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THE SEA MANUAL

FACT SHEETS

A SOURCEBOOK ON STRATEGIC ENVIRONMENTAL ASSESSMENT OF TRANSPORT INFRASTRUCTURE PLANS AND PROGRAMMES

PREFACE

This volume contains a collection of seven fact sheets that deepen the theoretical concepts highlighted in the third part of the manual, providing users and operators with issues and aspects on which they need specific orientation, clarification, tools, technical help, or any other kind of assistance. The arguments these seven fact sheets deal with are:

All the fact sheets, except that on "Impact assessment tools", have been structured on the basis of the following reference structure, that, case by case, has been slightly adapted in accordance with the contents of each of them:

A. What is the issue and its purpose?

B What are the expected results?

C What are its appropriate scales (network, corridor, local)

D How to do / run it?

E Who should do it?

F Who should be involved?

G What are key tools?

H Examples

I Further reading

The contents of the fact sheet on "Impact assessment tools" is briefly outlined within the corresponding chapter (1)

1. IMPACT ASSESSMENT TOOLS

This fact sheet describes the following important impact assessment tools, also outlined in the box 3.20 of the Manual (page 59).

- Cause effect modelling
- Screening - Ecological Risk Assessment Tools
- Transport Forecast Models
- Coupled land use/transport models
- Calculation of immission and exposure
- Cost benefit Analysis
- Life cycle assessment
- Intelligent GIS
- Decision support tools MCA
- Information Sharing, Group decision taking and Public involvement tools

For each of these tools, the following information is provided:

- Alias/related tools;
- Short description;
- Main purpose;
- Strengths;
- Weakness;
- Applications Examples/References;
- Suppliers.

Cause effect modelling

Alias/related tools
Impact matrices, Fishbone, Ishikawa Diagram

Short Description
Cause effect modelling may use different techniques. Apart from matrices the (fishbone) cause-and-effect diagram is a method originating from the total quality management. The diagram's purpose is to relate causes and effects. For impact assessment diagrams can be used for

- assessing robustness of problem solving strategies
- define input-output indicator models
- cause enumeration for building simulation tools

The effect is the impact on the environment, the problem to be resolved, opportunity to be grasped, result to be achieved.
www.ifm.eng.cam.ac.uk/dstools/represent/tqm.htm
www.uni-klu.ac.at/~gossimit/pap/guest/diseg.pdf
Flowchart cause effect diagram may be mapped into fishbone diagrams to better visualise the impacts on one effect(output indicator)

Cause effect modelling (continued)

Main purpose:
Screening: Identify the driving factors which could be used to define the alternatives and should be incorporated into the simulation and impact assessment models. The other impacts can be dropped from the quantitative assessment.

Strengths
Excellent for capturing team brainstorming output and for filling in from the 'wide picture'. Helps organising and relating factors, providing a sequential view. Useful for niches where transport research is not well developed

Weaknesses
Deals with time direction but not quantity. Can become very complex. Can be difficult to identify or to demonstrate interrelationships. Is obsolete for standard transport planning where guidelines and literature give accepted cause effect relations.

Application Examples/References
Emberger Günter, Interdisziplinäre Betrachtung der Auswirkungen, verkehrlicher Maßnahmen auf sozioökonomische Systeme, Dissertation 1999t

Suppliers
Mindgenius www.mindgenius.com/website/images/new/business/pdfs/CauseEffectAnalysis.pdf
Visio: office.microsoft.com/en-us/assistance/HA010744131033.aspx
Pathmaker: www.skymark.com/pathmaker/tour/cause.asp
Bayesware Discoverer: www.bayesware.com/products/discoverer/
JMP: www.jmp.com/jmpdemos.html
KYplot www.kyenslab.com/en/
RCAxpress fishbone software www.rcaxpress.com
The Unscrambler: www.camo.com
Vista: forrest.psych.unc.edu/research/index.html
WinBUGS: www.mrc-bsu.cam.ac.uk/bugs/winbugs/contents.shtml
GAUSS Engine Pro: www.additive-net.de/software/projekt/geo.shtml

Screening - Ecological Risk Assessment Tools

Alias/related tools
Expert Systems- decision support tools

Short Description
A generic screening tool based on an expert system includes:

- data base and interactive editor tools for defining alternatives;
- multi-layer, hierarchical geographical information system holding vector and raster data;
- set of data bases, eg., on meteorology;
- knowledge base with checklists, rules, background information and guidelines and instructions for the analyst;
- inference engine, that guides the analyst through a projects assessment in a simple menu-driven dialogue;
- summary Report generator, that summarizes and evaluates the impact assessment and produces reports.

An Expert System is a software capable of representing and reasoning about a knowledge rich domain. This system acts like a human expert solving problems and / or giving advice.
The expert system uses IF ... THEN rules for a qualitative assessment of potential environmental problems. The rule base is linked to a hypertext system that provides explanations of terms and concepts, background information, and instructions for the user

Main purpose:
Allows a quick assessment of parts of plans and programs in the screening phase of SEA. Helps reducing the effort to conduct the impact assessment. Expert systems can be divided principally into Expert / Knowledge Base Systems and Neural Networks

Strengths
Very quick assessment possible once the rules are defined.

Screening - Ecological Risk Assessment Tools (continued)

Weaknesses

Much depending on the users judgement, complex rule system - is difficult to make transparent, knowledge base must be validated for the type of plan/programme and the boundary conditions (pressure - state - impact interrelation [1])

Application Examples/References

EIAxpert: rule-based screening level EIA [2]

Suppliers/Sources/Further readings

EIA for developing Countries 1997 Chapter 8 Application of Expert Systems:
www.adb.org/Documents/Books/Environment_Impact/chap8.pdf
Calyx ESSA Software Ltd. Formerly Dos based SCREENER:
www.essa.com
ORBI: Universidad Nove de Lisboa
IMPACT: Department of Environment USA DoE Savannah River Geraghty 1993
RiskWare (Environmental Software and Services): www.ess.co.at/RISK/
RESRAD-ECORISK(EAD): www.ead.anl.gov/project/dsp_fsdetail.cfm?id=52

[1] Jesinghaus, Jochen, Pressure Indices programme coordinator, European Commission, Joint Research Centre, Institute for Systems, Informatics and Safety (ISIS),A European System of Environmental Pressure Indices First Volume of the Environmental Pressure Indices Handbook: The Indicators Part I: Introduction to the political and theoretical background TP 361 I-21020 Ispra (VA)
http://esl.jrc.it/envind/theory/handb_03.htm

[2] www.ess.co.at/EIA/; DDr.Kurt Fedra Environmental Software & Services GmbH, Kalkgewerk 1 PO Box 100 A-2352 Gumpoldskirchen AUSTRIA, Tel:+43 2252 633 05 Fax:++633 059 www.ess.co.at

Transport Forecast Models

Alias/related tools
Transport Modelling, multi modal transport model

Short Description
The models consist of a demand modelling and an assignment process.
The elasticity to cost of the travel demand is modelled through use of a 'demand curve'. Simple models use aggregate elasticity values, which represent in a single number all traveller responses. More complex models (multi-stage demand models) use linked hierarchies of equations which represent individual traveller responses separately and, it is argued, more realistically.
The Assignment is based on an impedance to travel which is measured by the 'generalised cost' of travel. This usually consists of a linear addition of the elements of journeys, such as time spent walking, waiting and travelling in-vehicle, plus money costs of using private vehicles or public transport, with the various elements weighted to reflect their importance to travellers. It is through the manipulation of these elements of generalised cost that the impacts of transport interventions are represented in a model. Logit, Nested Logit, and Probit models assume a fixed activity scheme whereas activity-based models focus on how people organise their activities in time and space.

Main purpose
Future transport data is the basis for quantifying the pressure factors. This is the input to all subsequent SEA tools using emission inventories, propagation and exposure modelling etc.
Overoptimistic demand forecasting is common. Skamris and Flyvberg (Inaccuracy of traffic forecasts and cost estimates on large transport projects, Vol. 4, No.3, pp141-46, 1997) provide a useful survey of the few publications documenting cost overruns and overoptimistic forecasts.
Their conclusion is that traffic forecasts that are 20-60% incorrect compared with actual developments are common in large transport infrastructure projects in a sample of countries including developing countries and the UK, Denmark and Sweden.

Strengths
If the model has been set up alternatives and sensitivity can be tested easily. It gives more reliable forecast data than extrapolation. Quantitative models can cope with discrete (0,1) and continues parameters (rail and trunk road network lengths)

Weaknesses
The accuracy of the demand model is also influenced by the extent to which the demand is segmented into separately identifiable and behaviourally distinct groups of travellers.
The more such segments are treated separately, the greater the accuracy of the modelling, but also the greater the complexity of the model and the longer the run times.

[3] www.webtag.org.uk/webdocuments/2_Project_Manager/4_Summary_Advice_on_Modelling

Transport Forecast Models (continued)

Application Examples/References

TEN-STAC http://www.nea.nl/ten-stac/

SCENES European Transport Forecasting model and Appended Module: Technical Description. SCENES Deliverable 4 to the European Commission, April 2000, see http://www.iww.uni-karlsruhe.de/scenes/#deliverables. The SCENES model has been used within a number of other recent European Commission projects including ASTRA, MC-ICAM, TIPMAC, IASON, EXPEDITE, SPECTRUM and the pilot Strategic Environmental Assessment of the Trans-European Transport Networks (TEN-Ts).

Suppliers/Sources/Further readings

NEAC2000 Freight www.nea.nl/neac/general_characteristics.htm

EUFRANET www.inrets.fr/ur/dest/europe/eufranet.htm

VACLAV/VIA passengers Traffic Forecast on the Pan-European Transport Corridors of Helsinki (1999)

DYNEMO traffic flow model www.icetact.tcd.ie/icetact/news/transport/nokel.pdf

THE SWEDISH MODEL SYSTEM FOR GOODS TRANSPORT - SAMGODS : www.sika-institute.se/utgivning/sam01_1.pdf

Microscopic simulation: PTV Very large networks in traffic and environmental simulation: applications and first results: www.icetact.tcd.ie/icetact/news/transport/nokel.pdf

Schneider, Walter, BVU Beratergruppe Verkehr+Umwelt GmbH, THE GERMAN NATIONAL FREIGHT TRANSPORT MODEL - Conference on National and International Freight Transport Models, D-79115 Freiburg im Breisgau www.ctt.dtu.dk/projects/clg/downloads/pdf/2003/NatFreightModConf/Schneider.pdf

Coupled land use/transport models

Alias/related tools
Land-use/transport interaction models LUTI, Spatial computable general equilibrium models SCGE

Short Description
'Land-use/transport interaction models represent the influences of transport upon different groups of economic agents (individuals and households, firms and other productive organisations, and national and local government) by modelling some or all of the markets (property, labour, goods and services) through which they interact. As their name indicates, they model both the transport and land-use systems, and relate the behaviour of residents and firms to physical changes in land-use. [4]

Main purpose
Introduces the indirect impacts of new transport infrastructure and reduces errors in the impact quantification

Strengths
Allows realistic quantification of changes in the demand and behaviour resulting from the new transport infrastructure. System dynamics models even allow to forecast transient processes which equilibrium models (SAMPERS/IMREL, RETRO) can't [5]

Weaknesses
At present, none of the land-use/transport interaction models are capable to produce the required estimates of user benefits. The difficulty is that user benefits are more difficult to accumulate in a rigorous fashion in a land-use/transport interaction model than in a transport model alone, and the required development work has not yet been undertaken.
Run times of the simulation may be rather long, so interaction with the model is cumbersome.

4 www.webtag.org.uk/webdocuments/2_Project_Manager/4_Summary_Advice_on_Modelling

5 PROSPECTS Developing Sustainable Land Use and Transport Strategies, A Methodological guidebook deliverable 14 2003 Institute of Transport economics Oslo

Coupled land use/transport models (continued)

Application Examples/References

The best-developed model of this type is IRPUD (Wegener, 1982), a model of Dortmund (Germany) developed for research purposes over a long period. Another UK example is the DELTA package, which has been developed by DSC since 1994 (see Simmonds and Still, 1998; Simmonds, forthcoming). DELTA has been applied to Edinburgh and to Greater Manchester, and in an extended regional form (see below) to the Trans-Pennine region. A rather similar model, URBANSIM, is currently being applied in the USA to Eugene/Springfield (Oregon) and is to be applied to the Salt Lake City region.

RETRO/IMREL was applied in Oslo, SAMPERS/IMPREL in Stockholm and EMME/2-SPM in Madrid [6]

Suppliers/Sources/Further readings

Land-Use / Transport Interaction Models

TAG Unit 3.1.3 http://www.webtag.org.uk/webdocuments/3_Expert/1_Modelling/3.1.3.htm

Economic Evaluation and Transport Modelling: Theory and Practice John Bates, Independent Consultant in Transport Economics http://www.ivt.baug.ethz.ch/allgemein/slides/bates.pdf

MEPLAN (Echenique et al, 1990) and TRANUS (de la Barra, 1989) are both commercial packages developed from a set of models devised at the Martin Centre at the University of Cambridge(1) . Both MEPLAN and TRANUS (http://www.modelistica.com./tranus_english.htm) have been applied in policy and research studies both in the UK and abroad since the 1980s. Each package includes both a land use model and a multi-modal transport model, and is usually implemented as a quasi-dynamic model. There are many similarities in the broad approach adopted by the two packages.

Literature:

Nellthorp John, Institute for Transport Studies, University of Leeds UK, European innovations in multi-modal assessment: how will they support and enhance the public political process- presented at the NECTAR Conference Espoo Helsinki 2001 www.vtt.fi/rte/projects/nectar/nellthorp_paper.doc

Strengths

Very quick assessment possible once the rules are defined.

[6] Minken Harald Institute of Transport Economics Oslo et al, Developing Sustainable Urban Land Use and Transport Strategies – A Methodological Guidebook, Prospects Procedures for recommending Optimal Sustainable Planning of European City Transport Systems 2003 p. 185ff

Calculation of immissions and exposure

Alias/related tools
Dispersion, propagation, spread models, Air/Water quality/noise modelling and population exposure tools

Short Description
Mathematical procedures are employed to estimate the ambient air/ground and surface water quality entities (i.e. concentrations, deposition, exceedances). In general term a distinction between process-oriented models and statistical models can be made. Process oriented models are based on the description of physical/chemical processes: starting with emissions, atmospheric advection and dispersion, chemical transformation and deposition is calculated. This type of model is able to give a description of cause-effect relations. Statistical models are valuable tools in the diagnostic of present air quality by means of interpolation and extrapolation of measuring data.
Although atmospheric models are indispensable in air quality assessment studies, their limitations should always be taken into account. However, Models can be used for estimating past, present and future air quality, provided that information on emissions is available. Uncertainties in model results may be large; uncertainties are both introduced by the model concept and by the input parameters (emission data, meteorology). The model results may be representative to a limited degree. In most models an implicit spatial and temporal average is introduced. This may make it difficult to perform a direct comparison with measurements at one location at a given moment. Input data results from emission inventories (CORINAIR [7], TEMOVE.org) or simulation of traffic operation

Main purpose
Evaluating the compliance of the expected impacts to environmental regulations, determining immission data for exposure as basis to quantify the costs in a CBA. Developing and testing strategies.

Strengths
Once a model has been developed, the further application of the model will be relatively cheap- this supports the evaluation of alternatives and sensitivity testing.

Weaknesses
Collecting the necessary input data might be cumbersome, limitation of modelling regarding complexity of mass transport phenomena, chemical reactions and reasonable thresholds. This is especially true for air toxics and chemical emergencies where mathematical expressions are often estimates. [8] Over reliance on models is prejudicial and leads to neglecting of other issues. [9]

Application Examples/References
Most applications relate to the urban environment (Budapest/Helsinki metropolitan area [10])
But there are also examples for noise impacts in silent areas. [11]

[7] EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition September 2004 UPDATE http://reports.eea.eu.int/EMEPCORINAIR4/en/page016.html

[8] http://reports.eea.eu.int/92-9167-028-6/en/page005.html and Snynder Comparative Ecological Risk Assessment Methodology: Approaches and unresolved Questions www.wced.org/publications/ComparativeEcolRiskAsses.htm

[9] Minken Harald Institute of Transport Economics Oslo et al, Developing Sustainable Urban Land Use and Transport Strategies - A Methodological Guidebook, Prospects Procedures for recommending Optimal Sustainable Planning of European City Transport Systems 2003 p. 25

[10] http://lib.hut.fi/Diss/2001/isbn9512257599/article4.pdf

[11] Declan Waugh, Sevket Durucan, Anne Korre, Oliver Hetherington and Brendan O'Reilly By SWS Environmental Services, SWS Group ENVIRONMENTAL QUALITY OBJECTIVES Noise in Quiet Areas (2000-MS-14-M1) Synthesis Report Prepared for the Environmental Protection Agency

Calculation of immissions and exposure (continued)

Suppliers/Sources/Further readings

Models:

DYMOS Dynamic Models for Smog Analysis, air pollution dispersion and photochemistry models [12]
http://www.ercim.org/publication/Ercim_News/enw34/sydow2.html
MEET/COPERT III emission calculation methodology
http://vergina.eng.auth.gr/mech/lat/copert/copert.htm
The RASTER methodology K. Spiekermann http://www.wspgroup.fi/lt/propolis/slideshows.htm
RAINS calculates emissions directly from fuel consumption, by using fuel and vehicle specific emission factors in terms of emissions per unit of fuel. [13] http://www.iiasa.ac.at/rains/Rains-online.html?sb=8
EXPAND EXPosure to Air pollution, especially to Nitrogen Dioxide and particulate matter
http://www.fmi.fi/kuvat/syttyreport2002.pdf
KOPRA - An integrated model for evaluating the emissions, atmospheric dispersion and risks caused by ambient air fine particulate matter, (2002-2005). http://www.fmi.fi/research_air/air_47.html
ARTEMIS develops new emission factors for all modes and all pollutants http://www.trl.co.uk/artemis/index.htm
PARTICULATES specifically focuses on PM size distributions - see http://vergina.eng.auth.gr/mech/lat/particulate

Risk assessment:

Spatial Analysis and Decision Assistance http://www.tiem.utk.edu/~sada/download.html

Literature: see also http://airnet.iras.uu.nl/inventory/index.php

de Leeuw F., Berge E., Grønskei, K. and Tombrou M. (1995), Review on requirements for models and model application, Report of the European Topic Centre on Air Quality to the European Environmental Agency.
Olesen H.R. and Mikkelsen T., eds. (1992), Proceedings of the Workshop "Objectives for Next Generation of Practical Short-Range Atmospheric Dispersion Models", Risiø, Denmark (available at NERI, P.O.B. 358, DK-4000 Roskilde).
Norwegian Meteorological Institute, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe PART I Unified EMEP Model Description. http://www.emep.int/index_model.html

[12] ptv Very large networks in traffic and environmental simulation: applications and first results 2000

[13] TREMOVE Report for: European Commission DG ENV Directorate C - Air and Chemicals Service Contract B4-3040/2003/366851/MAR/C.1 TREMOVE 2.30 Model and Baseline Description FINAL REPORT 18 February 2005

Cost benefit analysis CBA

Alias/related tools
Cost-effectiveness analysis (CEA), Cost-utility analysis (CUA) computable general equilibrium (CGE)

Short Description
Cost-benefit analysis (CBA) is a method to evaluate the net economic impact of a public project.[14] The calculus of social costs and benefits seeks to measure the value of the resources used by and the benefits created by the plan or programme. A CBA consist of the following steps:

- Documentation of the Settings/assumptions
- Calculation of Costs
- Calculation of Benefits
- Discount Costs and Benefits
- Evaluate Alternatives
- Perform a Sensitivity Analysis

Basics approaches (which may be combined) are[15]:

- market price approaches (e.g. productivity method)
- revealed preferences approaches (e.g. travel cost method)
- stated preferences approaches (e.g. contingent valuation method)
- imputed preference (e.g. replacement cost method)
- market stall: combination of stated preference and deliberate valuation in a group based deliberative fora

The CBA should give benefits to Business Users, Transport Providers and Consumers. If factor costs are used, tax revenues should not be counted as benefits [16]

Main purpose
To justify public expenses. CBA may also be used to minimise absolute monetised impacts of variants (against the do nothing variant).

