only work in one place. If a scarce production factor is used, this leads to a loss in production in another place. This loss in production will also result in job losses. The reasons for crowding out will, however, mostly be connected with higher productivity in respect of the new activities as compared to the old activities.

Even if the labour market is characterised by unemployment, it may be possible that more production in one place leads to less production in another place. There is a possibility that a project will result in greater demand for semi- and unskilled workers, but at the same time stimulate higher wages resulting in the increase in employment being partially or wholly negated. The functioning of the labour market and, in particular, *wage determination* are decisive in this regard.

In many accepted views of the labour market, unemployment is not a consequence of disequilibrium in the market which can be prevented by the creation of extra demand, but an inseparable part of market equilibrium. According to this view, unemployment is, in the long term, caused by labour market institutions such as government regulation (minimum wage and unemployment benefits) and negotiation processes between employers and employees. In this vision, no provision is made for investments in infrastructure, just like no provision is made for investment in capital or research and development. In this view the process of investments and resulting growing productivity does not lead to a drop in the unemployment rate, but rather to a rise in wages.

The conclusion can be drawn that infrastructural projects seem to redistribute jobs between regions in the Netherlands rather than to create jobs. The net impact of infrastructure on employment is not obvious. It can, in any case, not be substantiated by pointing to the creation of employment related to the project without considering the functioning of the labour market in general and wage determination in particular. However, a possible crowding out of activities is mostly related to a rise in income.

6 Step-by-step plan for economic project appraisal

Which tasks can be distinguished for a social-economic appraisal of projects and in which order should they be carried out? These questions will be discussed in this chapter. The step-by-step plan is linked to the structure of a cost-benefit analysis presented in chapter 4.

Not all the tasks will be equally important in the appraisal of particular projects. Moreover, the order of the tasks is not always unambiguous. Steps are sometimes repeated, especially when appraising large projects. Economic project appraisal is an iterative process. Insights, derived from a later step, may lead to the need for a more in-depth execution of earlier steps. That is why a pre-feasibility study is often carried out prior to a detailed appraisal study of a project.

The following groups of tasks will be discussed consecutively in the next section:

- I. problem analysis;
- III. project definitions;
- V. identifying project effects;
- VII. estimating relevant exogenous developments;
- IX. estimating and valuing project effects;
- XI. estimating investment and development costs;
- XIII. drawing up cost-benefit reports;
- XV. variant and risk analysis;
- XVII. supplementary tasks.

In order to see how the step-by-step plan in this chapter relates to the structure of a cost-benefit analysis outlined in chapter 4 and, in particular, Figure 4.2, it has to be considered that the figure relates especially to research perspectives while the discussion in this chapter focuses on research tasks. It is possible that one perspective may comprise a number of tasks or requires that a number of (sectional) studies be carried out. In this way, it is conceivable that various methodologies will be used for the qualitative and quantitative determination of indirect effects and that, as a result, various (sectional) studies will be conducted. Risk analysis, by contrast, is a task which can be important from every perspective.

6.1 Nine research steps

I Problem analysis

The preliminary phase of an appraisal study consists of formulating the problem, the (operational) aims of the project and the preconditions with which the project must comply.

The problem analysis must ensure that attention is not shifted from a general problem to a narrowly defined, technical problem. If this happens, there is a danger that the implementation of the project appears to be the only solution to the narrowly defined problem and that the more generally defined problem is ignored.

As aims (for example: the Netherlands must have airports with a capacity of x) and ancillary conditions (for example: capacity x must be coupled with compliance with environmental standard y) are defined more generally, more alternatives can be involved in the analysis. If aims and preconditions imposed on a project are too narrowly defined, there is a danger that sound project alternatives could be left out of the analysis by mistake. A sufficiently broad definition of aims and preconditions is therefore required.

A critical consideration of the problem analysis, the operational aims and the preconditions of the project should therefore not be omitted from the research task of the cost-benefit analysis.

II Project definitions

IIa Project definition (design, plan, alternatives)

- Describe the elements which form a functional part of the project: the investments and efforts which contribute to the realisation of the operational aims under the proposed preconditions. Examples: a high-speed rail link not only comprises the construction of the railway and stations, but also the availability of special trains; an airport cannot function without adequate access roads, company grounds and other facilities.
- Project variants can be designed. In addition, alternative procedures (as part of the project variants) can be formulated in order to achieve the aims. In this respect, special attention should be paid to the option of postponing the project and the possibility of phasing and flexibility (see section 5.2).
- When defining the project, attention should also be paid to the time horizon. Does the project comprise a surveyable economic life span or is this life span too long for sound future projections?