Strengths
Withstands misinterpretation giving a clear ranking based on one indicator summarising most environmental impacts (Noise, Local Air Quality, Greenhouse Gases, Journey Ambience, Accidents, Consumer Users, Business Users and Providers, Reliability, Option Values). It allows simulating different monetary strategies (taxation, fees, subsidies…).

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[14] Mysiak Jaroslav; UFZ Centre for environmental research Leipzig, Development of transferable multicriteria decision tools for water resource management

[15] Dr Douglas MacMillan University of Aberdeen with contributions from Dr Bob Ferrier, Macaulay Land Use Research Valuation of Air Pollution Effects on Ecosystems: A Scoping Study Report http://www.defra.gov.uk/environment/airquality/ecosystem/pdf/airpolln_ecovalue.pdf
Institute and Prof. Nick Hanley, University of Glasgow

[16] Commission for integrated Transport High-Speed Rail: international comparisons www.cfit.gov.uk/research/hsr/ac.htm

Cost benefit analysis CBA (continued)

Weaknesses

Monetisation of future use or non-use of resources is likely to produce high uncertainties. Comparison of European methodologies revealed double counting and overestimation of benefits deeply embedded into the methodology.[17] CBA is "reason blind" i.e. the cause of the willingness to pay (stated or revealed preferences) or the utility is not restricted introducing a bias into the decision process.[18] Appraisal summary tables should be used to bring together non monetised environmental and social impacts like intergenerational equity and

Application Examples/References

TREMOVE Report for: European Commission DG ENV Directorate C - Air and Chemicals Service Contract B4-3040/2003/366851/MAR/C.1 TREMOVE 2.30 Model and Baseline Description FINAL REPORT 18 February 2005
www.tremove.org

Suppliers/Sources/Further readings

ITEA, COBA User Manual with accompanying COBA software http://www.official-documents.co.uk/document/deps/ha/dmrb/vol13/sect1/13s1p8.pdf
ITEA, Transport Users Benefit Appraisal User Manual, TUBA User Guidance with accompanying TUBA software http://www.dft.gov.uk/stellent/groups/dft_econappr/documents/page/dft_econappr_507990.pdf
ExternE Externalities of Energy http://www.externe.info/
Literature:
Dr Douglas MacMillan University of Aberdeen with contributions from Dr Bob Ferrier, Macaulay Land Use Research Valuation of Air Pollution Effects on Ecosystems:
A Scoping Study Report
http://www.defra.gov.uk/environment/airquality/ecosystem/pdf/airpolln_ecovalue.pdf
National Transport Model - Working Paper 4 (welfare module)
http://www.dft.gov.uk/stellent/groups/dft_econappr/documents/pdf/dft_econappr_pdf_024023.pdf
Cost Benefit Analysis TAG Unit 3.5.4
http://www.webtag.org.uk/webdocuments/3_Expert/5_Economy_Objective/3.5.4.htm
Summary of NTF seminar on Cost Benefit Analysis in the Nordic Countries 7-8 December 2004 organised by NTF (Nordic Transport Research)
http://www.ntf-research.org/NTF-hjemmeside/konference071204/NTF%20seminar.pdf
Leleur, Steen; Holvad, Torben; Salling, Kim Bang & Jensen, Anders V. "Development of the CLG-DSS Evaluation Model" Published in:
CLG report series - report no. 1 - april 2004
http://www.ctt.dtu.dk/projects/clg/downloads/pdf/2004/MidtermReport_CLG_Task_9.pdf

[17] Commission for integrated Transport High-Speed Rail: international comparisons

[18] Dr. John O'Neill, Deliberation and its discontents, The University of Lancaster, United Kingdom http://www.arbld.unimelb.edu.au/envjust/papers/allpapers/oneill/home.htm

[19] New Approach to Appraisal http://www.webtag.org.uk/overview/appraisal.htm

Cost benefit analysis CBA (continued)

Tavistock Institute, GHK Consulting Ltd. and IRS, NEW GUIDE to evaluating socio economic development and associated resource materials:
http://www.evalsed.info/SRC/sourcebook2/techniques4_1.htm
Steer Davis Gleave, Guidance on Full Local Transport Plans
Department of the Environment, Transport and the Regions, Design Manual for Roads and Bridges, Volume 12
Sugden (1999) , Review of cost/benefit analysis of transport projects
IHT (1996), Guidelines for Developing Urban Transport Strategies (Chapter 6)
The MVA Consultancy, Oscar Faber TPA and ITS, Leeds (1994), Common Appraisal Framework for Urban Transport Projects. Report to Birmingham City Council and the Department of Transport
Rainer Friedrich, Peter Bickel, Environmental External costs of Transport, 2001
Minken Harald Institute of Transport Economics Oslo et al, Developing Sustainable Urban Land Use and Transport Strategies - A Methodological Guidebook, Prospects Procedures for recommending Optimal Sustainable Planning of European City Transport Systems 2003 p. 136ff

Life cycle assessment LCA

Alias/related tools
LCA

Short Description
Life Cycle Assessment (LCA) is a specific method among the MCDA Methods. Life Cycle Assessment is a technique for assessing the potential environmental aspects and potential aspects associated with a product (or service), by:

- compiling an inventory of relevant inputs and outputs,
- evaluating the potential environmental impacts associated with those inputs and outputs,
- interpreting the results of the inventory and impact phases in relation to the objectives of the study

Life-cycle assessments (LCAs) involves cradle-to-grave analyses of production systems and provide comprehensive evaluations of all upstream and downstream energy inputs:

- vehicle operation (comprising vehicle travel and pre-combustion)
- vehicle maintenance, manufacturing and disposal
- transport infrastructure construction, operation and disposal

LCA results comprise at least energy but may also include emissions into air and water, land use and depletion of natural resources.

Main purpose
LCA may be used in the scoping phase to determine the system boundaries for the evaluation of environmental effects for the different modes (which will give different system boundaries to be included) . LCA may also support CBA by including upstream and downstream impacts.

Life cycle assessment LCA (continued)

Strengths
Comprehensive analysis of impacts including erection and decommissioning of transport infrastructure. LCA serves as validation for the system boundaries used in the evaluation of the environmental effects.

Weaknesses
Apart from energy it is very difficult to quantify emissions from all possible processes, requiring huge emission inventories. Processes might differ from country to country, energy demand is answered by energy markets which might change the supply chain rapidly changing/relocating also pre combustion processes. LCA is an unnecessary effort for infrastructure with high usage figures, it is only necessary for well-lit streets with low usage and low frequency operated local rail. [20]

Application Examples/References
INTERREG III B Project Alp Frail Operational Solutions for the transalpine railway freight traffic for sustainable management of connections of the economic areas within the alpine space http://www.deutscher-verband.org/seiten/dv-ev-projekte/downloads/Alp_Frail-Kurzdarstellung-CADSES-en.pdf http://www.alpfrail.com/
Complete Life Cycle Assessment for Vehicle Models of the Mobility CarSharing Fleet Switzerland Gabor Doka, Doka Life Cycle Assessments Sabine Ziegler, Mobility Car Sharing Switzerland Conference paper STRC 2001 Session Emissions www.strc.ch/doka.pdf

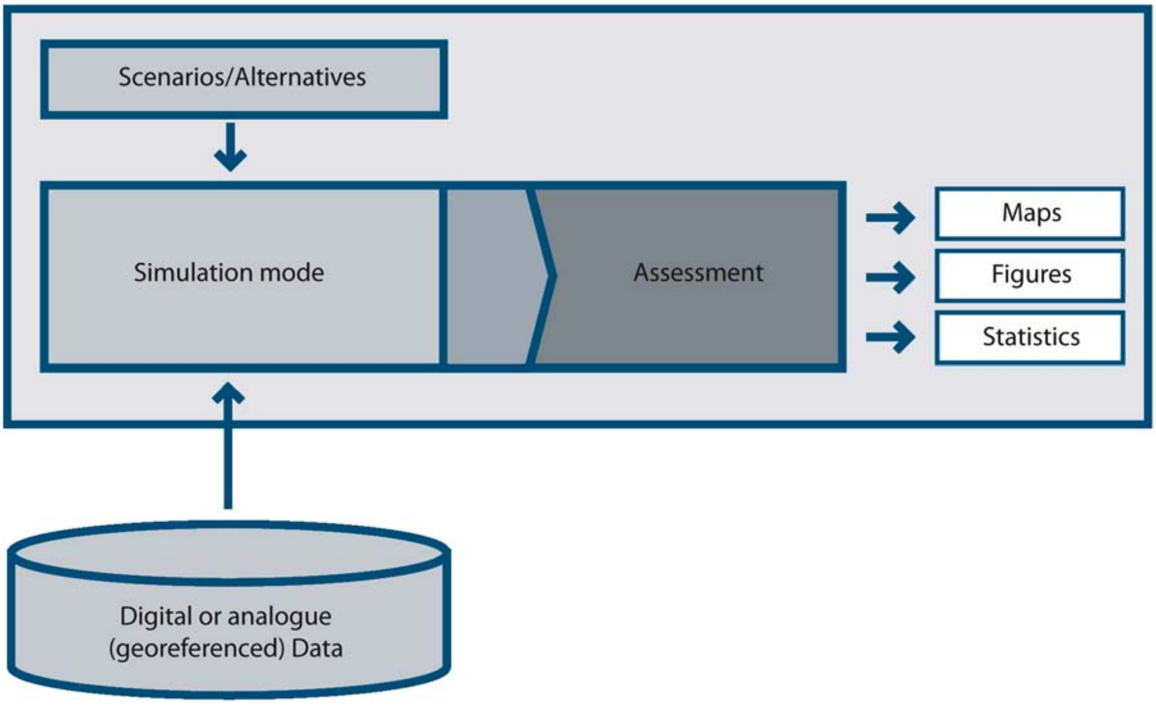
Suppliers/Sources/Further readings
Literature:
Håkan Stripple Martin Erlandsson IVL, Methods and Possibilities for Application of Life Cycle Assessment inStrategic Environmental Assessment of Transport Infrastructures
Peter Meibom, Technology Analysis of Public Transport Modes; Department of Energy Planning RAMBØLL and BYG-DTU Department of Civil Engineering Technical University of Denmark
Global Emission Model for Integrated Systems GEMIS http://www.oeko.de/service/gemis/en/index.htm
Software:
SimaPro http://www.pre.nl/simapro/simapro_lca_software.htm
Umberto http://www.umberto.de/de/
Gabi http://www.environmental-expert.com/software/pr_eng/pr_eng.htm
Demo-Download: http://www.environmental-expert.com/software/pr_eng/form.htm
ETH-ESU http://www.pre.nl/download/manuals/DatabaseManualETH-ESU96.pdf
IKARUS http://www.ikarus.iao.fhg.de/
Greet model ANL http://greet.anl.gov/publications.html
E2database LBST http://www.waterstof.org/20030725EHECO3-48.pdf
More LCA Databases and Software Packages: http://www.sematech.org/docubase/document/4238atr.pdf

[20] Peter Meibom, Technology Analysis of Public Transport Modes; Department of Energy Planning RAMBØLL and BYG-DTU Department of Civil Engineering Technical University of Denmark

Intelligent Geographic information Systems, GIS

Alias/related tools
GIS based assessment workbench, Environmental Information System

Short Description
Geographic Information Systems (GISs) are very powerful tools for the display of information on a geographical basis. Background information, such as designated areas, can be assembled in the GIS, along with detailed background mapping. A database is usually associated with a GIS in order to store information relating to the appraisal of each of the options tested. From this source, information from the appraisal can be displayed geographically, either for options individually or as a means of making comparisons between options.
The application of geographical information systems (GIS) in SEA has proved a useful tool. However, as with any data its value is dependent on the quality of the database with interpretation guided by understanding the context and limitations of that data. For example, planning a route only to avoid protected areas could overlook the dynamic aspects of landscapes such as migration paths between protected areas, or the relationship between protected areas and other dependent landscapes, such as a river catchments.
GIS is able to contribute in a couple of steps in SEA but it has also the capability to act as binding layer allowing to integrate simulation and assessment logic.
The GIS then holds the data and produces Maps, figures and statistics. The modelling and the assessment may by done in separate tools exporting and re-importing data, via DLL or via scripts written directly in the GIS.
Furthermore GIS embeds tools for generalising/cleansing data.



Intelligent Geographic information Systems, GIS

Main purpose
GIS is mainly used in the screening process - map overlay, presenting impact data or integrating the complete impact assessment. Also preparation of data and acting as presentation tools also for the internet belongs to the standard repertoire. Deeper embedding into the SEA is possible/feasible if all the necessary data already exist in a GIS and simulation modules can be linked/embedded in the GIS.

Strengths
GIS incorporates a lot of tools to handle spatial data and requires no programming knowledge (apart from the scripts). The real strength of GIS lies in its ability to combine computer-assisted mapping with statistical analysis of spatial data to perform spatial modelling

Weaknesses
Large datasets lead to a break down of the interactive usage concept. Stand alone simulation tools may be better suited for high computational loads. Although not explicitly said GIS-algorithms often relay on vector data which are expensive to generate.

Application Examples/References
Leleur Steen, Centre for Traffic and Transport CTT technical University of Denmark ;ASTRA New Analysis Methods in Transport Planning with Special Emphasis on Multi Criteria Analysis and geographical Information Systems, 2001
Impact analysis - Betuwe freight railway in Beinat Euro, A methodology for policy analysis and spatial conflicts in transport policies
Strategic Impact Analysis SIA for the multi-modal infrastructure linking Paris, France and Brussels, Belgium by means of the North Corridor.
"Raster-Net": The INRETS/DEST's tool for spatial forecastings of european networks
http://www.inrets.fr/ur/dest/europe/pagewebrastergrid.htm#English
Impacts of Exposure to different noxes in Europe
http://europa.eu.int/comm/environment/air/cafe/general/pdf/cafe_lot1.pdf
WRAP Review Application - A GIS-Enabled Application to Assist Environmental Assessment of Wetlands
A GIS Analysis Tool To Determine The Environmental Impact Of Transportation Corridors (USA)
Use of a GIS to identify environmental constraints for large-scale projects: Interstate 70 transportation corridor (USA)
The effects of highway transportation corridors on wildlife: a case study of Banff National Park (CAN)

Suppliers/Sources/Further readings

Suppliers:

www.ESRI.org
www.intergraph.com
www.autodesk.com
GIS-based Traffic Noise Prediction www.mapnoise.com/336.html

Literature:

Michel Patrick, Manier Thierry, BCEOM, L'evaluation environmental des plan es des programmes de transport - L'intérêt de la géomatique p. 63
Conference on Good Practice in Integration of Environment into Transport Policy (10-11/10/2002) http://europa.eu.int/comm/environment/gpc/pdf/ws2a_bernotat.pdf
Land use changes and GIS-database development for Strategic Environmental Assessment in Ha Long Bay, Quang Ninh Province, Vietnam www.vub.ac.be/MEKO/Vietnam/EU/Duong2.html
Automatic Generalization of Geographic Data VBB Viak http://129.187.175.5/publications/meng/paper/generalization1997.pdf
Uitenboogaart Hanno, Vermeij Bert, Traffic models for inland shipping in a GIS environment http://gis.esri.com/library/userconf/proc01/professional/papers/pap1077/p1077.htm

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Michel Patrick, Manier Thierry, BCEOM, L'evaluation environmental des plan es des programmes de transport - L'intérêt de la géomatique p. 63
Conference on Good Practice in Integration of Environment into Transport Policy (10-11/10/2002) http://europa.eu.int/comm/environment/gpc/pdf/ws2a_bernotat.pdf
Land use changes and GIS-database development for Strategic Environmental Assessment in Ha Long Bay, Quang Ninh Province, Vietnam www.vub.ac.be/MEKO/Vietnam/EU/Duong2.html
Automatic Generalization of Geographic Data VBB Viak http://129.187.175.5/publications/meng/paper/generalization1997.pdf
Uitenboogaart Hanno, Vermeij Bert, Traffic models for inland shipping in a GIS environment http://gis.esri.com/library/userconf/proc01/professional/papers/pap1077/p1077.htm

Decision support tools MCA

Alias/related tools
Multiple attribute decision making MADM, Multiple objective decision making MODM, Multi criteria decision aid MCDA, Multicriteria aggregation procedure MCAP, expert systems.

Short Description
There are two subgroups of MCA:
MADM may be implemented as outranking relation-based or utility function based and works with a restricted set of alternatives. Methods employed are the weighted linear combination of criteria into objective values or the Concordance-disconcordance analysis.
A standard feature of MADM is a performance matrix, or consequence table, in which each row describes an option and each column describes the performance of the options against each criterion. The individual performance assessments are often numerical, but may also be expressed as 'bullet point' scores, or colour coding.
MADM techniques commonly apply numerical analysis to a performance matrix in two stages:
1. Scoring: the expected consequences of each option are assigned a numerical score on a strength of preference scale for each option for each criterion. More preferred options score higher on the scale, and less preferred options score lower. In practice, scales extending from 0 to 100 are often used, where 0 represents a real or hypothetical least preferred option, and 100 is associated with a real or hypothetical most preferred option. All options considered in the MCA would then fall between 0 and 100.
2. Weighting: numerical weights are assigned to define, for each criterion, the relative valuations of a shift between the top and bottom of the chosen scale.
MODM works with objective functions and constraints on a continuous solution space using vector optimising as methodology. Aggregation is based on the decision makers preferences expressed as target values for the objectives. The output is defined as non-dominated solutions reducing the initial set of solutions. Calculation and dialogue steps are combined in the MODM software.
The objective may be also quantified using fuzzy methods. This gives a probability distribution as result which allows to use statistical test to determine if the alternative differ significantly.

Main purpose
MCA techniques can be used to identify a single most preferred option, to rank options, to short-list a limited number of options for subsequent detailed appraisal, or simply to distinguish acceptable from unacceptable possibilities.

Decision support tools MCA (continued)

Strengths

MCA has many advantages over informal judgement unsupported by analysis:

- it is open and explicit;
- the choice of objectives and criteria that any decision making group may make are open to analysis and to change if they are felt to be inappropriate;
- scores and weights, when used, are also explicit and are developed according to established techniques. They can also be cross-referenced to other sources of information on relative values, and amended if necessary;
- performance measurement can be sub-contracted to experts, so need not necessarily be left in the hands of the decision making body itself;
- it can provide an important means of communication, within the decision making body and sometimes, later, between that body and the wider community; and
- scores and weights are used, it provides an audit trail.

MODM requires less a priori information on the decision maker's preferences and thus is suited for group working.

Weaknesses

One limitation of MCA is that it cannot show that an action adds more to welfare than it detracts. Unlike CBA, there is no explicit rationale or necessity for a Pareto Improvement rule that benefits should exceed costs. Thus in MCA, as it is also the case with cost effectiveness analysis, the 'best' option can be inconsistent with improving welfare, so doing nothing could in principle be preferable.

Application Examples/References

Danish Road Directorate ASTRA

- Danish Road Directorate Method VD reference
- Analytical Hierarchy Process AHP
- Simple Multiattribute Rating techn SMART
- Composite Method COSIMA
- Outranking ELECTRE version FEIDA

Laaribi has analysed also the following MCAPs :

- PROMETHEE
- SMART
- ZAPROS
- MELCHIOR
- ORESTE
- QUALIFLEX
- REGIME
- PROTRADE
- STRANGE
- PROMISE

EIAxpert: An Expert System for screening-level EIA
Fedra, K., Winkelbauer, L. and Pantulu. V.R. (1991)
Expert Systems for Environmental Screening
An Application in the Lower Mekong Basin.
RR-91-19. International Institute for Applied Systems Analysis. A-236l Laxenburg, Austria. 169p.