IIb Describing the base case

In order to determine the effects of a project, a base case is required in addition to a project alternative (see section 5.1).

Without the project, some bottlenecks will probably develop, so that the developments in the base case, probably not will be an extrapolation of historical trends. The base case comprises the best possible solution for bottlenecks in a situation where the project is not carried out. The base case is therefore, by definition, something other than 'not doing anything' and also does not constitute 'existing policy'. If the base case is not adequately defined, there is the danger of seriously overestimating the profitability.

III Identifying project effects

The identification, estimation and valuation of effects is an important and extensive task when appraising projects. The classification of project impacts can take place according to Figure 3.1.verse, so that no effect is omitted and the identification can take place systematically. In this chapter, a distinction between three types of effects is sufficient: direct effects, indirect economic effects and external effects.

IIIa *Direct effects*

Constructing new infrastructure leads to additional supply or quality improvement in project services. It can be assumed that the sale of these services will be connected to an improvement in efficiency with respect to production and consumption. The sale of these services is a precondition for the benefits of the project. See section 5.3 and chapter 8.

A project provides capital goods (capacity) which are necessary to accommodate the demand for specific services. Which are the project services that are offered in respect of the different types of infrastructural projects and how are they to be defined operationally?

This question can easily be answered in connection with *line infrastructure* (railway, roads).

A *high-speed rail link* leads to more or better transport services for travellers (in terms of the numbers of journeys or kilometres travelled by passengers). The investment makes no sense without these services. It is therefore obvious that the effective demand for these services should be seen as the direct effects. It should however be borne in mind that this impact should not be reduced directly to the rail infrastructure: the development of the railway need not be owned by the same party who will construct, own and manage the infrastructure. The owner of the railway and stations actually offers infrastructural capacity to the railway company responsible for development which, in turn, supplies transport services to travellers. As the infrastructure does not lend itself to a use other than transport services, it is logical to regard the latter as direct effects.

Defining '*point*' infrastructure (airports, ports, company grounds) is a slightly different matter.

Take the example of the *Project Mainport Rotterdam*. What is the project service in this case? The infrastructural investment here relates to the construction of an area situated next to deep water suitable for large ships which has to be equipped for specific economic activities, for example for the delivery, storage and transport of containers, for bulk goods and for chemical basis-industry. Is the project service in this case a number of hectares of industrial ground which is suitable for specific activities or a specified annual processing capacity for containers, a specific refining capacity etc.? Defined by the former, it can be compared to the railway without superstructures in the example of the high-speed rail link. Defined by the latter it is essential to know exactly how the new area is to be divided among a number of activities and among (the expected development in) the utilisation of space by each activity. The area then shows many similarities, as regards function, with a station building of the high-speed rail link as walk-on, walk-off or change-over point and as link in the transport chain.

It is however not within the scope of this report to look into the issue of definition in any greater detail. The examples serve to show that a careful specification of the project service(s) is essential in order to translate these into monetised benefits. Moreover, they demonstrate the problem of defining services is not the same for all infrastructural projects.

IIIb Indirect economic effects

A number of different types of indirect or derived effects are linked to the project. These effects cannot be strictly ascribed to the project and/or do not affect users of the project services.

There are two reasons why indirect effects can also become indirect welfare effects. The first is situated in the economic-geographical borders between the Netherlands and other countries. The second is situated in market distortions. When identifying possible indirect effects, these two reasons should be taken into consideration. See section 5.4 and chapter 9.

IIIc External effects of the project

These relate to all changes in the welfare which arise as a result of a forced 'consumption' of non-priced by-products of the project services.

External effects can be subdivided into effects which users cause each other unintentionally (for example congestion during rush hour) and effects which users cause non-users (for example noise pollution to residents by road users). See section 5.5 and chapter 10 for more on this.

IIId Identifying relevant (social-economic) parties

Various parties in society are affected by the benefits and disbenefits of the project. Think for example of the project initiator/manager, suppliers for and buyers of the project services, producers and consumers who are indirectly affected by changes in price and quantity arising from the project, parties who are exposed to external effects, the government for which the tax incomes or subsidy-expenses change etc. CBA is based on the consolidated 'profit and loss accounts' of all these parties. In respect of the consolidation, typically the benefits for one party are cancelled by disbenefits for another party. (See step VII.)

Although insight into the distribution of benefits and disbenefits between groups of actors is not important for a monetised and consolidated survey of costs and benefits, it is advisable – for the benefit of political decision-making – to include this information in a cost-benefit analysis.