Suppliers/Sources/Further readings

Literature:

Multi-criteria analysis manual
http://www.odpm.gov.uk/stellent/groups/odpm_about/documents/page/odpm_about_60852405.hcsp#P252_38963

Software:

EIAxpert: rule-based screening-level EIA
http://www.ess.co.at/EIA/

HIVIEW Decisions and Designs, Inc., Krysalis and Enterprise LSE Ltd.
HIVIEW has the capacity to solve large and complex MCDA problems. It allows the value tree to be both visually created and edited. A variety of graphical input and output displays is available including visual support for data input, comparisons of options by the importance of their weighted criteria (Figure 7.11) and efficiency frontier presentation of overall costs and benefits (Figure 7.12). It also provides a mechanism for sensitivity analysis to test robustness (Figure 7.20). Input data can be exported to a spreadsheet for further modelling, then imported back into HIVIEW
http://www.catalyze.co.uk/hiview/hiview.html
Demo-Download:
http://www.catalyze.co.uk/search.html?/downloads2.htm

MACBETH supports the process of taking possibly incomplete qualitative judgements about the difference in attractiveness of pairs of options and converting them into numerical scores. These scores are entirely consistent with the qualitative pairwise judgements. The MACBETH approach can also be applied to determining criteria weights. MACBETH is particularly useful in public-sector applications when a new program, MULTI-MACBETH provides MCDA modelling along with the MACBETH scoring and weighting approach.
The authors are Carlos Bana e Costa, Jean-Marie De Corte and Jean-Claude Vansnick. For further information, contact Carlos Bana e Costa at
cbana@alfa.ist.utl.pt
http://w3.umh.ac.be/%7Esmq/macbeth.html
http://alfa.ist.utl.pt/~cbana/Multicriteria%20value%20measurement.pdf

V.I.S.A is another Windows-based implementation of the basic MCDA model. It is marketed by Visual Thinking and has been developed at Strathclyde University.
Its functionality is broadly similar to that of HIVIEW. It, too, permits on-screen creation and editing of the value tree and provides similar input and output display possibilities.

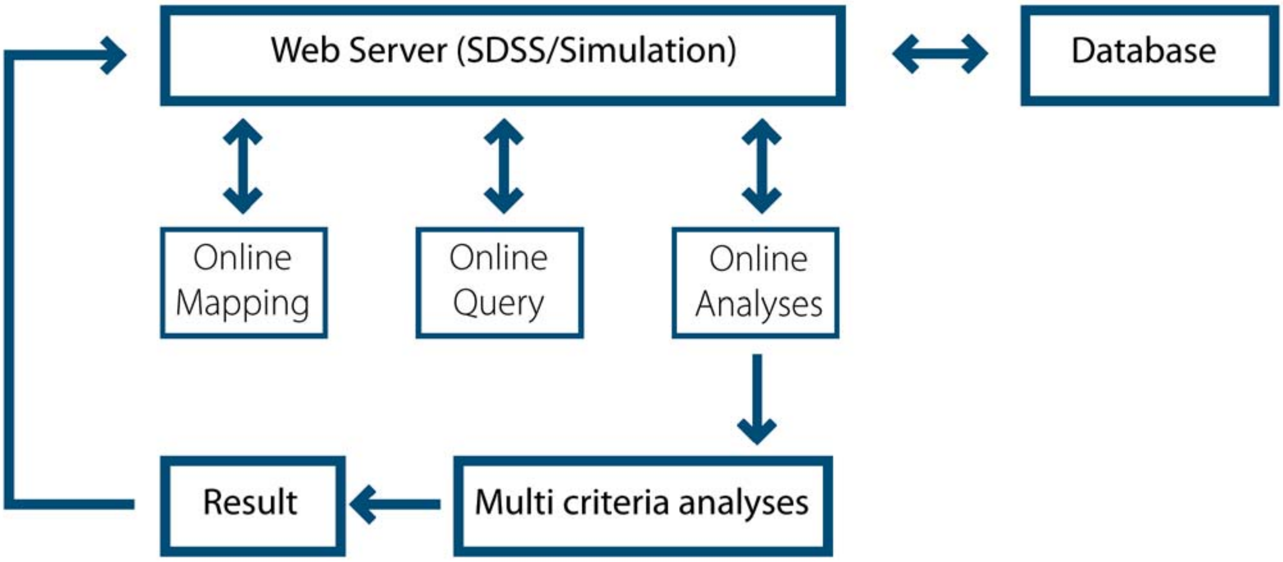
DESYSION DESKTOP supports application of the MCDA model in a Windows environment. Developed by the company DecideWise International BV in Amsterdam, it implements MCDA in a way that places special emphasis on guiding decision makers through the whole of the overall process of decision making.
http://www.decidewise.com/uk/downloads/desktop.pdf
Demo-Version:
http://www.decidewise.nl/downloads/desktop_demo.exe

OTHER PACKAGES that can provide support to implement the basic MCDA model include the Logical Decisions Package and HIPRE 3+. The latter supports the implementation of a number of different MCA support procedures, including both basic MCDA and AHP.
Apart from HIPRE 3+, support for AHP implementation is available also through the Expert Choice package
http://www.sal.hut.fi/Publications/pdf-files/pham94.pdf, http://www.sal.tkk.fi/Downloadables/,
Demo-Version:
http://www.sal.hut.fi/Downloadables/hpdemo.exe

IGP Information Sharing, Group decision taking and Public involvement tools

Alias/related tools
Web GIS, Web based decision support systems, groupware

Short Description
IGP tools may have different functionalities. In a basic version Web-based GIS is used to give feedback but it is also possible to set up interactive web pages allowing to alter the objectives and weighting in MCAs to allow the public to test the robustness of the decision. In an extended version, user may add/change variants. The tool includes a web based interface which may access server side modules producing overlay maps with output indicators, aggregating pressure indicators and comparing variants. Other architecture may use client based logic (java).



Main purpose
To present information and transport knowledge in an interactive way to as many citizens as possible in order to explain the decision procedure.

Strengths
Gives easy access to the impact assessment models and data. May be used to compile statistics about weighting of the public. Allows users to annotate in the online maps and collect statement with little effort.

IGP Information Sharing, Group decision taking and Public involvement tools (continued)

Main purpose
To present information and transport knowledge in an interactive way to as many citizens as possible in order to explain the decision procedure.

Strengths
Gives easy access to the impact assessment models and data. May be used to compile statistics about weighting of the public. Allows users to annotate in the online maps and collect statement with little effort.

Weaknesses
Only internet users benefit from the tool. Simplification of models may be necessary to achieve a good performance reducing the quality of the impacts assessment.

Application Examples/References
Virtual Slaithwaite Participatory Planning System
http://www.ccg.leeds.ac.uk/mce/mce-home.htm
Stone Forest Spatial Decision Support System

Suppliers/Sources/Further readings
Steve Carver Institute for Geography University of Leeds
http://www.ncgia.ucsb.edu/research/i17/htmlpapers/tomlinson/Tomlinson.html
Taylor & Francis Publishers, UK GIS for Group Decision Making Piotr Jankowski University of Idaho and Timothy Nyerges University of Washington
http://faculty.washington.edu/nyerges/gisgdmab.pdf

2. COMMUNICATION AND REPORTING

This fact sheet is divided into seven sections. Section A establishes what is understood by communication and reporting. The expected achievements are then outlined in section B. This is followed by section C, which describes communication and reporting throughout the SEA process. Sections D and E look at the practice of communication and reporting, providing an overview of the actors involved and of key tools and methods applied. Section F presents two examples for communication and reporting. Finally, section G lists sources for further reading and a list of legislative requirements within a European context.

What is the issue

SEA is a systematic, participative, transparent and integrated process. It is a decision-making support tool, which allows to expand the focus of a policy, plan or programme by:

- bringing together different perspectives and inputs (e.g. environmental, social and economic)
- combining the use of different techniques (e.g. environmental prediction and management)
- opening the decision-making platform to the needs and perceptions of different stakeholders.

Public communication and participation are integral parts of the SEA process, contributing to the overall effectiveness of SEA. In order to allow interested parties and affected stakeholders to play a role in the development of the final PPP, a systematic, integrated and transparent SEA process is needed. In this context, effective communication and public participation means that initial ideas may be revised and reshaped. Figure 1 visualises the key role of communication and participation in the SEA process.

A well-performed SEA effectively informs and involves interested and affected stakeholders throughout the process. Furthermore, it addresses the general public's input, making it explicit in reporting, and supporting its effective consideration in the decision-making process and effective communication. Finally, effective SEA also ensures that the general public is given sufficient access to information.

Whereas frequently, the terms communication, participation and reporting are used in an interchangeable way, they actually mean different

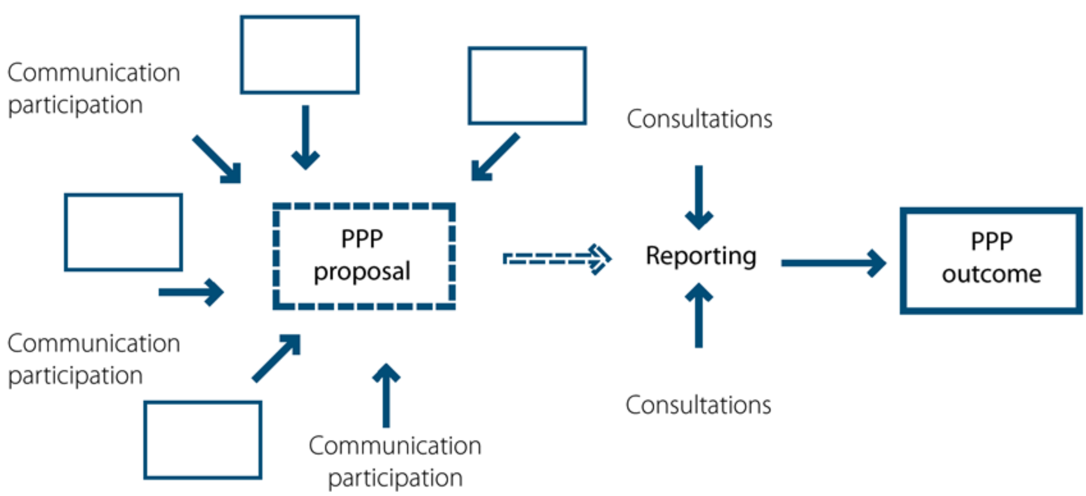


Fig. 1 The strategic decision support system

Box 1 Definitions	
Communication	One-way process, in which the objective is to inform and assist the public towards understanding of problems, alternatives, opportunities and solutions
Participation	Engagement process, in which the public is called to contribute to the decision-making process by exchanging information, predictions, opinions, interests and values
Reporting	Documentation process, summarising the SEA. Reporting results in an available written document for consultation, on the basis of which the public can make its comments, and SEA and planning teams can obtain feedback on the analyses made, alternatives developed or decisions made

things, representing different degrees of involvement, ranging from simple information to the full involvement of actors, as is shown in Box 1 (following Arnstein's, 1969, ladder of participation, and the spectrum for public participation developed by the International Association for Public Participation, IAP2, http://www.iap2.org):

What are the expected achievements?

In SEA, communication, participation and reporting have an important role to play in the decision-making process by introducing perspectives and inputs of different stakeholders to the PPP-making process. Expected achievements arising can be sub-divided into two main streams:

1. Long-term public empowerment:
   - leading to e.g. conflict resolution, gain of public support for future actions, increased public confidence in decision-making and in politicians, development of social ownership and belonging
2. An improved and more effective process:
   - leading to e.g. identification of public concerns, introduction of new ideas for alternatives and mitigation measures
   - ensuring that alternatives are considered and that decision-makers and proponents are accountable
   - providing opportunity to share expertise and to benefit from local knowledge and fresh perspectives into the SEA process

The practice of public participation in SEA should anticipate and, if possible, lead to avoiding the development of NIMBY (not in my back yard) and LULU (locally unwanted land-use) situations, mainly by preventing unforeseen situations that could occur at lower tiers of decision making, particularly the project level. Ultimately, this should lead to reducing costs and decision delays. The results to be achieved through communication, participation and reporting at SEA levels of decision making are likely to differ from those achievable in EIA and the general public will not necessarily be interested in all strategic issues. Therefore, normally a decision needs to be made on who should be involved. This is further discussed in section D.

When should communication and reporting happen?

Stakeholders and relevant interest groups (e.g. industry, agriculture, households, business and services) should be fully engaged in decision-making processes that concern sustainable transportation. Furthermore, as mobility is highly valued at a personal level and for social and economic reasons, the general public also plays an important. The extent to which the general public will want to be involved is likely to depend on the specific decision making situation. Whereas, for example, in more policy related situations, the general public can be expected not to show a great degree of interest, once more project related decisions are under consideration, this is likely to be very different.

In transport SEA, public communication and involvement are undoubtedly difficult tasks, especially when the SEA concerns large-scale infrastructure projects, affecting different conflicting interests. An important question therefore is when exactly to involve the public and relevant stakeholders in the SEA process. The SEA Directive and Protocol require the consultation of environmental authorities (i.e. government agencies and NGOs) during the scoping stage and on the draft SEA report. In addition, the international professional literature suggests that public input should occur throughout the whole SEA process, i.e. public participation and communication should be an integral part of SEA. Interest groups as well as the general public can contribute to the following tasks:

- defining SEA objectives
- supporting comprehensive baseline information
- identifying alternatives
- choosing between alternatives
- identifying mitigation measures
- ensuring the effective implementation of the proposed PPP.

From the very early stages of the strategic decision-making process, ie when setting the context for PPP making and SEA, decisions concerning who should be involved in the process need to be made (including the public, NGOs and other authorities). Information should be communicated with a view to the groups involved in SEA and PPP making.

The participative process preceding the preparation of an SEA report is of great importance. Reporting should include a description of this process, thus providing authorities, NGOs, consultants and the general public, with a documented basis for following up the environmental and sustainability considerations that have been taken into account.

Reporting may either occur at the end of the decision-making process with the preparation of a final document, or throughout the various stages of the SEA process, with the writing up of smaller reports which ultimately are brought together in a final report. Reporting may also occur through information bulletins and websites. In general, the information to be included in the SEA reports varies according to legal requirements. Within the European context, Annex I of the SEA Directive and Annex IV of the SEA Protocol (see section G) specify the minimum requirements member States must comply with when producing an SEA report.

Actors involved

An SEA may be conducted by the competent authority, by a consultant or as a shared effort. The actors responsible for enabling communication and participation should be the same as those responsible for the SEA process as a whole.

The responsible authority for an SEA will vary according to the type of PPP and to the scale of the proposed PPP. Considering the wide range of cross-cutting and conflicting issues transport SEAs usually tackle, the competent authority is likely to involve a variety of departments with a wide range of competences, e.g. pollution, health, environment, services, business, etc. Consequently, the target audience will involve a wide range of stakeholders, representing different community needs (e.g. rural versus urban), means of transport (cyclists versus drivers, etc.) or interests (e.g. economic, social or environmental) and the competent authority will need to report to different types of audiences; these are described in Box 2.

Box 2 Audiences involved in the reporting process

- The public (i.e. person or group of people that have an interest or a stake in the issue under consideration), information on why certain alternatives were chosen and how significant impacts will be mitigated
- Organisation responsible for quality control, which will also require information on the SEA methodology adopted in order to assess the rigor, accuracy and accountability of the process
- Consultants and academics, mainly interested in the SEA approach pursued.

Box 3 Selection of tools and methods for communicating, participating and reporting in Transport SEA

Communication	Leaflets, newsletters, newspapers, television and radio, site visits, exhibitions, telephone helplines, fact sheets, websites, open houses, etc.
Participation	Community advisory groups, workshops, visioning exercises, citizen juries, etc.
Consultation (on reporting)	Documentation process, summarising the SEA. Reporting results in an available written document for consultation, on the basis of which the public can make its comments, and SEA and planning teams can obtain feedback on the analyses made, alternatives developed or decisions made

Key tools and methods

According to the desired degree of empowerment, the literature presents a number of key tools and methods. Box 3 provides a selection of available tools and methods (following the International Association for Public Participation (http://iap2.org), Petts, Gerrard, Delbridge, Murrell and Eduljee (1996) or Sadler (2001).

There is no single tool or method that is applicable to all situations and the selection of fit for purpose methods will depend on the objectives to be achieved in the SEA and the stage of the SEA process. Tools for communication, participation and consultation may satisfy different functions. For example, a public meeting can be used for consultations, but also for communicating and providing information.

Examples

This section presents examples of communication, participation and reporting in transport SEA. Box 4 presents a problematic example in which SEA should have been applied, but where only an EIA was conducted. It shows what can occur if, those who have an issue at stake in a particular situation are not allowed to take part in the SEA/PPP process.

Box 5 presents and example in which communication, participation and reporting has enriched the overall SEA process, describing the Helsinki Metropolitan Area Transport System Plan. This shows how a participative and continuous SEA process allowed for cognitive and social learning to take place.

Further reading and European references

- IAP2, International Association for Public Participation, http://iap2.org, last accessed May 11th 2005.
- Petts J, Gerrard S, Delbridge P, Murrell L and Eduljee G (1996) Perceptions and communication issues for waste management, Research Report, CWM 151/96, Environment Agency, Bristol, UK
- Sadler B (2001) Postscript Strategic Environmental Assessment: An Aide Memoire to drafting a SEA Protocol to the Espoo Convention, in Dusik J (ed) Proceedings of international workshop on public participation and health aspects on Strategic Environmental Assessment –

Convened to support the development of the UN/ECE Protocol on Strategic Environmental Assessment to the Espoo Convention, The regional Centre for Central and Eastern Europe

Box 4 Enlargement of the intercontinental airport of Malpensa 2000, Italy.

The case: The enlargement of the Malpensa airport was subject to an EIA. However, there can be no doubt that an SEA would have been more suitable, due to the complexities and problems involved this project, which has a number of induced and indirect effects. As a consequence, the exercise failed to look at the airport within a strategic context, not taking into account the impacts and territorial transformations that would occur outside the immediate airport boundaries. Only the comuni (local governments) bordering with the airport (mainly those in the Lombardy region), were involved in the EIA of Malpensa 2000.

The issue: There was a lack of wider communication, participation and reporting to the public and stakeholders. This generated a unique public movement against Malpensa 2000.

Actors involved: different types of actors were involved in the "anti-Malpensa" movement.

- Institutional level: CUV (Consorzio Urbanistico Volontario – a voluntary consortium consisting of 9 comuni of the Lombardy region that aimed to coordinate and protect their territorial interests); the coordination of local governments of the Piedmont region (although this area had to cope with major impacts – noise and pollution – they were never involved in the consultation process concerning the strategic actions and alternatives); the coordination of Mayors of the Castanese area; the Park of the Ticino Valley.

- Political level: single representatives and group sections of political parties, associations, environmental groups and coordination groups, including also the Ecoinstitute of the Ticino Valley (groups of associates from the Lombardy and Piedmont regions and from the Ticino Canton). Their goal was to prove the airport's illegality.

- Spontaneous citizen committees: C.OVES.T (West Ticino Committee); UNI.CO.MAL (Union of committees of the Malpensa consortium for the protection of health and of the environment), Committees from the Lombardy region and from the Castanese area. These committees represented diverse identities, interests and specific goals, depending on their distance to the airport or to the flight routes.

Conclusions: the lack of public involvement extended to all those that had an interest at stake, limited the scope of the environmental assessment, the significance and the nature of the impacts to take into consideration, as well as the opportunity to chose from different strategic options. The impossibility to develop consensus on a strategic choices generated conflicts and NIMBY and LULU situations at different levels (institutional, political, public).

Box 5 Helsinki Metropolitan Area Transport System Plan (1998).

The case: the Helsinki Metropolitan Area Council (YTV) organised the planning and the environmental assessment process for the Metropolitan Area Transport System Plan. The goal was to define development objectives, decide the region's most urgent projects, describe the overall development of the regional transport system and its impacts on the environment

Actors involved: a task force was set up, including representatives from the capital city region municipalities; the Ministry of transport and communications; central administrations of rail and road traffic sectors; municipal environmental administration, the Ministry of the Environment and Ussimaa Regional Council. Local resident associations' and environmental organisations were also involved in the environmental assessment process

The issue: during the environmental assessment, discussions amongst the members of the task force and the official responses gathered from the parties involved and interest groups demonstrated how their conflicting interests were a result of the various participants' formulation of the policy issue and of their specific expectations from the SEA, as follows:

- A traffic policy view, supported by the planners of the YTV and the representatives of the environmental sector
- A regional cooperation view, supported by municipal and state representatives
- A project view, supported by municipal representatives

Conclusions: thanks to the approach adopted, the process was enriched by new ideas of impacts on social conditions, biodiversity and landscape aspects, opening-up the discussion on certain policy options previously unconsidered. This case is an example of social learning, where not only new and valuable knowledge was introduced, but thanks to the continuity of the process, the development of the regional transport system has helped participants' to reformulate their actions and increased the will and the need for cooperation in regional development.

European references

- Convention on Environmental Impact Assessment in a Transboundary Context (the EIA Convention), http://www.unece.org/env/eia/eia.htm
- Guidance on public participation in Environmental Impact Assessment in a Transboundary Context, http://www.unece.org/env/eia/publicpart_guidance.htm
- Protocol on Strategic Environmental Assessment (the SEA Protocol), http://www.unece.org/env/eia/sea_protocol.htm
- Public participation in strategic environmental decisions – Guide for Environmental Citizens organisations, http://www.unece.org/env/eia/documents/Ecoforum%20-%20PP%20in%20Strategic%20Decisions%20-%20pamphlet%2012.1.pdf
- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, http://www.unece.org/env/pp/
- Aarhus Convention, An Implementation Guide, http://www.rec.org.ba/arhusprir.pdf
- European Commission, Environmental Assessment, http://europa.eu.int/comm/environment/eia/
- EIA Directives, http://europa.eu.int/comm/environment/eia/eia-legalcontext.htm
- SEA Directive, http://europa.eu.int/comm/environment/eia/sea-legalcontext.htm
- Public participation Directive: http://europa.eu.int/eurlex/pri/en/oj/dat/2003/l_156/l_15620030625en00170024.pdf
- Governance in the EU, White Paper, http://europa.eu.int/comm/governance/white_paper/index_en.htm

3. THE CONCEPT OF TIERING IN TRANSPORT SEA

The concept of tiering in transport SEA

This fact sheet is divided into seven sections. Section A introduces the thinking behind the concept of SEA tiering. This is followed by section B, which lists expected achievements. Section C describes appropriate scales of SEA tiering and associated issues and tasks to be addressed. Section D lists key tools and methods to be used and section E identifies the various actors who may be involved in SEA at different tiers. Section F presents two European examples for current tiering practice and section G lists sources for further reading.

What is the issue?

SEA is not only supposed to support a better consideration of environmental aspects in strategic decision making by gathering and analysing information within a systematic and participative process, it also aims at enabling greater transparency and integration. SEA may support more effective streamlining of strategic planning, making connections with other PPPs explicit and helping to avoid duplications. In this context, effective tiering is of fundamental importance.

Strategic decisions preceding and leading to concrete infrastructure projects are taken at various administrative levels and systematic tiers, not just in transport planning, but in other sectors, as well, with spatial and land use planning being of particular importance. Administrative planning levels may include national, regional and local levels. Systematic tiers may consist of policies, network-plans, corridor-plans and programmes. Effective and efficient planning means that the various administrative levels, systematic tiers and sectors need to address different issues and perform different tasks that are complementary to each other. Figure 2 visualises the concept of tiering in transport and spatial/ land use planning, with which it should be integrated. Possible administrative, systematic and sectoral relationships are shown. In practice, normally tiering does not work in a strict hierarchical manner, but bottom-up feedbacks are possible. What issues may be addressed and what tasks performed at the different tiers is outlined in section C of this fact sheet.

What are expected achievements?

The main rationale behind the concept of SEA tiering is that it may help addressing the right issues at the right time in strategic transport planning. An underlying assumption is that it is possible to support more effective and efficient transport policy, network-plan, corridor-plan and programme (PPP) making, whilst at the same time achieving a better consideration of environmental aspects. A transport planning and SEA framework which identifies specific issues and tasks to be addressed and performed at different administrative levels and systematic planning tiers is thought to be able to effectively address implementation gaps. Furthermore, links between different strategic and project tiers can be made more explicit. By strengthening strategic planning frameworks and participative processes, public trust may be enhanced and good governance supported. Better co-ordination of different planning levels and tiers and increased transparency may enhance credibility and lead to wider support of key actors and stakeholders. Ultimately, a more systematic approach to decision making through effective tiering may save time and money and help to avoid environmental mistakes.

Appropriate scales of SEA tiering, associated issues and tasks

Tiering in transport planning may take place between different administrative levels and systematic tiers. Furthermore, relationships with other sectors' policies, plans and programmes need to be made explicit. If a clear and transparent transport planning framework is in place, it is possible to address certain issues and perform distinct tasks at different tiers.

This fact sheet is based on the assumption that whilst it is possible to develop a standard tiered transport planning and SEA framework, this will need to be applied in a flexible manner, according to specific transport planning systems' features and specificities. The appropriate scales, issues and tasks of tiered transport planning will therefore vary between different systems. This is further explained by the two examples provided in section F.

Generally speaking, the thinking behind both, administrative and sectoral tiering is that actors of the different decision tiers are fully aware of objectives, targets and actions of other tiers, leading to a reconciliation of inconsistencies. The thinking behind the concept of systematic tiering is that the range of concrete, site specific issues increases from policy down to project levels, the range of possible alternatives decreases. This is visualised in Figure 3.

Figure 4 introduces a standardized transport planning and SEA framework. This connects assessment issues and tasks to different systematic tiers. The framework looks similar to strategic corporate management, where firstly a course of direction is identified within a strategic vision, before goals are set in a corporate mission and a course of action is specified in a plan. Specific projects follow based on an implementation programme. Combinations of different types of activities/tiers are possible, which is indicated by the broken lines between

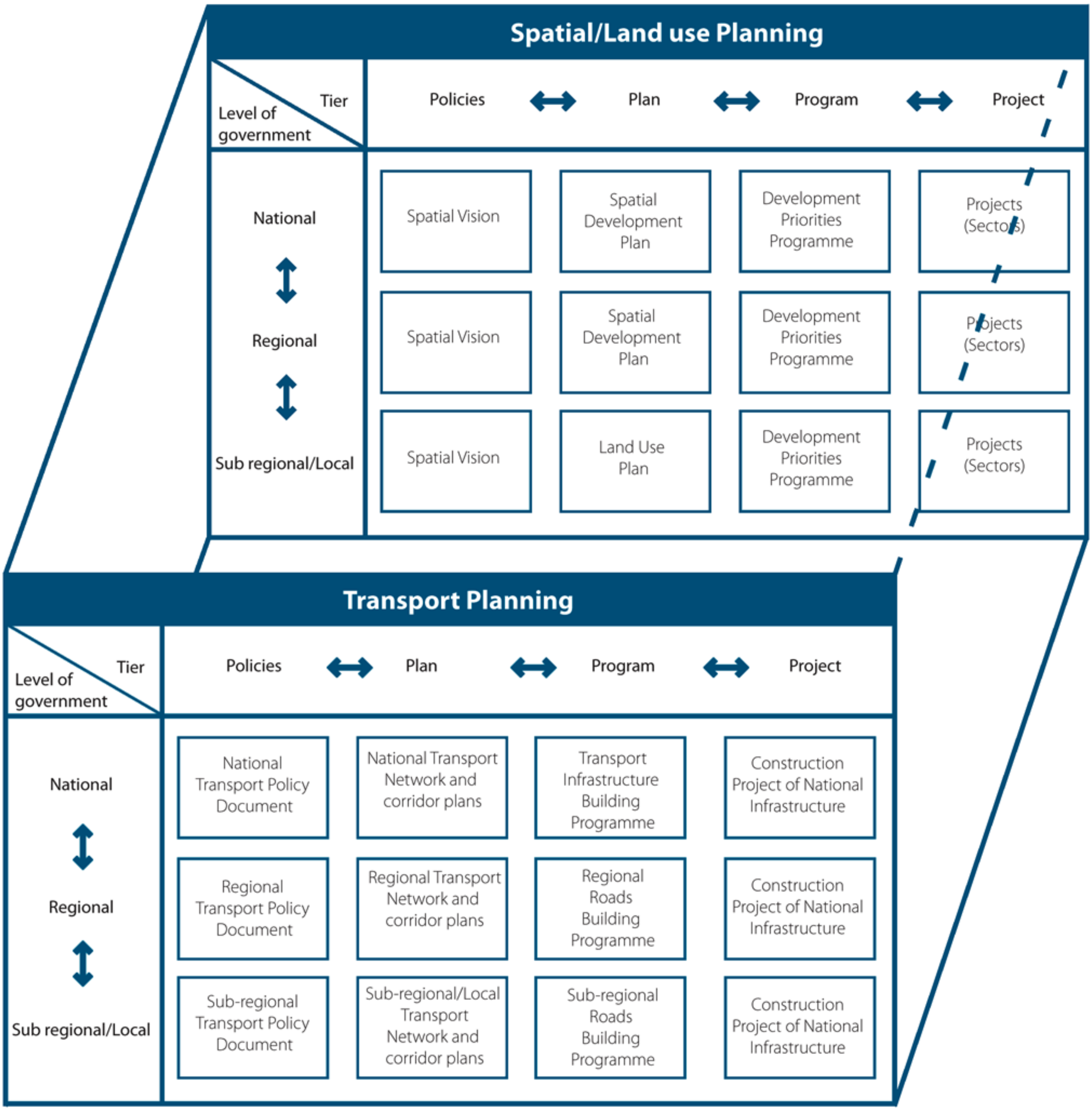


Fig. 2 The concept of tiering in transport planning

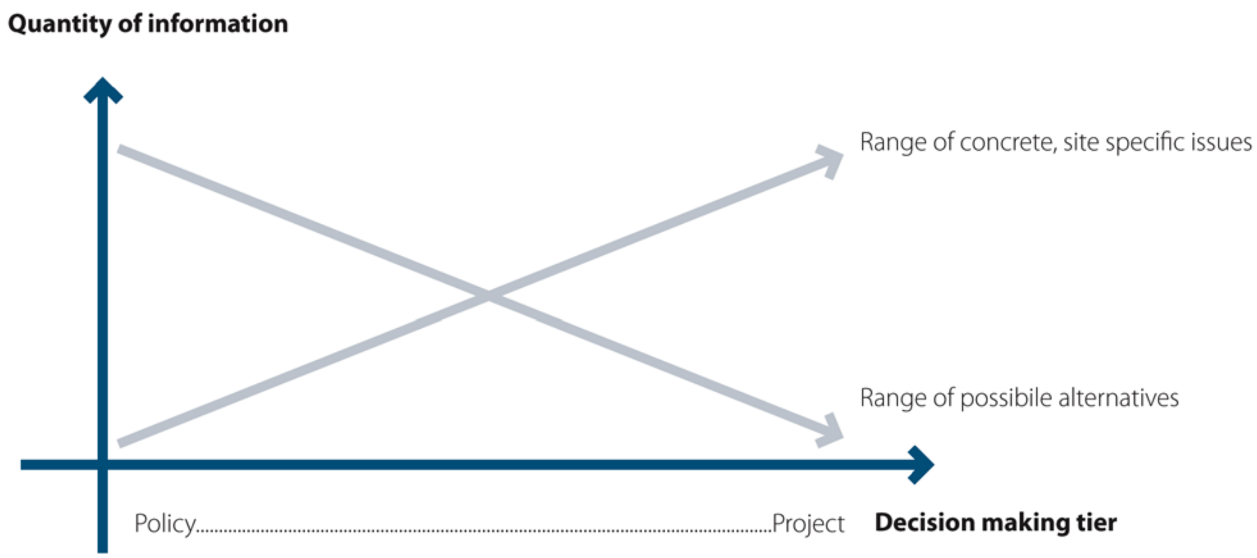


Fig. 3 Information provided by different systematic tiers

the various tiers (see also fact sheet on 'Criteria / indicators for sustainable transportation').

1 Options may include petrol price increases, vehicle taxes according to CO2emissions, subsidies for motor vehicles, parking policies, road pricing, speed limits, access restrictions, new infrastructure, better public transport, transport management systems, public campaigns and others

In reality, hybrid form of activities are often observed. For example, policy related types of activities may be considered in combination with network types of activities or corridor types of activities may be combined with programme types of activities.

Furthermore, 'real' transport planning systems often do not systematically address certain types of activities and there are certain gaps in any system. The SEA framework therefore based on a 'compensation principle', which means that if a certain decision tier is not in place in a system, another tier may address resulting gaps in a pro-active way. In this context, if, for example, a transport planner wishes to conduct corridor-plan related SEA and finds that no network-plan related issues have previously been considered, multi-modal alternatives will need to be addressed within corridor-SEA. Furthermore, in the absence of, for example, a strategic transport vision, considering various policy options, a corridor-SEA may also want address policy issues, such as road pricing or better public transport. Box 6 lists the core assumptions to be considered when using the standardized SEA framework and Figure 5 visualises the thinking behind tiering in transport planning and SEA

Type of activiy/ Tier	*Focus*	*Tasks*	*Process*	*Assessment issues / core indicators*	
Policy related	All policy options that might lead to meeting overall policy objectives and targets	• analysis of current situation in jurisdiction • listing existing economic, social and environmental objectives and targets and adaptation to transport • identifying different development scenarios (eg economic and spatial) • identifying different policy options1 that may lead to objectives and targets • evaluating options in the light of scenarios, indicating trade-offs for achieving objectives and targets, policy –assessment • monitoring actual developments • adjusting policies regularly	• integrated policy and SEA process, some Flexibility	• Resource depletion • Climate change • Acidification • Land take • Biodiversity • Safety • Overall policy targets in other areas	

Fig. 4 Standardized tiered transport planning and SEA framework

Type of activity/ Tier	*Focus*	*Tasks*	*Process*	*Assessment issues / core indicators*	
Network plan related	Transport infrastructure development options within networks leading to specific projects	• analysis of current situation in network • identifying – multi-modal – development options for meeting objectives, targets and needs identified in policies • assessing impacts of different options in terms of objectives and targets, network-assessment; indication of possible trade-offs (combine with economic assessment) • feedback to policies • monitoring actual developments • adjusting network plans regularly	• full SEA process, integrated or parallel with regular feedbacks	• Resource depletion • Climate change • Acidification • NMVOC • CO • Severance • Land take & impacts on soil, air, water, fauna, flo-ra, biodiversity	↕

Fig. 4 Standardized tiered transport planning and SEA framework (continued)

Type of activity/ Tier	*Focus*	*Tasks*	*Process*	*Assessment issues / core indicators*	
Corridor plan related	Spatial alternat-ives within corridors	• analysis of current situation in corridor • potential impacts of preferred options, possibly uni-modal (only if multi-modal alternatives are addressed at both, policy and network level, corridor-assessment • monitoring actual developments • feedback to policies and networks	• full SEA process, integrated/ parallel with regular feedbacks	• severance • noise • biodiversity • visual impacts • land take and emissions on air, water, soils, flora, fauna	
Programme related	Project design	• analysis of current local situation • optimise project design in terms of policy objectives and targets (project-assessment) • monitoring actual developments • feedback to previous tiers	• EIA process	• severance • biodiversity • visual impacts • noise • land take and emissions on air, water, soils, flora, fauna	

Fig. 4 Standardized tiered transport planning and SEA framework (continued)

Type of activit y/ Tier	Focus	Tasks	Process	Assessment issues / core indicators	
Project related	Project design	• analysis of current local situation • optimise project design in terms of policy objectives and targets (project-assessment) • monitoring actual developments • feedback to previous tiers	• EIA process	• severance • biodiversity • visual impacts • noise • land take and emissions on air, water, soils, flora, fauna	

Fig. 4 Standardized tiered transport planning and SEA framework (continued)

Box 6 Core assumptions underlying the standardized SEA framework

- The SEA framework attempts to make the considerations, leading to project ideas more explicit and systematic
- Whereas the framework is based on a hierarchy of logical thoughts that are expressed by decision tiers, it can be adapted to 'real' planning systems, which all have currently gaps
- The framework can be used flexibly, according to a compensatory approach ('compensation principle); ie in the absence of a certain decision tier in a planning system, another tier may address the issues that 'ideally' should have been addressed at the non-existing tier;
- Whereas in the 'real' world, no 'one-fits all' approach is available, the suggested framework provides for a shelf that can be filled according to individual needs

Policy related consideration:

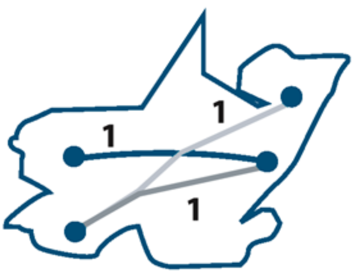
organisational, regulatory, fiscal and infrastructure policies, for example vehicle taxes according to C02 emissions, parking policies, roadpricing, speed limits, new infrastructure, better public transport, transport management system, public campaigns

Network-Plan related consideration:

multi-modal development options for the transport network for meeting objectives, targets and needs identified through policy considerations, including new transport infrastructure and transport management measures

Corridor-Plan related consideration:

potential impacts of preferred options within corridors between two main nodes, according to needs indentified through policy and network considerations



Programme related consideration:

identifying priority projects using multicriteria-analysis or cost-benefit analysis

Fig. 5 Tiering in strategic transport planning and SEA

Key tools and methods

Key tools and methods can be allocated to the various types of activities / tiers introduced in Figure 4. This allocation is based on the specific focus of a particular tier, as well as the tasks and issues to be addressed. Figure 6 summarises these key tools and methods. Generic tools and methods, which may be used at all tiers, are distinguished from specific tools and methods that are typically applied at a specific tier. Furthermore, a few practice examples for each category are presented.

	Examples	***Specific key tools and methods***	***Generic tools & methods***
Policy related	• 1st part of Dutch Second Transport Structure Plan, 1989 • UK Merseyside Integrated Transport Study MerITS, 1995 • German Transport Development Concept Hamburg, 1995	• Policy analysis • Scenario modelling • Simulation analysis, forecasting • Sensitivity analysis (considering extreme, ie optimist and pessi-mist views)	• Workshops • Matrices • Checklists • expert judgements
Network plan related	• Dutch Regional Transport-Environ-ment Map, Regional Body of Amsterdam, 1995 • German General Transport Baden-Württemberg, 1995 • North Germany Transport Investigation North-East Triangle, 1995	• Simulation analysis, forecasting • Sensitivity analysis (considering extreme, ie optimist and pessi-mist views) • Overlay/vulnerability mapping (GIS – based on existing data)	
Corridor plan related	• Swedish Gothenburg-Jönköbing Corridor, 1998 • UK Trans-Pennine corridor study, 1998 • Italian High Speed Rail Milan-Bologna Corridor Study, 1993	• Overlay/ vulnerability mapping (GIS – based on existing data and environ-mental baseli-ne studies)	
Program me related	• 2nd part of Dutch Second Transport Structure Plan, 1989 • German Federal Transport Infrastructure Plan, 1992 • UK Trunk Roads Programme, 1994	• Multi-criteria analysis (MCA) • Cost-benefit analysis (CBA)	

Fig. 6 Key tools and methods in SEA at different strategic transport planning tiers plus examples

Actors involved in SEA at different decision tiers

Any SEA conducted according to the SEA Directive will need to involve expert and authority consultation at the scoping stage and public participation after a draft assessment document has been prepared. Furthermore, the SEA itself should be headed by an environment planner/ assessor. A further specification of key actors and experts to be involved in SEA is possible, according to the specific type of activity (tier) of the standardized SEA framework, as follows:

- Policy related types of activities: Policy analysts and modelling experts are likely to be key actors. As modelling exercises should be transparent, a range of public an private key environmental stakeholders should be involved in the decision on the issues to be included and the weighting given to the various assessment aspects.
- Network-plan related types of activities: Transport planners, modelling experts and GIS experts are likely to be key actors. As modelling exercises should be transparent, a range of public an private key environmental stakeholders should be involved in the decision on the issues to be included and the weighting given to the various assessment aspects.
- Corridor-plan related types of activities: Transport and environmental engineers, GIS experts, ecologists (for biotic environmental aspects) and geographers (for physical environmental aspects) are likely to be key actors. Furthermore, public and private environmental stakeholders should be involved.