IV Assessment of relevant exogenous developments

In order to assess the sales of project services, sound assumptions in respect of changes in the environment of the project are required which are crucial for the development in demand. Other factors which are essential for the success of the project must also be included in the scenarios. Scenarios are also a method of dealing with uncertainties (see step VIII). As the projects often have a long life span, it is useful to look at connections with (existing) scenarios for the Dutch economy which are used as frameworks in other policy areas²¹.

Notes

²¹⁾ Examples are scenarios formulated from time to time by the CPB for the benefit of macro-economic projections. The scenarios however do not have to be restricted to economic scenarios.

The scenarios which are drawn up to assist with the appraisal of the project, usually cover the following areas:

- the development in national and international economy, split as far as possible into relevant sectors;
- international changes in government policy (liberalisation of trade, European competition policy, environmental policy in various countries etc.).

The scenarios should be formulated for the entire period to which the project appraisal relates.

V Assessment and valuation of project effects

Va Direct effects

Direct effects are, by definition, related to the construction, presence and use of an infrastructural project. Of all the considerations in respect of an infrastructural project, the total direct effects form the most important reasons for investment expenditure. Solving bottlenecks and/or seizing opportunities will also mean an significant efficiency-profit for the users.

How great the increase in welfare for individual parties will be, largely depends on the free market system. As a result of pressure from competitors, users will eventually be forced to share the efficiency-profit with others.

In order to be able to calculate in advance what the demand for project services would be, it is necessary to carry out a *market and competition analysis*. It was already emphasised in section 5.3 that carrying out good transport prognoses with the relevant valuations are essential when appraising a project.

- A *market analysis* looks at how the total demand for services of the type which will be offered by the project will develop in the relevant regions. The relevant regions comprise the entire area within which the supplier of the new project service can sell his services, i.e. where he can compete. When carrying out a market analysis, it is sometimes necessary to incorporate specific government policy, for example in respect of the environment, in the analysis.
- The *competition analysis* should show which part of the total demand of this type of services the project would be able to obtain in the relevant region. It is also necessary to take inventory of the plans for similar (competing) large-scale infrastructural projects abroad. A number of questions must be addressed. How price sensitive is the demand for the project services? How important are the more qualitative aspects of the project services for the users? How will competitors react? In short, the behaviour of potential users and (competing) operators must be described and analysed fully.

Both of these separate analyses should not be carried out for only one future scenario for the (economic) environment.

Vb Indirect economic effects

An infrastructural project does not only affect operators, users and residents in the area. An impact on the rest of the economy can also be expected. Effects will, for example, also be perceived higher up or lower down in the production chain (backward or forward effects). Indirect effects also include changes in location patterns. These changes are often important arguments for implementing infrastructural projects. A successful project could attract foreign investors or could prevent an exodus of Dutch companies.

The attracting aspect of infrastructure comprises either the fact that a company, as buyer of project services, could realise efficiency profits or that the project may lead to such changes in the relative prices that relocating to the area of the project becomes attractive to companies.

The question whether an indirect effect implies the redistribution of welfare or leads to an increase in welfare is not easily answered. The guide does not provide a ready-made recipe for answering this question. The answer depends on project-specific circumstances (see chapter 9).

Although it is difficult, in some cases, to distinguish between the redistributive and efficiency effect, it is however often possible to indicate the importance of an indirect effect. Answering the following sub-question could assist in this:

- Does a project lead to indirect effects (for example relocation of companies or foreign investments)?
- Under which circumstances can an indirect impact lead to an increase (or decrease) in welfare?
- Have these circumstances in the case of the project been fulfilled?

According to these sub-questions, it also has to be determined whether the project *could* make a contribution to the national welfare. A number of research methods can be used to answer these sub-questions. See section 5.5 and section 9.4.

Vc Assessment and valuation of external effects

The environmental impact assessment (MER) carried out for the project in question can be used when making an inventory of the physical environmental effects. In order to be used in the cost-benefit analysis, it is necessary that, when carrying out the MER attention be paid to the differences between development 'with' and 'without' the project for all the project variants to be studied. The economic value of these differences must then be determined.

When valuing environmental effects, a distinction must be made between physical effects with and without market prices. As far as the last category is concerned, it has to be established if, and to what extent, it is possible to determine an economic value via shadow prices or estimates thereof. Chapter 10 gives a concise overview of the methods which can be used for this, the advantages and disadvantages thereof and a number of methodological points of particular interest.