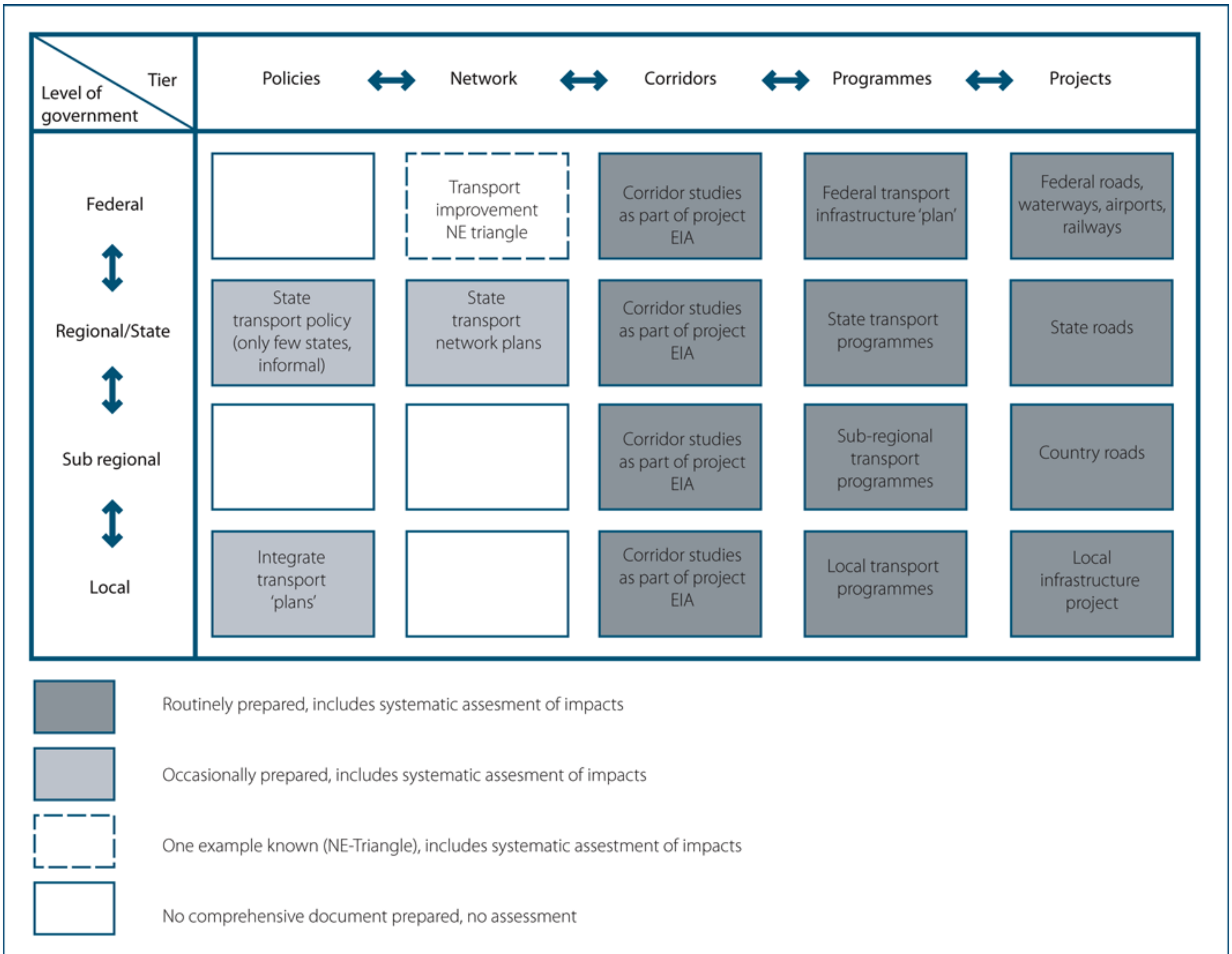


Fig. 7 Tiered transport planning system in Germany

- Programme related types of activities: Transport planners and engineers are likely to be key actors. Furthermore, public and private environmental stakeholders should be involved, particularly in the process of allocating weights to different MCA/CBA criteria.

Examples

This section shows examples for how the standardised SEA framework can be used in practice. In this context, strategic transport planning in Germany and the UK is considered. Figure 7 shows the tiered transport planning system in Germany. Furthermore, it indicates those tiers that include an assessment of impacts and current 'gaps' in the transport planning system.

Whilst there is routine practice in programme related considerations in transport planning, with impacts being assessed systematically, there are currently some considerable gaps in policy and network related considerations in the transport planning system in Germany. Corridor considerations are currently addressed through project EIA. A preliminary analysis of the transport planning system as is shown in Figure 6 helps assessors to decide on what aspects to consider in any specific SEA. If, for example, a corridor-SEA was to be conducted, the following issues would need to be addressed:

A) Justification for the need of the potential project:

- Does the potential project contribute to overall transport policy objectives?
- What development scenarios have been considered? Are these consistent with those underlying the Federal Transport Infrastructure Plan (FTIP) and other existing network-plans and programmes? Is existing information still up-to-date?
- What policy options have been considered or are available? – has any thought been given, for example, to multi-modal solutions, road pricing, spatial planning or other policy options?

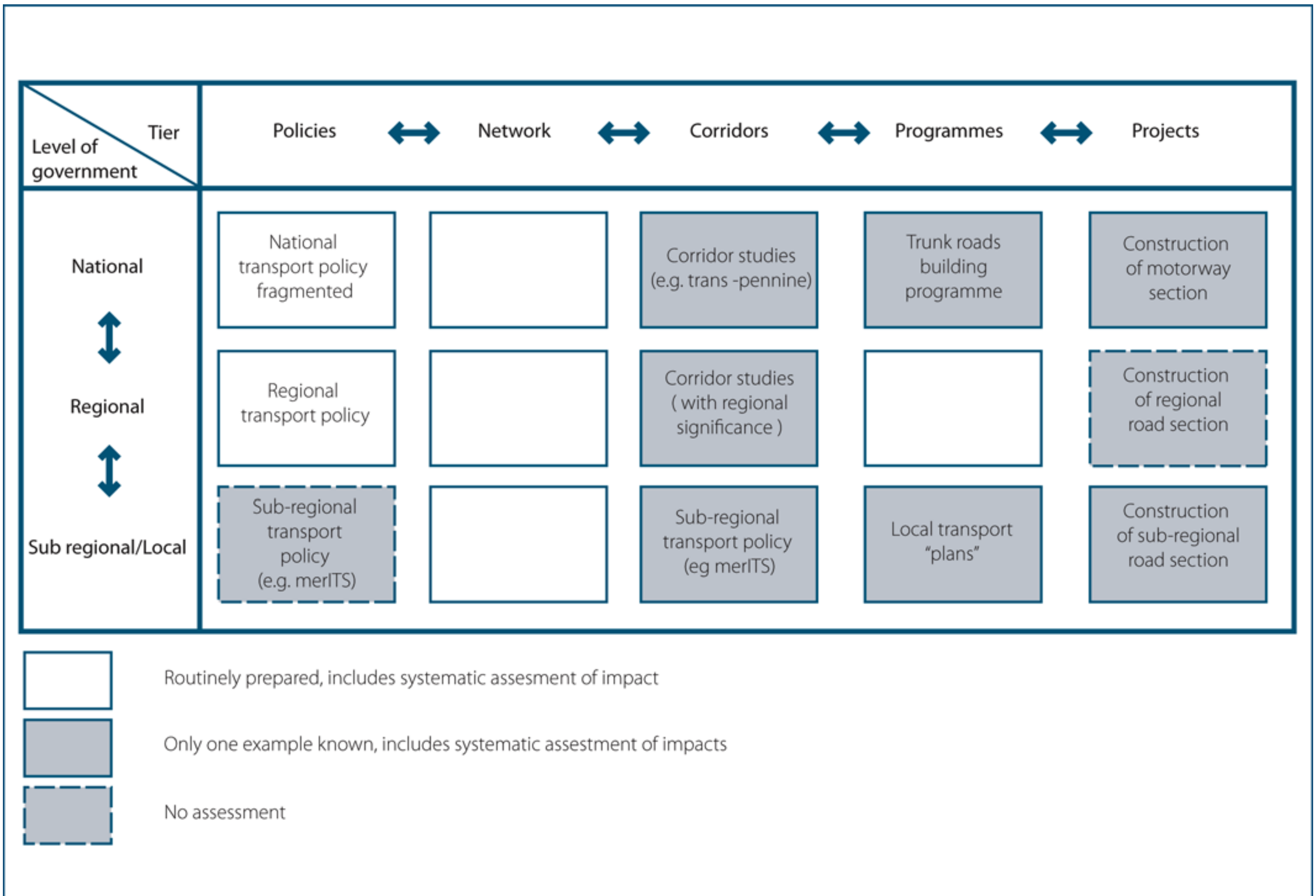


Fig. 8 Tiered transport planning system in the UK

- What network options have been considered or are available? Is the corridor the best strategic solution?

B) Assessment of potential impacts of multi-modal options, considering SEA Directive requirements; integrate with FTIP corridor assessment and possibly project EIA

Figure 8 shows the tiered transport planning system in the UK, again, indicating those tiers at which an assessment of impacts is conducted and current 'gaps' in the transport planning system. Whilst Corridor studies are now routinely conducted in the context of guidance on multi-modal methodologies (GOMMMS) at the various levels of decision making, there are gaps regarding policy and network related considerations.

Figure 7 helps assessors to decide on what aspects to consider in, for example, a corridor-SEA to be considered in the UK, as follows:

C) Justification for the need of infrastructure; in this context, the following questions may be involved:

- Does the potential project contributes to overall policy objectives?
- What development scenarios are the basis for the consideration of the TEN project?
- What policy options have previously been considered, for example, in multi-modal studies? – does this include the full range of possible options?
- What other network options have previously been considered, for example in multi-modal studies? Have all feasible options been included?

D) Assessment of potential impacts of multi-modal options according to SEA Directive; integrate with GOMMMS

Further Reading

- Bina, O 2001. Strategic Environmental Assessment of Transport Corridors: Lessons learned comparing the methods of five member states, European Commission, Directorate General for the Environment, Brussels.
- Brokking P, Schmidtbauer Crona J, Eriksson IM and Balfors B 2004. SEA in Swedish transportation policy-making and planning – political ambitions and practice, European Environment Journal 14(2): 94-104.
- Fischer T B 2000. Lifting the fog on SEA – towards a categorisation and identification of some major SEA tasks: understanding policy-SEA, plan-SEA and programme-SEA, in: Bjarnadóttir, H (Hrsg.). Environmental Assessment in the Nordic Countries: 39-46, Nordregio, Stockholm.
- Jansson AHH, 2000 Strategic environmental assessment for transport in four Nordic countries, in: Bjarnadóttir, H (Hrsg.). Environmental Assessment in the Nordic Countries: 81-88, Nordregio, Stockholm.

4. LAND USE AND TRANSPORT INTEGRATION

What is the issue and its purpose?

Transport and land use interact: changes in travel times and costs (e.g. due to new infrastructure projects, changed prices or subsidies) for distinguished modes may affect land use and land-use changes may affect travel Behaviour. Many models as used for SEA do not include this two-way interaction. The purpose of this factsheet is to explain the interaction between land use and transport, and to present suggestions on how to deal with this interaction within the context of SEA.

Traditional transport models, both aggregated as well as disaggregated models, estimate transport effects such as transport demand and traffic intensities on the road or rail network for a given situation including land-use patterns, incomes, etc. These models therefore include the impact of land use on transport, but do not assume an impact of transport on land use. The only way they can deal with the impact of transport on land use is by assuming a certain land-use pattern at the scenario level. But the model itself is a 'one way' model. However, it is generally recognized that land use and transport interact, and that this interaction has an impact on external effects, including environmental effects. Figure 9 visualizes these relationships.

Therefore it is highly unlikely that major changes in the transport system, such as building new important roads or rail links would not affect land use. Several assessment (both environmental and others) however, assume the same land-use

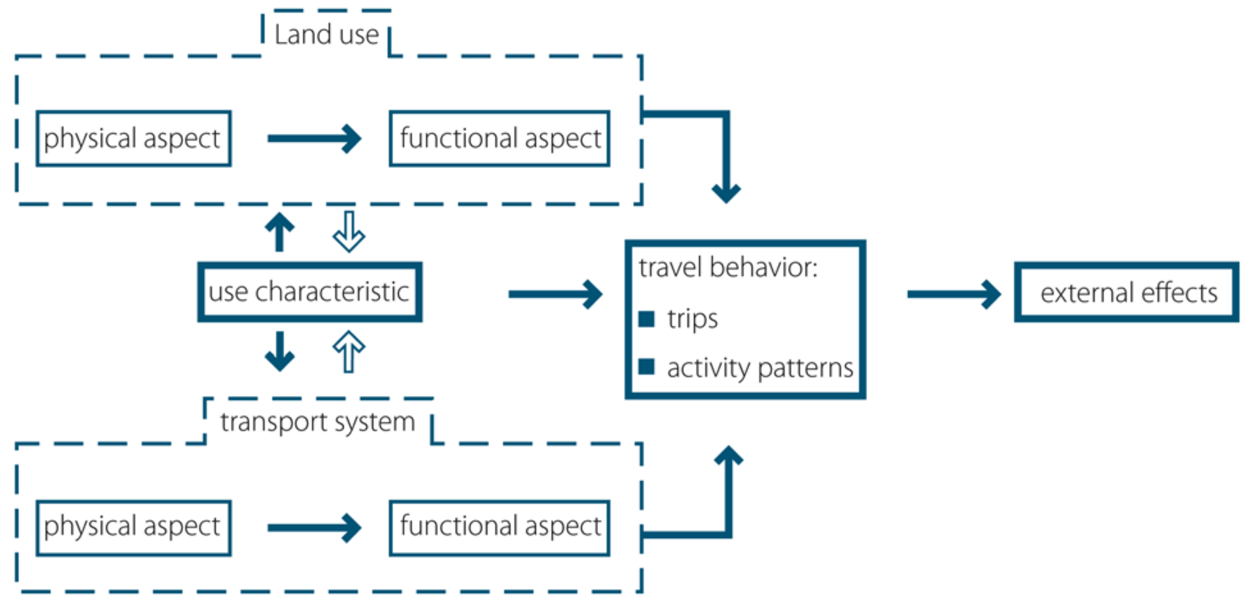


Fig. 9 relationships between land use, transport, travel behaviour and external effects

Source: Meurs and Van Wee (2003).

pattern regardless the differences in infrastructure. Ignoring the impact of transport on land use might result in significant errors in environmental impact assessment. Firstly, the changed land-use pattern might result in other levels of transport demand and traffic intensities, secondly the changes in land-use themselves are of importance for indicators such as noise nuisance (the locations of houses matter for noise nuisance), exposure to pollutants, open space conservation, landscape effects and flora and fauna impacts.

For a detailed description of Figure 9 above, see Meurs and Van Wee (2004).

What are expected results?

Including the interaction between transport and land use has several advantages:

- It increases the plausibility of the (policy) scenarios
- It increases the quality of transport demand forecasts
- It increases the plausibility of environmental indicators, firstly due to the better quality of demand forecasts, and secondly because the higher quality of the spatial distribution of traffic over the network as well as the distribution of activities over space (due to the more adequate location of dwellings, offices and other space demanding activities).

To summarize, both the quality of environmental indicators as used in SEA will improve as well as the plausibility and therefore acceptability of the results.

What are its appropriate scales (network, corridor, local)

Interaction between land use and transport occurs at least theoretically at almost all spatial scales, starting at the local level and up to the national level. In case of cross border projects and policies it might even have international impacts. However, in case of a LUTI model there is no such thing as a 'one size fits all model': depending on the spatial scale of the interaction the interaction should be modelled in the LUTI-model. Note that the scale of the interaction is not necessarily the same scale at which effects should be modelled to obtain plausible results. For example, regional or national interactions may have an impact on travel intensities on roads or rail links, but detailed spatial data for the area surrounding the infrastructure are needed to estimate impacts on noise.

For SEA I consider very detailed modelling both of the interaction as well as of effects as a possible overshoot. My advise would be to concentrate on relatively important effects of the interaction between land use and transport at least at the regional level as far as the interaction is concerned.

How to do / run it?

If possible, using a Land-Use Transport Interaction model (LUTI-model) would allow the researchers to give an indication of the land-use changes due to the transport changes, and then the related environmental impacts (often: after applying other models). I realize that a LUTI-model is often not available. If this is the case an alternative might be to use expert judgment to estimate the land-use changes due to the transport changes. And even if a LUTI model is available the question is if benefits of applying it exceed costs. My general impression is that if an existing model (both software as well as scenario runs including data needed) are available anyway, adapting it for SEA may be worth the effort. But if a new model needs to be developed the expert judgment approach may be the preferred method.

Who should do it?

Including the interaction in SEA has a research or scientific component as well as a context component. For the research component it needs researchers in the area of land use and transport modelling to do the job. Running LUTI models without knowing how they work and based on which theories and data they are developed is very risky. It is very important to understand the model structure and to understand the mathematical equations. In case of the expert judgment method it is important to include experts that are generally known and qualified, both because of the quality of the method as well as for the acceptability of the results.

Secondly the context is of importance. E.g.: LUTI models often ignore land use regulations, institutional aspects and the planning culture in the region or county under study. The knowledge and opinions of interest groups and planners should be used to obtain plausible results. In fact, if such aspects are of big importance one can even argue to not use a LUTI model but to use expert judgment as the basis for the study.

Who should be involved?

The context is also important for the acceptability of the results. Actor groups that are or importance for the acceptation of the results, should be involved to make the results acceptable for them. If they are not involved they might not accept the results, because the model (or even expert judgment method) is a black box to them and they may easily get suspicious if they do not like or understand the outcomes.

What are key tools?

As stated above LUTI models and the expert judgment method are the key tools

Show of examples

An example of the application of a LUTI model is the paper of Eradus et al. (2002). They used the LUTI model TIGRIS Four studies have been conducted in the past few years using increasingly sophisticated versions of the model. Their paper places the model applications in their geographical context, provides an overview of the main interactions in the model, and discusses its validation (a particular problem in land-use transportation interaction models). Finally the four applications are presented, one of which (the proposed Randstadrail light-rail system) is dealt with at length. An example of the application of the expert judgment method is the paper of Geurs van Van Wee (2004) in which they ask their selves the question how the Netherlands would have looked like in the year 2000 if in the period 1970 – 2000 the land use regulations would not have been adapted. They calculate both travel demand impacts as well as the impact on environmental indicators.

Two alternative land-use scenarios were constructed for the 1970-2000 period, differ in the assumptions about the regional distribution of population and employment to account for the uncertainty in behavioural responses of households and firms. The scenarios were developed using an expert-based method of scenario construction. Since the Delphi method for scenario construction, using several rounds of questionnaires with controlled feedback, is known to be quite time consuming, they used a simplified Delphi method. In the first round, a full day workshop was organised to achieve early consensus among (a group of 10) Dutch spatial planning and transport experts. The participants received general information about the project beforehand and discussed the scenarios in qualitative terms during the workshop. Afterwards, the scenario narratives were translated into quantitative scenario descriptions. In a second round, the quantitative scenario information was sent (as a spreadsheet file) to the experts who were then able to alter the absolute and relative changes of population and employment (by economic sector) by (COROP) region for the year 2000, with fixed totals at the national level. Finally, the expert's changes made were incorporated into the final scenarios.