In the same way as the production and the use of project services lead to *direct* external effects, effects derived indirectly from the project, in turn, lead to *indirect* external effects. In practice, indirect external effects are difficult to determine.

VI Assessment of the project costs

The next step is to estimate the costs involved in the implementation of the project. People who are involved in the technical aspects of the project, in particular, will be able to provide information on this. This involves preparation costs, investment costs during the construction period, development costs during the life span of the project and the costs of removal or change of destination (in so far as these are not attributed to the new destination).

VII Producing a cost-benefit set-up

Once the steps described above have been successfully completed, a business and social profitability analysis can then be carried out (see Figure 4.2)²².

VIIa Business profitability

The first step involves producing a business cost-benefit set-up for the project. In this respect, investment and development are considered to be a private economic activity. The expected financial costs and benefits for each year of the expected life span are, if necessary, expressed at the same price level and then added up. They also serve as input for calculating the profitability criteria such as net present value, internal rate of return or payback period.

Calculating the business profitability requires – given the information available from the steps described before – relatively little extra effort. An important advantage of having information on this is that it indicates to what extent the project is attractive to private investors. It forms a useful pretext for the development and implementation of public private partnerships (PPP).

VIIb Social profitability

In order to determine the social-economic profitability, all monetised benefits and disbenefits for all parties in the national economy are consolidated. Decision criteria (net present value, internal rate of return) can then be calculated for these benefits and detriments. The cost-benefit set-up must also reflect provisionally the benefits and disbenefits which cannot be expressed in monetary terms (unique areas of natural beauty, distributive issues etc.). The aim of the research is to uncover as much quantitative and qualitative information on these effects as possible. This information could perhaps be processed in a cost-benefit set-up but should, in any event, be recorded clearly.

A distinction between a partial and comprehensive CBA was made earlier in this report. The difference between the two is that, in respect of a fully-specified CBA, all indirect welfare effects are taken into consideration while a *partial CBA* is confined to the direct effects and indirect effects within the transport sector (network effects).

Although the partial and comprehensive cost-benefit analyses are not separate end products in separate reports, a separation of the direct and indirect effects will be informative. Moreover, external effects deserve extra attention. Therefore, in order to achieve a transparent set-up of costs and benefits, it is advisable to treat the items which relate to direct effects, indirect economic effects and external effects separately.

VIII Variant and risk analysis

Ex ante economic appraisal of a project involves all kinds of risks and uncertainty. Risks and uncertainty cannot be dealt with in one single research step, but play a role in most of the steps distinguished up to now.

Notes

²²⁾ Not all the steps described above are necessary to carry out a business analysis.

The treatment of structural uncertainty was already discussed in step IV (determining scenarios). Scenarios provide an overview of critical success factors for the project and help in determining under which circumstances a project will have favourable or unfavourable effects on the national economy. In this way, discussions on opportunities and threats can be structured in a sensible manner.

Uncertainty can be dealt with by providing for the possibility of phasing and flexibility when planning the implementation of the project. Possibilities of postponing a project must be carefully considered and assessed. It is advisable, wherever possible, to calculate actual option values for project variants and to make optimal use, in each case, of the information which will become available in future.

IX Supplementary tasks

Once the above-mentioned steps have been carried out, the process of project appraisal is actually completed. A cost-benefit analysis however also provides starting points for public private partnerships and ex post evaluations.

IXa Possible expansion to PPP

The guide does not explicitly raise the question of whether the project to be appraised will be entirely run by public investment or whether private parties will also participate in the project. This aspect however is becoming more and more pertinent, which is why this will be discussed briefly below (see also chapter 11).

Once the social profitability of the project has been determined by means of a cost-benefit analysis, it has to be established whether the project can be carried out entirely by public investment or by public-private partnership. In order to get an overall picture of the social-economic advantages and disadvantages of both variants, a *Public Private Comparator* (PPC) is used. Information on the variants is derived from the business profitability analysis and the social profitability analysis. The results of the PPC serve as point of departure for the negotiations between public and private project partners (for example over the set-up and implementation of a PPP and the identification and distribution of risks).

If the overall PPC comparison is in favour of a PPP, and as soon as concrete proposals have, during a next stage, been laid on the table, another comparison is made between these private project variants and a public implementation. This takes place by means of a so-called *benchmark-method*, the *Public Sector Comparator* (PSC). A decision will then be made on the manner of implementation²³.

XIb Ex ante project appraisal: basis for ex post project evaluation

Finally, it has to be pointed out that an important source of information for ex ante project appraisals could come from ex post evaluations of comparable projects. It is therefore all the more important to pay attention to well executed project evaluations. Despite the differences, the set-up of ex ante evaluations and the set-up of ex post evaluations also show strong similarities. It is advisable, already in the stage of ex ante project evaluation and the presentation and justification of the results, to take this into consideration when deciding on the best way in which to set up, when appropriate, an evaluation of the project.

Literature

N.B. A more extensive reading list is given in Section II of this publication.

- AVV (1996), 'Handboek Economische Effecten Infrastructuur', Adviesdienst Verkeer en Vervoer, Rotterdam.
- BCI (2000), 'Spill-over effected mainportprojecten', OEEI partial report A3, Buck Consultancy International.
- Boneschansker, E., M.G. Lijesen and H. de Groot (1995), 'Economisch rendement en strategische betekenis van nieuwe infrastructuur', IOO, PI series, Ministry of Transport, Public Works and Water Management, The Hague.
- CE (2000), 'Economische beoordeling van grote infrastructuurprojecten; leren van internationale ervaringen', OEEI partial report A1, Centrum voor Energiebesparing en Schone Technologie.
- Commissie Betuweroute (Co. Hermans) (1995), Report, The Hague.
- CPB (1995), 'Economische effecten van de Betuweroute op basis van recente informatie', Working document 75, The Hague.
- 100bv (2000), 'Een regionaal databestand voor de analyse van de economische effecten van infrastructuur', OEEI partial report A4.
- Ministry of Finance (1995), 'Kabinetsstandpunt Heroverweging Disconteringsvoet', The Hague.
- Ministry of Finance (1998a), 'Meer Waarde door Samenwerken', The Hague.
- Ministry of Finance (1998b), 'Referentiekader voor evaluatie-instrumenten', The Hague.
- MuConsult en Vrije Universiteit (2000), 'Welvaartsaspecten bij de Evaluatie van Infrastructuurprojecten', OEEI partial report B1.
- NEI, TNO and RUG (2000), 'Fundamenteel voorwaarts; naar een praktisch werkbaar en theoretisch gefundeerde benadering van voorwaartse economische effecten', OEEI partial report C, Nederlands Economisch Instituut, TNO-Inro and Rijksuniversiteit Groningen, Faculty of Economic Science.
- NYFER (2000a), 'Markten voor infrastructuur: de invloed van institutionele aspecten op de prestaties van infrastructuur', OEEI partial report A2-2.
- NYFER (2000b), 'Verdelingsaspecten van grote infrastructuurprojecten', OEEI partial report B2-1.
- SACTRA (1999), 'Transport and the Economy', Standing Committee on Trunk Road Assessment, Department of the Environment, Transport and the Regions, The Stationery Office, London, UK.
- TNO-Inro (2000), 'Internationale Benchmarks voor Prestatievergelijking Infrastructuur', OEEI partial report A2-1.
- Venables, A.J., and M. Gasiorek (1998), The welfare implications of transport improvements in the presence of market failure, momeo.

List of definitions

Allocation effect (also: *Location effect*): see *Relocation effect*.

Alternative costs of a project (also: opportunity costs): the missed benefits if the project is carried out because the used production factors can no longer deliver the returns which they would have generated in the base case.

Backward impact: the impact (advantages and/or disadvantages) of the construction, running or dismantling of a project on direct or indirect suppliers.

Base case: the most likely economic development should the current project under review not be implemented. The difference of the development with the project and the base case (the development without the project) forms the point of departure for each return analysis and therefore also for a CBA (see also *Project alternative*).

Benefit-cost relationship: a profitability or decision criterion normally used in a CBA in terms of which the net present value of the project effects is divided by the net present value of the capital expenditure.

Business cost-benefit analysis: see *Business profitability analysis (BPA)*.

Business profitability analysis (BPA): an analysis used to determine whether the project will generate sufficient profit for the investor and/or operator during its intended life span to justify beginning with and/or participating in the project.

Capacity service: see *Project service*.

Cash flow: all expenditure of a business related to buying goods and services, interest payments, taxes and dividends on the one hand (outgoing cash flow) and all income from sales, net loans and owner's equity on the other hand (incoming cash flow). The cash flow can be subdivided into financial and non-financial items. The total cash flow is important when carrying out a liquidity analysis; only the non-financial cash flow is required when carrying out a business profitability analysis.

Club effect: a (market) externality of a project where the users of the transport services of the project cause non-priced advantages or disadvantages for one another.