Further reading

Examples as presented in the main text

- The paper of the LUTI-model example:
- Eradus, P., A. Schoemakers, T. van der Hoorn (2002). Four applications of the TIGRIS model in the Netherlands. Journal of Transport Geography 10(2): 111-121.

The paper of the expert judgment example:

- Geurs, K.T., B. van Wee (2004), Ex post evaluation of 30 years compact urban developments in the Netherlands, Paper presented at the World Conference on Transport Research (WCTR), Istanbul, 4-8 July 2004
- A revised version of the paper is forthcoming in Urban Studies.

Some key references

- For recent developments in the modelling of land use and transport interaction: see the special issue on this subject in the European Journal of Transport and Infrastructure Research, 2004, all free available at http://ejtir.tudelft.nl/
- For the state of the art of studies on the impact of land use on transport, see the special issue on land use and sustainable mobility, of the European Journal of Transport and Infrastructure Research, 2004, all free available at http://ejtir.tudelft.nl/

The most important reference for further information on the interaction between land use and transport, might be:

- Wegener, M., F. Fürst (1999). Land-Use Transport Interaction: State of the Art. Deliverable D2a of the project TRANSLAND (Integration of Transport and Land use Planning). Dortmund, Universität Dortmund, Insititut für Raumplanung.

Some other suggestions for literature:

- Bristow, A., A. May, S. Shepherd (1999). Land use - transport interaction models: the role of environment and accessibility in location choice. Selected Proceedings of the Eighth World Conference on Transport Research. Amsterdam, Pergamon. Volume 3: pp 227-240.
- DSC/ME&P (1999). Review of land-use/transport interaction models. Reports to The Standing Advisory Committee on Trunk Road Assessment. London, David Simmonds Consultancy/Marcial Echenique and Partners/Department of the Environment, Transport and the Regions.
- Miller, E. J. (2000). The integrated land use, transportation, environment (ILUTE) microsimulation modelling system: description & current status. International Association of Travel Behaviour Research, 2-7 July 2000, Gold Coast, Australia.
- RAND_Europe (2001). Literature Review of Land Use Models. Leiden, Rand Europe.
- Torrens, P. M. (2000). How land-use-transportation model work. London, Centre for Advanced Spatial Analysis, University College London.

5. PROJECT ALTERNATIVES AND FORECASTING METHODS

What is the issue and its purpose?

In SEA several plan and project alternatives are often evaluated. An important question is: which alternatives should be evaluated? Once these alternatives are defined they should be evaluated. An important aspect of the evaluation is the transport demand forecast, because transport demand has a major impact on several evaluation criteria. First of all transport demand has an impact on environmental criteria, such as emission and immission levels of pollutants and noise impacts. Secondly transport demand has a major impact on benefits of infrastructure projects, and therefore on the decision to construct new infrastructure and on the decision to choose between alternatives. This factsheet focuses on the selection of alternatives and on forecasting methods. Its purpose is to give some practical guidance in the selection of alternatives and to give insights in how to obtain useful demand forecasts. With respect to demand forecasts it is not the aim to give methodological advise on modelling (see the handbooks on transport modelling for these issues), but rather on the process.In this part of the factsheet some general thoughts on both subjects are presented.

The selection of alternatives

Ideas for transport plans and infrastructure projects are often launched without a clear problem definition. The solution is easily found (often: new infrastructure), the problem then needs to be found to legitimate the project. This of course is not an ideal procedure. It is much better to start with the problem: which problem(s) should be solved? For whom is there a problem? How big is the problem? Secondly, options to solve the problem should be investigated. It is advised not to look at infrastructure options only, and if infrastructure options are considered, not to look at building new infrastructure only. If, for example congestion is the problem, then a non-infrastructure option might be congestion pricing. And if infrastructure expansion is an option, then an additional lane to an existing road might be an alternative for building a new road. Thirdly, criteria to evaluate the options should be defined.

Step 1 in this procedure should precede steps 2 and 3, but steps 2 and 3 can have overlap and do not necessarily have to be carried out sequentially. Note that for SEA the scope is limited to environmental criteria, whereas for the overall evaluation several non-environmental criteria are relevant. So, the selection of criteria for the process in general is much wider than for SEA only.

Transport demand forecasts

Decision making with respect to transport policies and plans, including large infrastructure projects, is often partly based on ex ante evaluations of costs and impacts. Impacts include economic, environmental and social impacts, sometimes aggregated in a cost-benefit analysis. For such ex ante evaluations the quality of the related demand is very important. The relevance of the quality of demand forecasts for impacts deserves some reflection. This reflection will be limited to economic and environmental effects, being the most dominant effects in most ex ante evaluations. Firstly environmental effects are considered. Many of these effects, such as emissions of pollutants and CO2, noise and to some extend barrier effects depend on transport volumes. If transport forecasts are too low all effects that depend on transport volumes, are underestimated. An underestimation might also result in a lack of noise mitigating measures such as noise screens and barriers, compared to what would have been build in case of accurate forecasts. But problems also occur if demand forecasts are too high. That would imply that maybe the infrastructure project was constructed but it should not have been, for example because it lacks economic viability. All environmental impacts of the new project, both at its location as well as other network effects, would not have occurred if the project would not have been build. That over- and underdimensioning of facilities as a negative consequence of inaccurate demand forecasts exists, is shown by Flyvbjerg et al. (2005), giving the Bangkok Sky Train and UK roads as examples. To conclude, accurate forecasts are of major importance for ex ante evaluations, including SEA.

To understand the importance of demand forecasts for the economic viability of infrastructure project, and therefore for the decisions on construction, economic impacts will be discussed as well. Economic impacts include direct impacts as well as indirect impacts. Direct impacts directly relate to the transport benefits. Due to the new infrastructure project travel times will be reduced. The multiplication of the change in travel times with the number of travellers and their value of time monetizes these impacts. Values of time differ between mode, motive (business, commuting, leisure etc.) and income classes. For these travelers the total so called consumers surplus (the difference between the price of a good or service and the willingness to pay for in by the consumer) increases equal to this monetized impacts. Another category of direct effects relate to the additional travel due to the new project. In transport economics it is generally recognized that a person who does travel after the project is constructed but who did not before has a consumers surplus of half of the reduction in generalized transport costs (mainly: the reduction in travel time), assuming a more or less linear demand curve between the points connecting the generalized transport costs in the situations with and without the project. Multiplying half of the reduction of the generalized transport costs with the number of additional travellers is often referred to as the 'rule of half' (SACTRA, 1999). Because these two categories of direct effects linearly depend on the impacts of a project on (changes in) transport demand the relevance of good forecasts of transport demand is evident.

Apart from the direct effects large infrastructure projects are often claimed to have indirect effects, for example due to the improved image of the country or region in which it is located. There still is a lot of debate about indirect effects, the summarizing of which is beyond the scope of this factsheet. What is important is that the size of indirect effects may be related to the size of direct effects and therefore may be related to transport demand, again emphasizing the importance of high quality demand forecasts.

To summarize, a good quality of demand forecasts is of crucial importance for both economic and environmental evaluations of plans and project. However, based on a literature review (see references in list at the end of this factsheet) it can be concluded that only few authors pay attention to the quality of demand forecasts of infrastructure projects. Considering the huge costs and impact on exploitation, this seems strange. In general overestimation of demand is more common than underestimation, especially for rail projects. Strategic behaviour seems to be more important for differences between forecasts and actual demand than shortcomings in travel demand models including the data used.

What are expected results?

The selection of alternatives

A 'correct' selection of alternatives has several advantages. First of all, the chance that the 'best' alternative will be chosen, increases. Note that there is not an objective criterion to decide what is the 'best' alternative. Here it is assumed that the best alternative is the alternative that the decision makers would have chosen if they would have had an overview of all possible alternatives, including all relevant information as far as possible to obtain for these alternatives. Secondly, the chances of changes in the project definition will be reduced. Note that changes after the decision making are not necessarily bad, new insights may lead to adaptation to the original project specification. But often such changes occur due to a 'bad' procedure before the decision making, causing unexpected cost overruns, politically initiated changes in the project leading to a not very well 'balanced' project and to changes that might be decided upon without a careful check on overall costs and benefits at the project level. Thirdly, a correct selection of alternatives increases the chance that most – if not: all - actors will more or less be satisfied with the procedure and the outcomes, avoiding debate and contra-productive actions after the decision making.

Finally, assuming that all relevant environmental indicators will be included in the ex ante evaluation a correct selection of alternatives increases the quality of the SEA and its possible impact in decision making processes.

Transport demand forecasts

As stated before, a good quality of demand forecasts is of crucial importance for the quality of SEA and other evaluations (including economic evaluations) and for the contribution of these evaluations to the decision making process.

What are its appropriate scales (network, corridor, local)

The scales may vary from a country or region, in case policy plans are considered for a whole country or region, to the corridor scale, in case of specific infrastructure projects. In case of cross-border infrastructure projects the scale may also be international (or, to be more specific, a cross-border corridor). In other words, the scale is the same as the scale of the project or plan.

How to do / run it?

The selection of alternatives

See 'what is the issue' for a three step approach related to the contents, and 'who to involve' for the procedure.

Besides it is very important to decide what the reference alternative is. For SEA and EIA it is quite common to define a reference scenario, assuming business as usual (BAU) or current policies. Economists have argued that this is not the best reference alternative. In stead or in addition to BAU it is advised to define 'the best possible alternative for the project'. This may be 'do noting', 'current policies', but it might also be an alternative for the plan under consideration. Compare a person putting his money in an old sock. A bank might say: we give you 2% interest, so this is to be preferred. But if another bank gives an interest rate of 4%, this is a better option. The same is true for infrastructure projects. If a country or region supposes to build a new motorway to stimulate economic growth in a region, the reference scenario might be business as usual, but it might also be building a rail line, building another major road but not a motorway costing less money, or stimulate economic growth in that region by fiscal measures making it more attractive for firms to locate to that region.

Transport demand forecasts

In literature several ideas to improve the quality of demand forecasts are presented. These include:

- The application of state-of-the-art methods, data and techniques;
- The introduction of 'better' institutional arrangements;
- The introduction of clear targets and instruments to measure how targets can be realized and to reward good performance and punish bad performance;
- Improve transparency, for example by making information generally available;
- The inclusion of risk capital;
- The application of the method of 'reference forecasting', making use of an 'outside view' (see below);
- The inclusion of an independent peer review;
- The introduction of measures to reduce or avoid strategic behaviour/manipulation; these measures can be clustered into (1) measures to improve public sector accountability by transparency and public control, and (2) measures to improve private sector accountability by competition and market control.

Below some references upon which this list is based will be discussed. Key references for this subject are Bruzelius et al. (2002), Flyvbjerg et al. (2005) and Trujillo et al. (2002).

Bruzelius et al. (2002) carried out research into large infrastructure projects in Denmark and Germany (see section 2), and present recommendations. The Danish Transport Council adopted their approach and advised it to the Danish government. Their research shows that transport demand is often overestimated between 20 and 70%. Rail projects show the greatest overestimation, some of them exceeding 100%. Bruzelius et al. (2002) conclude that for forecasting transport demand often data and methods of poor quality are used. Therefore they recommend using the best available methods. Considering the large amount of money the projects need and the long-term impact on the economy, accessibility and the environment, I fully agree. The additional research costs will be negligible compared to the investment costs. Besides they advise to explicitly be clear about risks in an early stage. In case private parties are involved, there is no reason to make the government run the risk of uncertainty in demand. If private parties run these risks, the incentives to be overoptimistic with respect to transport demand are reduced – if not eliminated. For further information on risks and uncertainty in general and the role of the state versus private parties, see Froud (2003).

They also conclude that good decision making not only is a matter of better information and methods, but also of institutional arrangements to improve accountability. Concerning current practices they list some important characteristics:

1. The cycle does not include a pre-feasibility stage before the decision to carry out

decent research is taken. Therefore over-commitment of resources and political prestige may occur in an early stage.

2. Too often people only think in technological solutions only.
3. External effects often are included in the discussion in a late stage of the project cycle.
4. Parties for which the project is disadvantageous and interest groups are included in the process in a relatively late stage and only to a limited extend.
5. No risk analysis is carried out.
6. Institutional, organisational and accountability aspects with respect to the implementation, the use stage and economic regulation play a limited role in the preparation of the project.

Ad 1: the authors conclude that this may lead to an polarisation in an early stage of the project.

Ad 2: The authors advise not to think of technological solutions only but to focus in an early stage on what is needed to get the economic, environmental and safety characteristics.

Ad 4 and 6: The authors conclude that the roles of different parties need to be defined clearly. Note that the government has different, sometimes conflicting roles.

They conclude that the most important shortcoming of current practice is a lack of clear targets and of instruments (1) to measure how the targets can be realised, and (2) a system to reward good performance and to punish bad performance.

They further conclude that four basic instruments are available to get an adequate process:

- Transparency
- Specification of performance
- Explicit formulating the regulating regime, and define (or – if possible - eliminate) policy risks before the decision making.
- The inclusion of risk capital

Flyvbjerg et al. (2004) distinguish between two situations: (1) planners have an interest in improving the quality of forecasts, and (2) planners do not have such an interest. In the first situation a new method called 'reference forecasting' might be interesting. According to this method an 'outside view' is used, based on information on comparable projects. The method includes three steps: (1) identifying the relevant class of reference projects, (2) estimating the distribution of the variable needed (such as transport demand), and (3) comparing the project under research with this distribution. They conclude that many people and organizations tend to strongly rely on the 'inside view' of experts, whereas these experts do not think of comparing the project with comparable projects. This method is especially useful in case of non-routine projects, such as a rail project in a city or town currently without rail infrastructure, or a new bridge or tunnel of a type the city or town did not build before.

In the second situation (planners have no interest in improving the quality of demand forecasts) planners like to see the project constructed and financed. Then an optimistic forecast is very attractive. In this situation they recommend two types of accountability: (1) public sector accountability by transparency and public control, and (2) private sector accountability by competition and market control.

Ad 1: their suggestions include:

- An independent peer review for demand forecasts should be included.
- A benchmark for comparable forecasts should be included (see the method of 'reference forecasting' described before).
- Forecasts, peer review and benchmarks should be available for the public, including related documentation.
- Public meetings should be organised at which stakeholders and the public can express critics and support. The results should be integrated in planning and decision-making.
- Scientific and professional conferences should be held.
- Professional and legal sanctions should be applied in case of manipulation.

Ad 2: their suggestions include:

- Public parties should not finance the whole project, private money should be included.
- People and organisations making the fore-

casts should be financially responsible in case of misinterpretation or manipulated forecasts.

Trujillo et al. (2002) recommend using state-of-the-art forecasting methods and reducing possibilities for strategic behaviour/manipulation. They recommend establishing an independent committee evaluating the forecasts. Odeck (2004) recommends presenting an uncertainty analysis for all forecasts. Also Hall (1980) recommends improvements in forecasting methods. He also states that more independent teams of experts should be established.

Who should do it?

The selection of alternatives

In the case of transport plans it is common in the EU that the authorities involved in the decision making process take the lead. This does not imply that they select alternatives all by themselves. On the contrary, it is very common and strongly advised to include all relevant actors in an early stage of the process (see 'who should be involved?').

In case of a project also the authorities normally take the lead, but the role of the market might be bigger compared to plans. E.g. (combinations of) market parties might be challenged to propose plans that meet certain criteria as defined by the authorities. Relevant criteria are related to travel times, safety, finance, the environment, time and social issues.

Transport demand forecasts

In case of plans transport demand forecasts are made by either consultants or authorities including authority related institutes.

Transport demand forecasts are generally made by consultants.

In both cases often independent (or even not independent) experts are included in one way or another, e.g. in an advisory board.

Who should be involved?

The selection of possible options, particular at the project level, is often based on a rather technocratic procedure of experts. However, for building new infrastructure and using it (as well as for realizing non-infrastructural options), many actors are of importance. These include national, regional and local authorities, environmental action groups, people living in the area, companies that need to build and exploit the infrastructure, car drivers associations, firms that benefit from the improvements, etc. It is advised to search for options together with the main actors involved. This firstly avoids the 'not invented here' syndrome. Secondly, other options might be put on the agenda that experts would not have selected simply because they did not come in their minds. Thirdly, for those options that would have been put on the agenda anyway, the actors might have useful ideas on certain aspects of the options, such as routes, visual aspects, or barrier mitigating measures. Note that putting options on the agenda that turn out to be unattractive might be good for the process. It might avoid that the discussion on such options starts in a later phase and intervenes with the process as planned. Therefore, for process reasons it might be good to know which options are considered to be potentially interesting for important actors.

In case of plans it is more common to include relevant actors. The advantages of involving actors in case of plans are equal to those as described above.

Note that policy makers do not necessarily use the information available. As In 't Veld (undated) formulates it: 'it seems that there is a tendency that policy makers do in fact disregard or ignore particular knowledge which is not welcomed or actively countered'. Involving policy makers in an early stage might al least reduce this 'non use' to some extend. However, involving them of course is no guarantee that policy makers will use the information available.

An important actor (category) is the public. Several countries have experiences with public engagement models, each with their own advantages and disadvantages. It is very risky to formulate general advises based on these experiences, because cultures and traditions significantly differ between countries and even regions within counties. Therefore I only give the general advise to seriously consider models for public engagement in an early stage of the process.

Apart from actors that are relevant for realizing and using infrastructure, experts are also relevant.

Also their roles should be clear. The role of experts is manifold, but at least one of them is to avoid what is referred to as 'negotiated nonsense' (Van de Riet, 2003): the outcome of the interaction between actors might be a solution that does not solve the problem, or only to a small extend, or in a very cost-ineffective way. Another role of experts might be to provide independent information. Even if the same information is available at one of the actors involved, it might be much more acceptable if brought in the process by an independent expert. Of course, the experts then should really be independent because other ways people will not believe them and argue that the results are 'bought'.

Next citation obtained from In 't Veld and Verhey (2000) illustrates the importance of the links between policy making and science:

'The consequence that one links to this asymmetry in social-scientific meta theories is that a separation between science and policy is not desirable. Not only should the arenas of policy-making and the arenas of knowledge production each be composed in a broad way (since they have to represent different groups of values) but they should be coupled to each other emphatically. Knowledge production must not be done exclusively from one paradigm that is dominant in the policy arena, but must be done from a range of paradigms that is as varied as the range of paradigms represented in the policy arena. That is a democratic postulate. There must be an open debate about choices, points of departures, on which knowledge (production) is based. In this debate also other parties than professional knowledge producers must be involved. Science in such a context ideally is 'postnormal science'.

What are key tools?

The selection of alternatives

To the authors knowledge there are no tools in the sense of standard models, software or standardized procedures for the selection of alternatives.

Transport demand forecasts

Several categories of models for transport demand forecasts exist. The most common are trip based models, based on conventional economic theory (see, for example, Ortuzar and Willumsen, 2001; Hensher and Button, 2001). Other approaches include activity based models, system dynamics based models and land use – transport interaction models (LUTI-models – see separate factsheet).

Literature on modelling is generally available and normally well known among modellers. Therefore a further description and review of models is not included in this factsheet. Note that, although using state of the art models is recommended to forecast transport demand, the most important cause of bad quality forecast is not the quality of the models used, but rather strategic behaviour or unrealistic assumptions.

Show of examples

The selection of alternatives

Many countries have interesting examples of how not to select alternatives, e.g. because only one alternative was considered, even without a proper problem definitions. Below is an Dutch example, the so-called Betuwe line.

To improve the competitive position of the Port of Rotterdam and to boost the economy a new dedicated rail-freight line was proposed. This line would not only have a positive impact on macro-economic development, but also on the levels of emission from freight transport due to a modal shift from road to rail, and on the congestion levels the motorways increasingly have to cope with.