Compensating variation (CV): a measure for the change in welfare of an individual in respect of the original (or 'no project') situation which occurs as a result of a project. The CV is the maximum amount which a person who might benefit from the change can be deprived of without him being worse off than without the project (willingness to pay); it is also the minimum amount which the loser requires not to be worse off in terms of welfare when the project is carried out (willingness to accept). The CV is a measure for the consumer surplus (see also Equivalent variation).

Complements: Goods (or services) which are normally purchased when other goods are purchased because they 'complement' the latter (see also the opposite: Substitutes).

Consumer surplus (CS): (estimate of) the maximum amount that someone (the consumer) is willing to pay for a good or a service less the actual amount to be paid.

-
- Cost-benefit analysis (CBA)*: confrontation of all costs and benefits experienced by all parties in the (national) community associated with the implementation of a project expressed in monetary terms, supplemented by (preferably quantitative) information on impacts which cannot reliably be expressed in monetary terms.
(N.B.: the national community is normally taken as the basis for the welfare effects of a project. It is however also possible not to take the inhabitants of a country, but rather of a region or of a larger community, such as the European Union, as the community on which the CBA is based).
- Cost-effectiveness analysis (CEA)*: an analysis where for a number of alternatives or variants of a project is determined with which alternative (or which variant) the (one-dimensional) project objective can be realised at the lowest cost or with which alternative or variant the best results can be achieved with a given cost budget.
- Direct effect*: the effect of the project on the owner or operator on the users of the transport services, or externalities which stem from the infrastructure or the use thereof (see also: *Indirect effect*).
- Discount rate*: the interest rate used to calculate the present value of the sums of money which must be paid or will be received in future (see also: *Social discount rate*).
- Economic project evaluation*: the systematic and rational basis for the choice between relevant alternatives for a project in terms of which all social welfare aspects are considered.
- Economies of scale*: the reduction in the average production costs which occur (in the long run) as production increases (for example as a result of spill-over effects or an improved utilisation of the means of production). Scale advantages is an important reason behind natural monopolies (economic activities which can be carried out most efficiently by one producer).
- Efficiency effect (also Technological effect)*: the contribution of the project to a more efficient production and/or consumption technology (so that more output is produced with the same production resources or more utility can be derived from using the same amount of goods and services). In other words: a drop in the marginal social costs and/or a rise in the marginal utility from goods and services which occurs as a result of the implementation of the project.
- Environmental impact assessment (MER)*: a description required by law of (1) the intended project activity, (2) the condition of the environment prior to the activity and (3) the change which will occur in the condition of the environment (and the expected consequences thereof) with and without the activity (base case). The MER should, furthermore, provide a description of the 'most environmentally friendly' alternative.
- Equivalent variation (EV)*: a measure for the change in welfare of an individual which occurs as a result of a project. The EV is the minimum amount which a person who benefits from the change is willing to accept in order to give up the benefit (willingness to accept); it is also the maximum amount which the loser is willing to pay in order to avoid the change (willingness to pay). The EV is a measure for the consumer surplus (see also *Compensating variation*).

External effects: a change in welfare, as a result of the project, for people other than the owner or developer and the users of the project services which the owner or developer and the users did not include in their decision-making. A more exact and general, but also economical-technical, definition is given by Muconsult/Free University Amsterdam (2000): "An external effects exists if the utility or production function of an economic actor (the 'receiver' of the impact) contains a variable, which value depends on the behaviour of another economic actor (the 'originator' of the effect) who does not include this effect in his decision-making".

First year rate of return (FYRR): the rate of return (present value of the return divided by the present value of the investment) during the first year of return of the project. Indicator for the sensitivity of postponing a project, in terms of which it is expected that it will be related to an annual increase in the return.

Forward effect: the effect (advantages and/or disadvantages) of the construction, operating or dismantling of a project on direct or indirect customers of the project services.

General Equilibrium Model: a model which represents explicitly the interaction between markets and which takes into consideration income effects.

Hicks-Kaldor criterion: see *Potential Pareto-improvement*.

HSL: High-speed link railway.

OEEI: Research Programme on The Economic Effects of Infrastructure (initiated by the Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs).

Effect (of a project): see *Project effect*.

Indirect effect (also Derived effect): the impact of a project which is not included in the direct effect (see *Direct effect*).

Infrastructure: an umbrella term for social capital goods: utility companies (power and water supply, sewerage etc.), public works (roads, dykes, drainage etc.) and transportation (railways, harbours and airports).

Integrated CBA, (also called comprehensive CBA): CBA which takes into consideration all indirect effects of the project in addition to the direct impacts.