A very effective lobby favouring the Port of Rotterdam (consisting amongst others of representatives from the Port Authority itself, the Dutch National Railway Company and the Ministry of Transport) succeeded in establishing a positive climate for the project among politicians. The approval from the Dutch government and both Chambers of Parliament was rapidly secured. In the 1990s more and more information became available showing that it was far from certain whether the benefits of the project would indeed exceed the costs.

The first official plan announcing the Betuwe Line, the Second Transport Structure Plan (Ministerie van Verkeer en Waterstaat, 1990), assumed costs would amount to approximately 2.3 billion Dutch guilders, just over 1 billion

Euros. In 2005, the costs of the railway line, which is currently under construction, are estimated at 4.8 billion Euros. An important factor explaining the difference is the addition of many infrastructure elements to reduce local impacts: to gain support (or better: to reduce resistance) of local and regional authorities and the public many amendments were made to the line.

The economic benefits were based on forecasts that were not 'neutral' forecasts, but rather 'wishful thinking' scenarios (Janse et al. (2000). The environmental legitimacy was based on a very simple line of thought: rail-freight transport produces less emission per tonne kilometre compared to road-freight transport. Therefore construction, maintenance and operation of the line would benefit the environment. However, calculations made in 1994 showed that the reduction of emissions of CO2 and NOx by freight transport that would occur in the Netherlands would certainly not be more than 0-2.5%, if these reductions occurred at all.

This paradoxical conclusion could be drawn from the scenarios for the transport impacts of the line, which were used as a basis for the economic calculations. It was assumed that additional rail-freight transport in the Netherlands due to the Betuwe Line would otherwise be transported via other countries (50%), via barge (40%) or via road (10%) (Van Wee et al., 1994). This distribution was chosen because it was assumed that the added value of transporting goods via rail is bigger in comparison to barge, but smaller when compared to road transport. The scenario was therefore biased in favour of higher economic impacts for the new rail line. However, this assumption was in contradiction with the simple line of reasoning for the environment. In fact, more generally, assumptions used for the economic calculations seemed inconsistent with those used to support the environmental legitimacy. Despite, or possibly due to, more than 2 meters of reports, there was no clear or useful overview of pros and cons or costs and benefits of the project, making it very doubtful on what grounds the decision-making was based.

To summarize, the experience with the ex ante evaluation of the Betuwe Line was less than positive, to put it mildly. In fact, it was an incarnation of just about everything that could go wrong: a huge underestimation of the costs, inconsistent use of scenarios, transport volume forecasts that proved to be wishful thinking, a lack of overview for decision-makers, and finally a railway link that nearly all consider as a bad project.

To summarize, a major problem was a lack of consensus on the problem definition. Besides, no alternatives were considered. And demand forecasts were not at all 'neutral.

Transport demand forecasts

An interesting example of good practices is that, in the USA, there are companies that are willing to 'sell' their forecasts combined with an insurance in case of a greater difference than a certain limit (Trujillo et al., 2002). This seems an interesting concept that deserves considering for other countries as well. 'Guaranteed' quality of forecasts including penalties for deficiencies in forecasts might even be a criteria to select consultants or even a 'conditio sin ne qua non'.

Further reading

- Auditor General Sweden (1994), Riksrevisionsverket. Infrastrukturinvestingar: en kostnadsjamorelse mellan poan of utyfall i 15 storre prosjekt innom vagverket of ban-verket. RVV 1994: 23
- Bruzelius, N., B. Flyvbjerg, W. Rothengatter (2002), Big decision, big risks. Improving accountability in mega projects. Transport Policy, 9 (2), pp. 143-154
- Flyvbjerg, B., N. Bruzelius, W. Rothengatter (2003a), Megaprojects and Risk: An anatomy of ambition, Cambridge: Cambridge University Press
- Flyvbjerg, B., M.K. Skamris Holm, S.L. Buhl (2003b), How common and how large are cost overruns in transport infrastructure projects?, Transport Reviews, Vol. 23, No. 1, pp. 71-88.
- Flyvbjerg, Bent, Cowi, 2004, Procedures for Dealing with Optimism Bias in Transport Planning: Guidance Document. (London: UK Department for Transport).
- Flyvbjerg, B., M. K. Skamris Holm, S.L. Buhl (2005), How(In)accurate Are Demand Forecasts in Public Works Projects? The Case of Transportation. Journal of the American Planning Association, vol.71, No. 2, Spring,

pp. 131-146.

- Flyvbjerg, B., M.K. Skamris Holm, S.L. Buhl (2004), What causes cost overrun in transport infrastructure projects? Transport Reviews, Vol. 24, No. 1, pp. 3-18
- Froud, J. (2003), The private finance initiative: risk, uncertainty and the state, Accounting, Organizations and Society 28. pp. 567-589
- Hall, P. (1980), Great Planning Disasters, Middlesex, England: Penguin Books
- Hensher, D.A., Button, K. (2001) (eds.) Handbook I: Transport Modeling, Pergamon, Elsevier Science, Ltd.,
- In 't Veld (undated), In search for a better use of knowledge by policy makers (http:/www.rmno.nl/uk8a.htm) (extracted from internet March 2005)
- In 't Veld, R.J., A.J.M. Verhey (2000), Willingly and knowingly: about the relationship between values, knowledge production and use of knowledge in environmental policy. In: R. In 't Veld (ed.), Willingly and Knowingly. The roles of knowledge about nature and the environment in policy processes. Utrecht: Lemma
- Janse, P., W.J. Dijkstra, J.M.W. Dings, G.P. van Wee, R.M.M. van den Brink, C.J. Ruijgrok, H. Uitenboogaart, D.A. Henstra, C.E. Cornelissen (2000), Milieuwinst op het spoor? Synthese van onderzoeken naar milieu-effecten van het goederenvervoer per spoor (Environmental benefits with rail transport? Synthesis of research results into environmental effects of rail freight transport), Delft/Bilthoven/Delft: CE, RIVM and TNO Inro, in Dutch
- Ministerie van Verkeer en Waterstaat (1990) Tweede Structuurschema Verkeer en Vervoer. Deel D: regeringsbeslissing. (Second Transport Structure Plan, part D: decision of the governement). The Hague: Ministry of Transport and Public Works
- Nijkamp, P., B. Ubbels (1999), How reliable are estimates of infrastructure costs? A comparative analysis, International Journal of Transport Economics, 26 (1), pp. 23-53.
- Odeck, J. (2004), Cost overruns in road construction – what are their sizes and determinants?, Transport Policy, 11 (1), pp. 43-53
- Ortúzar, J.d.D., & Willumsen, L.G. (2001). Modelling Transport. Chichester, West Sussex, England ; New York, NY: Wiley
- Pickrell, D.H. (1990), Urban rail transit projects: forecasts versus actual riderschip and cost. Washington DC: US Department of Transportation
- Pickrell, D.H. (1992), A desire named streetcar – fantasy and fact in rail transit planning. Journal of American Plannig Association, Spring 92, Vol 58 (2)
- Quiet, E. (1998), Principes d'economie des transport, Paris: Economica
- Riet, O. v. d. (2003). Policy Analysis in Multi-Actor Policy Settings. Delft, Eburon Publishers, Delft.
- SACTRA (1999), Transport and the Economy, The Standing Advisory Committee on Trunk Road Assessment, London: UK Department of the Environment, Transport and the Regions
- Schafer, A., D. Victor (1997) The Past and Future of Global Mobility, Scientific American, 227, no.4, October 1997, pp. 36-39
- Skamris, M.K., B. Flyvbjerg, B (1997), Inaccuracy of trafic forecasts and cost estimates on large transport project, Transport Policy 4 (3),pp 141-146
- Szalai, A. (ed.) (1972) The use of time: daily activities of urban and suburban populations in twelve counties, The Hague: Mouton
- Trujillo, L., E. Quinet, A. Estache (2002), Dealing with demand forecasting games in transport privatization, Transport Policy, 9 (4), pp. 325-334
- Van Wee, G.P., R. Thomas, W. Dunnewold, M. van den Heuvel (1994), Effecten van de Betuweroute op NOx- en CO2-emissies. (Effects of the Betuweline on NOx and CO2 emissions) RIVM Report nr 251701015. Bilthoven/Delft: Rijksinstituut voor Volksgezondheid en Milieuhygiëne/ Instituut voor Ruimtelijke Organisatie TNO
- Wachs, M. (1989), When planners lie with numbers, APA Journal 476, Autumn 1989
- Wachs, M. (1990), Ethics and advocacy in forecasting for public policy, Business and

Professional Ethics Journal, 9 (1&2)

- Zahavi, Y. (1979) the UMOT-project, US Department of Transportation, Report DOT-RSPA-DPB-2-79-3, Washington.

6. THE CONCEPT OF HANDLING TRANSBOUNDARY ISSUES IN TRANSPORT SEA

What is the issue and its purpose?

The physical structure – how settlements, traffic routes and green areas are located - is a key issue in the work towards achieving sustainability in the development of the European Union. The physical planning is entangled with other vital issues such as politics, economics, legislation, organization, technical solutions and living patterns in the different countries and regions.

In the matter of planning larger transport corridors in the EU, there are in most cases more than one country that will be affected by the planned investment and/or its resulting impact, in different ways and on different levels. The impacts can be either direct or indirect.

For example, investments in new or improved waterways in Europe could contribute to modal shift from road and railway towards shipping. This may even change transport patterns and reduce volumes of road transports in adjacent countries that are not directly affected by the new waterways. The waterway investments can also have direct physical impacts on the environment in the countries it passes through, and in adjacent countries as well. There are a lot of aspects and side effects to consider.

To get an overview of all direct and indirect impacts that can arise from a larger transport investment involving a large region and to stimulate the positive and to minimize any negative direct and indirect impacts, transboundary issues need to be handled early in the planning process. This fact sheet deals with the different aspects of transboundary cooperation in such planning processes concerning transport SEA to make it successful and of use for the participating countries and regions.

What are expected results?

There will be a need to form a base for cooperation in handling the transboundary issues between politicians, the public, planners, environmentalists and other groups of experts. A common perception and understanding of objectives, issues and policies with the view to establish a transboundary sustainable management by the participating countries and/or regions will be a desired output from a transboundary cooperation in a SEA process.

As a part of the SEA, an important part is to describe the process of handling the transboundary issues and establish a holistic approach on an interregional or international level. What is it that the investment aim to accomplish? Will all the affected regions and countries get the same output? What about impacts, direct and indirect? The output of such a cooperation on transboundary issues will probably be a set of indicators, objectives and measures to enable a desired development and output of the investment on an environmental as well as economical and social level in the affected regions and countries. But another important outcome is to highlight and enable a common understanding of the visions and goals behind the planning process.

When should transboundary issues be handled?

In the process of making a SEA of a plan or programme proposed in one country (the country of origin) that is considered likely to have significant environmental effects on another (the affected country); or SEA of a proposed plan or programme extending over more than one country, i.e. a transboundary plan or programme.

What are its appropriate scales (network, corridor, local)

This depends on the characteristics of the discussed investment and should be decided on basis of not only the scale of the project itself but also on the scope of its impacts on environmental, social and economic levels.

It is important to include other existing or planned investments for transport infrastructure in the affected countries or regions in the transboundary SEA, to give a relevant and full picture about the effects, rather than trying to estimate effects of the investment alone. If, for example, similar investments are planned to increase capacity in other transport modes within the same transport corridor, such parallel investments could eliminate the effects regarding modal shift from the transport investments being discussed and the possible outcome could be an increase of total transport capacity, but not any clear modal shift which may be the objective of the planned investment.

How to do / run it?

Before adopting or submitting to the legislative procedure a proposed plan or programme, the country of origin notifies potentially affected countries. Similar, if a country considers it likely that it will be significantly affected by a proposal in another country, it may request notification.

A joint working group should be formed and if necessary also subgroups for subtopics of the process. The working group should involve representatives from national, regional and/or local governments. The group should also consist of the different expertise needed – expertise in relevant environmental issues, transport management, risk analysis etc.

The key objective of the working group is to enable and stimulate the exchange of experience and expertise.

Different key tools can be used to encourage discussion and support strategic environmental analyses, for example for the purpose of comparing various planning alternatives. One way to get the process going is to start with dialogues, for example as seminars. The use of indicators is also a good way of stimulating the dialogue. This should generate comparison between environmental objectives.

The position paper on Transboundary SEA for the IAIA Conference on SEA (September 2005) points out some of the challenges to effective transboundary SEA:

- Identification of points of contact – who to contact for different types of plans and programmes, in different sectors and at different levels of government. This may become more complex for more decentralized government;
- Language – translation of documents and interpretation during meetings. How much of the documentation has to be translated, into which languages, by whom (plan or programme proponent, central government, the affected country, etc), and who pays;
- Public access to documents in an affected country – beware over-reliance on the internet, excluding disadvantaged groups;
- Access to public hearings if only held in the country of origin – costs of travel, border restrictions, need for interpretation, etc;
- Willingness of the public to participate. A plan or programme in another country may not attract much public interest – it may not appear concrete and may be too remote;
- Equity – whether equal opportunities to participate are sought for the public in the country of origin and in the affected country. If so, how this may be achieved;
- Timing of notification – when to notify? At the latest, transboundary effects might be identified during preparation of the environmental report, but if identified earlier then informal notification would best be initiated earlier as well, during scoping; doing so may reduce delays in reaching the decision stage;
- Delays in implementing the plan or programme – a transboundary consultation process may significantly lengthen the plan- or programme-making, because of delays in notification, having to wait for a response from a potentially affected country, translation of documentation, additional consultation and public participation, etc;
- Need to work within institutional arrangements for transboundary plans and programmes to identify entry point for SEA; and
- Compatibility of national systems for environmental assessment and public participation, etc.

Procedures for consensus building and conflict management are central to successful handling of transboundary issues. Conflicts can occur for many reasons. Areas for potential conflict include: interdependence of people and responsibilities; jurisdictional ambiguities; functional overlap; competition for scarce resource; differences in organizational status and influence; incompatible objectives and methods; differences in behavioural style; differences in information; distortions in communications; unmet expectations; unmet needs or interests; unequal power or authority; misperceptions, and others. Conflicts need not end in polarization or impasse. Conflicts can also be positive. For example, conflicts may help in:

- Identifying real problems needing solutions;
- Bringing about needed change;
- Permitting adjustments to be made without threatening the basis of a relationship;
- Helping to build new relationships;
- Changing the way we look at issues, clarifying purposes and identifying what is most important.
- Identifying what is most important.

Just as in all aspects connected with SEA and infrastructure planning, the final conclusion is that the transboundary goals, impacts and effects of different scenarios need to be discussed and handled at a very early stage in the planning process. Only when this is achieved, a fair discussion of the visions and goals behind the discussed investments can become a reality.

Who should be involved?

A direct involvement of local, regional and national officials is needed. It is also important to try to bridge gaps between planners, environmentalists and researchers. By bringing these different type of experts together in a working group a mutual understanding of the aims, goals and impacts of different developing strategies can be achieved.

It is of vital importance to make the public in the affected countries/regions involved in the creation and discussion of the visions on long and short term that the discussed strategies and investments are based on. Arrangements need to be made to ensure an exchange of information so that the decision-makers are fully aware of the views expressed by the public on the other side of the frontier.

Who should do it?

Consultants and/or public servants should be allocated to handle the practicalities and to make the working group work smoothly and efficiently, while the decision making abilities remain within the working group.

What are key tools?

Apart from the methodology of Strategic Environmental Assessment (SEA) of which the transboundary issues are a part, there are other methods and tools that can be useful. It is important to realise that no methods can be used in all planning situations. Different tools and methods must be chosen depending on the local conditions. In some cases it may be difficult to demonstrate the immediate environmental gains of planning.

- Visions, scenarios and future images inspire discussions.
- Geographical Information Systems (GIS) provide new opportunities although competence and the collection of data have to be improved.
- Scenario methods and planning and environmental dialogues in order to encourage forward-looking discussions and collaboration between various specialities in the planning process;
- Swot analysis for the purpose of identifying the characteristics of an area, its strengths and weaknesses, opportunities and threats;
- Focus diagrams that make it easier to assess the magnitude of a problem and the significance of planning when it comes to dealing with it
- Mental maps based on dialogues and questionnaires; the views and wishes that emerge are then drawn on the maps, preferably with the help of GIS;
- Ecological footprints, which give a picture of the area needed by an individual, or the inhabitants of a municipality, for necessary supplies;
- Multi-criteria analysis, which are used to evaluate and compare the quality of various planning alternatives by weighting certain factors or indicators;
- Planning indicators can facilitate evaluation

of the implementation of environmental objectives in planning. However, caution must be taken not to oversimplify and use quantifiable measures instead of more relevant, qualitative factors.

The **availability of adequate information** about the proposed activity, its likely effects on environmental, social and economic levels and the measures proposed to mitigate negative effects is a key issue in **effective public participation** in a transboundary SEA process. Specific arrangements should be made to ensure that members of the public have access to relevant information about the effects of the whole of the planned development strategy, its investments and the impact on environmental, economical and social level. A good and timely **translation of documentation** into the relevant languages will greatly facilitate meaningful involvement in the SEA procedure of the authorities and members of the public in the affected countries and regions. On the other hand, a poor translation may impede the process if in translation key information is "lost" or inadvertently misrepresented.

The tools mentioned above are suitable to a varying degree for use in the proposed procedure.

Show of examples

A framework for the creation of a long term vision on the Scheldt Estuary has been developed by the Netherlands and Belgium, with the direct participation of local and national officials from both countries. Ever since the countries of Holland and Belgium became separated in 1830, their governments have been arguing over the management of the Scheldt Estuary. Therefore, the generation of a draft long term vision document, in which the two countries use common objectives, issues and policies with the view to establish a transboundary sustainable management, can be welcomed as a remarkable success. With direct involvement of local and national officials, interviews, methodology development, literature study, workshops, and consultations were used to arrive at this result.

The most important success factors that are mentioned was the process of vision development, actively learning from each others working procedures, sharing the available knowledge and information and undertaking joint research to support the vision development.

The link between research and vision development has particularly been very useful in achieving consensus on potentially conflicting issues such as access to the harbors, safety against flooding and the maintenance of ecological values. Throughout the process, the balance between knowledge (study results) and opinions (political and social forces) has been carefully maintained.

Working from a short term perspective directly towards a set of long term objectives, and then dealing with possible medium term policy options provided the basis for agreement. In this way the long term vision is not a (simple) extrapolation of current policies, but an agreement on more abstract long term objectives.

The process adopted in the development of the long term vision helped creating a climate of cooperation on the Scheldt Estuary that extends beyond the agreed policy document – relating to both bi-national cooperation as well as cooperation across scientific disciplines and sectoral interest groups.

In Sweden, the SAMS project (Samhällsplanering med miljömål i Sverige – Environmental objectives and indicators in spatial planning and SEA) has examined the role of transboundary issues in spatial planning, including planning of transport infrastructure. A case study in the larger Stockholm region was to make an assessment of the environmental impact in connection with the transformation of comprehensive plans for the region into detailed development plans. The planning process covered all municipalities in the region and included transport corridors, water management and other issues of a transboundary nature. Indicators were developed that are useful in connection with environmental assessments at the area level. Proposals were presented for an appropriate procedure for performing strategic environmental assessments and a manual and a guide were produced for environmental impact assessments in connection with the detailed development plan process.

Examples of potential environmental, economical and social gains indicated by the development work carried out in this case study as well as other parts of the SAMS project and where transboundary issues were a key part of the planning process are:

- a better living environment due to the reduction of barrier effects and the nuisance caused by major road and rail thoroughfares
- improving access to green spaces and recreation areas;
- reduction of air pollution and climatic effects by improving the availability and quality of the public transport system and cycle tracks;
- improvement of the built environment and mutually beneficial exchanges between town and country;
- maintained and enhanced biological diversity in park and recreation areas and agriculture and forestry;
- projects that are important for the viability of rural areas based, for example, on tourism or local industries that utilise local resources.