Internal interest rate: the (highest) discount rate at which the net cash value of the project impacts is equal to zero.

Internal market effect: see *Priced effect*.

Inventory-taking of economic effects (IEE): the description of as many economic impacts of a project as possible without considering the issue of whether these impacts are also welfare effects which could be called upon. The IEE – in contrast to a CBA – does not form an appraisal framework for the economic evaluation of projects, but includes much of the preparatory work required for a CBA.

Location effect: see *Relocation effect*.

Market distortion: the deviation of one market situation with complete competition and without transaction costs (that is: an equilibrium market situation) which occurs as a result of the introduction of taxes and subsidies, transaction costs, monopolistic market positions, exchange rate distortions etc. Market distortion shows up in prices which deviate from the equilibrium prices in a equilibrium market situation.

Market externalities: see *External effects*.

Multi-criteria analysis (MCA): a method for assessing projects in terms of which various assessment criteria are simultaneously used as point of departure (physical quantities can be used as criterion in addition to money). Weights are allocated to the various criteria (mostly by policy makers) before the weighted (quantitative and qualitative) scores are combined. The basis for the allocated weights is not always clear. Double-counting of project effects is more difficult to avoid than with a CBA because strict criteria for the inclusion of effects are lacking.

National income: the total money value of the income accruing from a country's economic activity (in particular labour and entrepreneurship).

National-economic analysis (NEA): the application of a quantitative economic model for the national economy in order to calculate how a project impulse (for example a cost saving) affects all other activities within the economy.

Net present value (NPV): a profitability or decision criterion used in cost-benefit analysis. The amount which is derived from deducting the present value of the expected costs of an investment from the present value of the expected return. In a CBA, the NPV is calculated by using the social discount rate. If the NCV is positive, it would, from an economic point of view, seem defeasible to implement the project.

Opportunity cost: see *Alternative costs*.

Pareto-optimum: an economic situation is called Pareto-optimal if the resources and the production in the economy are allocated in such a way that every other allocation which provides extra benefit for someone in the community is at the expense of the welfare of someone else.

Partial CBA: CBA in terms of which the direct effects, but not explicitly (all) the indirect impacts, are considered. (N.B.: This does not have to mean that the CBA is not complete and that all types of welfare effects are not considered. In many cases, it is plausible that the indirect effects which are not considered will on balance have no or hardly any influence on the extent of the national welfare).

Pecuniary effect or pecuniary external effect: there are a number of definitions for this concept; for this reason, the use of this concept is avoided as far as possible in this report. These effects should not be confused with external effects (see *External effects*). In this report, pecuniary externalities are considered to be indirect impacts (see *Indirect effects*). One possible definition is: "price changes which third parties (therefore people other than, on the one hand, owners/operators and, on the other hand, users of the project services) experience of shifts which, in respect of the project, occur in prices and quantities". Another definition is provided by Venables and Gasiorek (1998): "Pecuniary externalities arise when interaction goes through markets, but markets do not equal the true social costs and benefits of the action, for example, because of monopoly power or distortionary taxation".

Potential Pareto-improvement (PPI) (also: Hicks-Kaldor criterion): economic decision criterion which states that a project must be implemented if those people who benefit from the project are able to compensate completely those who suffer losses without themselves being worse off in real terms. This relates therefore to potential compensation; whether the compensation is actually carried out is not important for the decision. If the project does not fulfil the PPI criterion, it must not be implemented. If a project does however fulfil the PPI criterion, it still does not show that a welfare improvement will actually be achieved for everyone, because a possible necessary compensation is not actually carried out.

Present value: the current value of a future stream of returns and/or costs (see also: *Net present value*).

Price distortion: see *market distortion*.

Priced effect (also Market-internal effect): advantages or disadvantages of a project which are expressed as prices of goods and services via transactions and price setting in markets.

Problem analysis: steps which are taken during the preparatory process in order to solve a policy issue. The most important steps are: confronting the expected development with policy objectives which will occur without policy intervention, design of solutions (including projects) and confronting the expected effects with policy objectives.

Producer surplus (also: Economic 'rent'): (estimate of) the maximum amount that one producer is willing to pay for a production factor less what he actually has to pay.

Project alternative: the expected development in the (national) community if the project is carried out (in any variant) (see also *base case*).

Project external effects: effects which are experienced by people other than the owner and/or developer of the project. N.B.: the concept project externalities should not be confused with the concept external effects (see *External effects*).

Project effect: difference between a development with a project (project alternative) and without the project (base case).

The effect must have a causal relationship with the project.

Project service: a service which is derived directly from the use of the project (see also *Direct effect*).

Project: an investment, or collection of mutually coherent investments, which amount to (or involve) a public intervention in the market. In order to prevent that, in respect of the collection of investments, the profit of one part conceals the loss of another, an accentuation is desired. A project is then defined as the smallest possible collection of mutually coherent investments which could be implemented technically and which could be attained economically.

Project-internal effects: advantages and disadvantages which are experienced by the owner and/or the operator (see also *Project external effects*).

Public goods: goods or services which are, as soon as they are supplied to one person, also available without extra cost to other persons. Strictly speaking, it is possible to define public goods (services) as goods (services) which are non-exclusive and non-rival. Non-exclusiveness means that the use thereof by non-paying parties cannot be excluded; non-rivalness implies that the use of the goods by party x will not affect the availability thereof for party y. Many infrastructural elements comply to a large extent with these characteristics (at least in a situation of overcapacity, therefore the absence of congestion).

Public-private Partnership (PPP): forms of collaboration between authorities and individual parties, in terms of which it is endeavoured to combine the disadvantages of governmental intervention in the market – deemed necessary as a result of inadequacies of markets – with favourable effects of a free market system in order to realise a higher welfare return ('synergy') than which is deemed possible without the combination. Another distribution of the financial risks which the parties accept when undertaking the joint projects arises from this collaboration.

Pay-back period: the time required for a project to generate sufficient cash flow to recover all expenses (including the investment) incurred up to that time. This may or may not take into consideration discounting.

Relocation effect (also: location effect): the effect of the implementation of a project on the location behaviour of companies or persons. It is a spatial distribution effect. The location behaviour can be related to backward and forward effects.

Revealed preference (also revealed behaviour): an estimate of the demand which is based exclusively on actual observations of the manner in which consumers react to changes in prices and/or income (see also *Stated preference*).

Scenario: mutually coherent system of assumptions about and indicators for the development of the physical and economic environment within which the project will function. Mutually diverse scenario's can be employed (for example based on optimistic and pessimistic projections) in order to gauge of the sensitivity of project effects for uncertain exogenous developments.

Shadow price: the imputed value of a good or service in case such a value cannot be determined accurately on markets where demand and supply meet. The shadow price is equal to the increase in welfare produced by an extra unit of these goods or services.

Social cost-benefit analysis: see *Cost-benefit analysis*

Social discount rate: the discount rate used in a CBA to calculate the present value of the social costs and returns of a project. The social discount rate deviates from the interest rate used when discounting private investments. Currently, the central government prescribes a real interest rate of 4% in a risk-free environment.

Spill-over effects: indirect efficiency effect (see *Efficiency effect*).

Stated preference (also: stated behaviour): the method used to estimate the demand for a good or service which is based on the answers of consumers to questions on how they would react in a hypothetical situation to changes in the prices and/or income (see also *Revealed preference*).

Strategic effect: a concept for which there is no clear definition. In this report, the use of this term is therefore avoided as far as possible. In a broad sense, this involves each indirect impact intended by the project which causes a more or less permanent change in the economic structure. In respect of infrastructural projects, the term 'strategic effect' is often more specifically used as a synonym for relocation effect, see for example Boneschansker, Leijsen and de Groot (1995): "The strategic effects of infrastructure are the economic impacts which are related to the changes in the choices of locations of companies and citizens as a result of the new infrastructure. This includes both the attraction and the preservation of locations. (...) These changes relate, for that matter, to regional shifts in particular".

Substitutes: goods (or services) which are normally not purchased if another good are bought because they replaces the latter (see also *Complements*).

Sunk cost: investment costs which have already been incurred in view of the proposed project. As these occur, by definition, within the base case and within the project alternative, they need not be considered in a CBA.

Technological effect: see: *Efficiency effect*.

Utility: economic-theoretical concept used to describe the availability of choices in economic models. Utility is that which individuals experience when using goods and services and which they try to maximise.

Value added: the value of the production of a company less the value of the inputs which the company obtains from outside; this value amounts to the sum of the rewards of the production factors (labour, capital) of the company.

Welfare: see Utility.

Willingness to accept (WTA): the minimum amount which one person wants to receive in exchange for giving up a good or a service or for accepting a loss (for example damage or nuisance).

Willingness to pay (WTP): the maximum amount which a person is willing to pay in order to have at his disposal some good or service or to avoid a loss (for example damage or nuisance).