Other examples of work that has been carried out regarding transboundary SEA, particularly for consulting foreign stakeholders on a domestic plan or programme having a transboundary effect:

- Transboundary environmental analysis of the Nile River basin (World Bank and others);
- Management of the Mekong River basin (Mekong River Commission);
- Transport on the Danube River (International Commission for the Protection of the Danube River);
- EU trans-European transport networks, TEN-T (European Commission/BEACON);
- ‘Environmental threats and opportunities assessment’ for Eastern & Southern Africa (USAID);
- Regional guidelines for the environmental assessment (EIA and SEA) of shared ecosystems within the East African Community (African Centre for Technology Studies).

Sources for further reading

- Transboundary - Framework for a long term vision on the Scheldt Estuary, Belgium and Netherlands (#171) : http://www.proses.nl, http://www.arcadis-global.com/service+types/environment/strategic+planning+consultancy+management/projects/strategic+assessment+for+a+strategic+waterway.htm

  http://gwpforum.netmasters05.netmasters.nl/en/content/case_B59396DF-4EEE-11D7-8F33-0002A508D0B7.html
- The Swedish Environmental Protection Agency and the National Board of Housing, Building and Planning: Planning for sustainable development. The SAMS project. ISBN NV 91-620-8008-3, December 2000.
- Danube River: http://www.icpdr.org
- East African Community: http://www.acts.or.ke
- EC BEACON: http://www.transport-sea.net
- Hong Kong SAR: http://www.epd.gov.hk/eia/english
- IIED, SEA – A sourcebook & reference guide on international experience: http://www.iied.org/spa/sea.html
- Mekong River: http://www.mrc.org
- Nile River: http://www.nilebasin.org
- Northern Ireland: http://www.planningni.gov.uk/

7. CRITERIA / INDICATORS FOR SUSTAINABLE TRANSPORTATIONS

What is the issue and its purpose?

The issue is the use of environmental criteria or indicators in the SEA process. In the present fact sheet criteria or indicators for sustainable transportations are primarily approached from the point of view of impact assessment. However, there is a multiple application potential for indicators. They can be used e.g. for:

- the screening decision, whether an SEA is necessary or not,
- the scoping, e.g. which plan alternatives are considered with their impacts and indicators corresponding,
- the impact assessment itself (using indicators for the prediction of environmental effects),
- the consultation and participation of stakeholders and the public,
- the monitoring and
- quality control purposes.

What are expected results?

Although criteria or indicators can be used for several purposes (see above), the main purpose is their use in impact assessments. The rationale of using criteria or indicators for sustainable transportations in this phase of the SEA is to facilitate an objective and quantified impact assessment of transport infrastructure plans or programs.

What are its appropriate scales (network, corridor, local)

Criteria and indicators have to be used according to their relevance regarding the planning level of the impact they represent:

- Network decisions, which mainly determine transport infrastructure capacity between several urban centres and poles, sometimes for a whole country.
- Corridor decisions, which determine the need for developing transport infrastructure capacity and the appropriate modes and routes between two urban centres or poles.

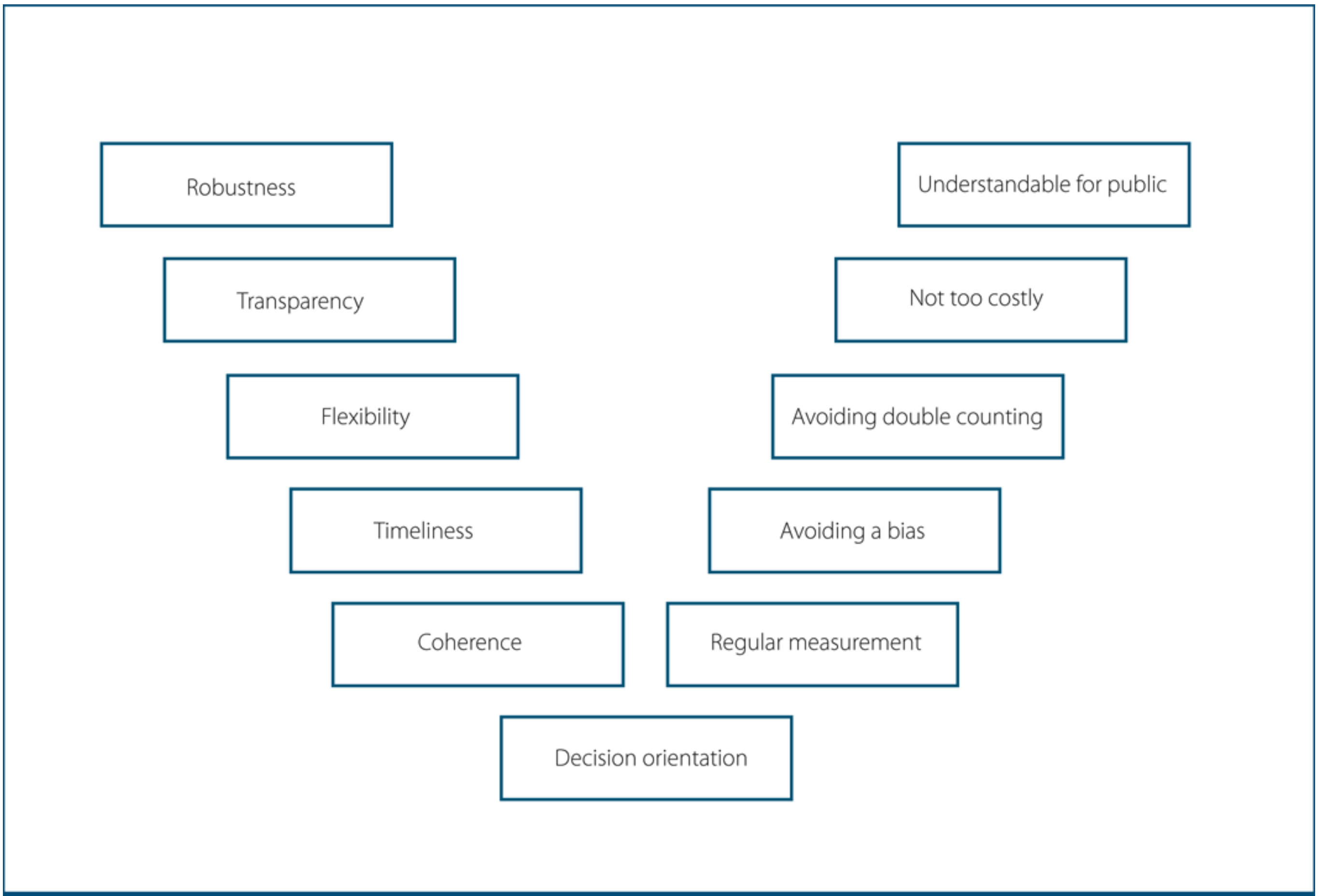


Fig. 10 Selected criteria for indicators

- Project decisions, which consider the detailed location and design of individual infrastructure projects, including mitigation measures, and are subject to environmental impact assessment (EIA).

So, one can distinguish between different planning and decision-making levels, and state that the different environmental impacts and the indicators correspondingly vary. For an overall conceptual description of environmental effects used for a scenario decision (equivalent of the network level, using global and regional impacts), e.g. the following environmental impacts should be elaborated and reported: use of resources, climate change (greenhouse gases, ozone), acidification, land take, fragmentation and noise. These impacts are used in order to identify e.g. energy consumption and emissions of pollutants.

For a project orientated approach it would be sensible to explore the following environmental impacts: adverse effects on biodiversity, public health, soil, ground water/surface water, landscape and cultural, archaeological or geological valuable areas as well as local air pollution (smog). The indicators corresponding measure immissions into soil, ground water, surface water, land take in and proximity to restricted areas and consumption of areas in general.

How to do / run it?

Identification, selection and application

Environmental objectives and the indicators corresponding are widely recognized as one crucial way in which environmental impacts can be identified, described, analysed, evaluated, compared and reported. Hence, it is a necessary, important and often difficult task to identify and to select the suitable indicators for the given task, e.g. a transport SEA, and therefore one has to consider some essential criteria, because indicators "need to be fit for purpose". Some of the mentioned required criteria and qualities for indicators to make them fit fur purpose are summarized in Figure 4.10. However, in order to achieve comparability and transferability of indicators data, it is necessary to consider a number of aspects when applying criteria or indicators:

- The relevant dimensions.
- The market segments.
- The choice of the future year.
- The choice of the study area.
- The location of the emissions.

Who should do it?

The impact evaluation for the SEA should be carried out by independent bodies and consultants. Parties with a large financial interest in a possible new project, like parties linked to the construction industry (banks, engineering companies), may be tempted to influence the SEA-process. In order to keep the SEA-processes "clean" such parties should preferably be excluded from the impact assessment process.

Who should be involved?

On the various planning levels there often are different stakeholders and different players involved. This is usually the case between the national and regional level, but when projects cross borders also the different national interests are involved. Each group has its own preferences and there may be marked differences between the ranking of environmental objectives as a category versus other policy objectives and amongst different groups of environmental objectives (for example between local and global environmental impacts).

What are key tools?

In principle the following key tool categories can be distinguished:

- Transport models: the basis to calculate impacts
- Calculation totals for the direct effects (emissions, land usage…)
- Calculate spatial distribution of direct effects (emissions)
- Overlay influence corridor (given distance at both sides of the corridor) with spatial data for sensitive areas (habitats for critically endangered species)
- Epidemiology: Overlay spatial distribution and human inhabitants/indigenous species to calculate the number of people/species affected by it
- Ecosystem Network analysis same as III for

Table 1 Global/Regional impact of transport infrastructure plans (km per mode can be vehicle, passenger, or ton km

Impact	*Indicators*	*Unit*	*Data*
Resource depletion: • Fossil energy • Other non-renewable energy (e.g. uranium) • Renewable energy • Non-renewable natural resources • Renewable natural resources	Energy / fuel use	Litres / tonnes / mega joules Tonnes of materials used	Changes in kms Energy use per km per mode
Climate change	Energy / fuel use	Litres / tonnes / mega joules	Changes in vehicle kms Energy use per km per mode
	CO_2	Tonnes	Changes in vehicle kms CO_2 per km per mode
	N_2O	Tonnes	Changes in vehicle kms N_2O per km per mode
	CH_4	Tonnes	Changes in vehicle kms CH_4 per km per mode
	CFC	Tonnes	CFC per km per mode
Acidification	Energy / fuel use	Litres / tonnes / mega joules	Changes in vehicle kms Energy use per km per mode
	SO_2	Tonnes	Changes in vehicle kms SO_2 per km per mode
	NO_x	Tonnes	Changes in vehicle kms NOx per km per mode

Table 1 Global/Regional impact of transport infrastructure plans (km per mode can be vehicle, passenger, or ton km (continued)			
Impact	***Indicators***	***Unit***	***Data***
Photochemical smog	Energy / fuel use	Litres / tonnes / mega joules	Changes in vehicle kms Energy use per km per mode
	NO_x	Tonnes	Changes in vehicle kms NO_x per km per mode
	NMVOCs	Tonnes	Changes in vehicle kms NMVOCs per km per mode
	CH_4	Tonnes	Changes in vehicle kms CH_4 per km per mode
	CO_2	Tonnes	Changes in vehicle kms CO_2 per km per mode
	O_3	Tonnes	Changes in vehicle kms O_3 per km per mode
Eutrophication	BOD (water) COD (water) N-total (water) NOx (air)	Tonnes	Changes in vehicle kms Energy use per km per mode

Table 2 Local impacts of transport infrastructure plans			
Impact	***Indicators***	***Units***	***Data***
Health hazardous emissions	Proximity of high emissions (CO, VOCs, SO2, NOx, particulate matter) to settlements	Distance between settlements pollution emitting areas	Link level traffic load Emissions per km per mode Location of residents
	Number of affected residents	Number of residents in pollution contours	Link level traffic load Emissions dispersion knowledge Location of residents

Table 2 Local impacts of transport infrastructure plans (continued)

Impact	*Indicators*	*Units*	*Data*
Noise	Proximity to settlements in relation to typical noise levels caused by a transport mode	Distance between noise emitting areas and settlements	Location of residents
	Proximity to tranquil zones in relation to typical noise levels caused by a transport mode	Distance between noise emitting areas and tranquil areas	Link level traffic load Noise dispersion knowledge Location of tranquil zones
	Number of affected residents	Number of residents affected by noise	Link level traffic load Noise dispersion knowledge Location of residents
	Number of people exposed to noise above standard levels	Number of people affected by noise	Link level traffic load Noise dispersion knowledge Location of residents
	Affected tranquil zones and other areas sensitive to noise	Number of tranquil zones affected by noise	Link level traffic load Noise dispersion knowledge Location of tranquil zones
Vibrations	Number of affected residents (especially during construction phase)	Number of residents affected by vibrations	Location of residents Vibration dispersion knowledge
Land use	Direct land take of different categories of land (including protected areas)	Square area of direct land take	Direct land take for project capacity Location of protected areas
	Indirect land take (induced spatial development)	Square area of indirect land take	Induced spatial development by economic effects Location of protected areas
Biodiversity	Proximity to valuable habitat (including protected areas and IBAs)	Distance	Location of valuable habitat
	Risk of fragmentation and loss of valuable habitat	Share of small patches of land	Land use data
	Disturbance of noise and light by direct and indirect land take	No indicator	Location of valuable habitat Induced spatial development by economic effects

Table 2 Local impacts of transport infrastructure plans (continued)

Impact	*Indicators*	*Units*	*Data*
Visual/ landscape impacts	Direct damage to visually important elements and patterns	Number of damaged elements	Location of visually important elements and patterns
	Risk of significant emission of pollutants to sensitive water resources (including accidents)	Pollution by accidents	Number of accidents Pollution per accident
Barrier effects	Fragmentation of sensitive elements, patterns and landscapes	Share of small patches of land	Land use data
Waste production	Waste production for: • recycling • combustion • deposition • effluent from ships • Rainwater runoff from roads containing pollutants such as hydrocarbons and heavy metals	Tonnes Tonnes Tonnes Tons of pollutants Volume of pollutants in water runoff	• Traffic intensity • Effluents per ship • Pollution • Climate
Toxic substances	• Heavy metals like lead and cadmium (only at very short distances) • Copper from railway power lines • de-icing salt and other chemicals • wear of roads and tyres	Volumes Tonnes Tons of chemicals Tonnes	• Emissions of lead and cadmium • Local knowledge of use of chemicals
Accidents	Risk of accidents/casualties for: • humans • animals • environment	Number of: • casualties • accidents	

Table 3 Environmental indicators in TEN-STAC

Assessment	***Objective***	***Indicator***	***Unit of measure***
Cost-benefit analysis	Global warming	Change of the transport contribution to global warming	1000 € / year Mln. kg CO2 / year
	Atmospheric pollution	Change of the NOX transport emissions	1000 € / year Mln. kg NOx/ year
		Change of the emission of particulates	1000 € / year Mln. kg particulates / year
	Transport safety	Variation of accidents	Mln. € / year
Non-monetised impacts	Modal rebalancing	Volume of road freight traffic shifted to rail, IWW or sea transport	Mln. tkm / year
		Volume of road and air passenger traffic shifted to rail	Mln. passenger.km / year
	Traffic transfer	Transfer of traffic from infrastructure lying in sensitive zones to the projected infrastructure	% of road traffic transferred from sensitive areas
	Distance	Percentage of the length of the project lying in a sensitive area	% length
	Emissions	Changes of inhabitants' level of concern caused by emissions of NOx and particulates	% NOx % Particulates
	Proximity	Synthetic appreciation of the proximity of the project from specially protected areas (SPAs) or densely populated areas	Proximity of the project from SPA (km); Number of inhabitants living in the zone traversed by the project

indirect effects affecting living conditions of the population (human and indigenous species)

- System theory based integrated models, including all relevant impacts on the environments and feedback of the demand.

Show of examples

This paragraph shows some examples of criteria or indicators. In particular, Table 1 and Table 2 show the lists developed in the BEACON project. Table 3 describes the calculations of the environmental indicators in TEN-STAC.

Appendix to Factsheet 7: European Data Sources

The following pages lists a selection of the common European spatial data that can be usefully used as a valid support to prepare the baseline environment for the indicators evaluation (and input to modelling).

Data are deeply connected to the use of tools. Firstly the modelling relies on quantified cause effect relationships, forecasting uses quantified elasticity, the exposure has to be based on existing environmental data (immissions) and habitats and biodiversity have to be localised to quantify the impacts. Modern remote sensing technologies allow a better coverage of the land cover however endangered species are identified from the ground. The following sources, referring to common European spatial data, have been thus identified:

Endangered species

BirdLife's World Bird Database

This provides a list of Important Bird Areas in Europe and reflects periodically updated information published in Heath, M. F. and Evans, M. I., eds (2000) Important Bird Areas in Europe: Priority sites for conservation. 2 vols. Cambridge, UK: BirdLife International (BirdLife Conservation Series No. 8) and updated. Fields: Region, two-letter country code, country, International name, National name, area (km2), latitude, longitude.

http://www.birdlife.net/datazone/downloads/index.html

Areas of high ecological value/ CORINE Biotopes:

The CORINE biotopes (Version 2000) database is an inventory of major nature sites. CORINE Biotopes is a relational database made of different tables including: (i) species tables (mammals, birds, reptiles, etc.), (ii) habitats tables, (iii) natural sites tables, and (iv) look up files.

http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=548

Unfortunately they have only one co-ordinate for the whole area.

Land cover

Corine land cover 2000 vector by country (CLC2000).

Main Categories are:

- Artificial surfaces
- Agricultural areas
- Forest and semi natural areas
- Wetlands
- Water bodies

Available for the EU 25 (with the exception of the United Kingdom), Bulgaria, Rumania, Albania, Bosnia and Herzegovina, Liechtenstein and Macedonia.

Croatia, Cyprus and United Kingdom are expected in the course of 2005.

The smallest mapping unit is 25 ha.

http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=667

Landscape Pan Europe (LS) – GISCO/EUROSTAT

Main categories are:

- Artificial landscapes
- Boscages or enclosed landscapes with hedges
- Open fields
- Regional landscapes
- Steppes-like and arid landscapes
- Taiga

- Tundra
- Upland

The Landscape Pan Europe dataset is available for whole Europe but Turkey.

http://eusoils.jrc.it/gisco_dbm/dbm/home.htm

Vegetation

Natural Potential Vegetation

Three levels of classification can be distinguished within this data layer, starting with the highest level:

- vegetation classes, which contain
- vegetation types (22), which are constituted of
- vegetation associations

The dataset was created in 1988

The Natural Potential Vegetation dataset includes all western European countries and Turkey

http://eusoils.jrc.it/gisco_dbm/dbm/home.htm

Other Data

EuroGlobalMap - Arc Info Layer Structure

- Administrative boundaries
- Hydrography
- Transport
- Settlements
- Elevation
- Named location (geographical names)

http://www.eurogeographics.org/eng/04_products_globalmap.asp

Further reading

- OECD (1999): Indicators for the Integration of Environmental Concerns into Transport Policies, Environment Directorate, Environment Policy Committee, Working Group on the State of Environment, ENV/EPOC/SE(98)1/FINAL from 11 October 1999, Paris
- SUMMA (2004): Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators, Deliverable 3 of Workpackage 2 of SUMMA (SUstainable Mobility, policy Measures and Assessment), Final Version 1.1, http://www.summa-eu.org/control/reports/SUMMA-D3-1-1-pdf.zip, last accessed 29 December 2004
- Tomlinson P, Fry C, Cloke J, Abbott P, Paulley N and Griffith P (2000): Robust Environmental Indicators from Transport Model Output: Draft Scoping Report, TRT Ltd., The Scottish Executive Central Research Unit
- Van Wee, B., Van den Brink, R., Nijland, H. (2003), Environmental impacts of high-speed rail links in cost benefit analyses: a case study of the Dutch Zuider Zee line, Transportation Research Part D, 8: 299-314
- Van Wee, G.P. (1991), Better public transport, better environment? (Beter openbaar vervoer, beter milieu?) Verkeerskunde 7/8: 14-15.

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