Analytical methods that can be used in an SEA

Source: UNECE and REC, (2006)

This annex provides a menu of selected analytical tools and techniques that can be used in an SEA and offers an overview of each method. In practice, the SEA experts may find it appropriate to vary their approach, for instance, in combining qualitative and quantitative assessment. The following methods are described:

- Expert judgments
- SWOT
- Checklists
- Matrices
- Spatial analyses: overlay maps and GIS
- Trends analysis/extrapolation
- Networks and flow diagrams
- Delphi technique
- Modelling
- Multi-criteria analysis

The key features of these tools can be summarized as follows:

	Application within the SEA process				
Tools	Identification of issues and impacts	Analysis context and baseline	Contributing to development of alternatives	Assessment of impacts	Comparing key options for decision-making
Expert judgment	✓	✓	✓	✓	✓
Checklists	✓				
SWOT	✓	✓			✓
Matrices	✓		✓	✓	✓
Networks and flow diagrams	✓	✓		✓	
Spatial analyses: Overlay maps and GIS	✓	✓	✓	✓	✓
Trends analysis/extrapolation	✓	✓	✓	✓	✓
Delphi technique	✓	✓	✓	✓	✓
Modelling	✓	✓	✓	✓	
Multi-criteria analysis			✓	✓	✓

Tool: Expert judgment	
Linkages to other tools	• Matrices • Delphi technique • Modelling • Multi-criteria analysis
Purpose	Expert judgment is a process for obtaining data directly from experts in response to a technical problem.
Description	Expert judgments are part of any SEA process. This is inevitable because SEA is an analytical process that examines the relevant trends and risks through: • Identification of key strategic issues relevant for the plan (and its position in the decision-making process); • Determination of the spatial and temporal scale of the relevant issues; and • Selection of appropriate indicators (or proxy-indicators) that simplify the evaluation and turn it into manageable assessment. Use of all analytical approaches and tools in the SEA is therefore always influenced by expert judgments. The SEA tools that most rely on the expert judgments include: • Matrices: experts need to use their own judgment to determine the key impacts, synergies, or conflicts addressed by the matrix; • Modelling: experts need to use their own judgement to identify the specific issues and interactions that need to be modeled; determine key assumptions and boundaries of the modeling; Select a suitable model and verify it, calibrate it, and fine-tune it to fit the local situation and data availability; and • Multi-criteria analyses: experts need to use their own judgement to determine the assessment criteria, their relative importance (weights), and performance (scoring) of each proposed option. This summary deals with one specific form of expert judgment when the recognized “experts” in the relevant fields directly formulate explicit and quantitative views on the probability and magnitude of the expected impacts and explain uncertainties in these predictions. Well-organized expert judgments do not mean “guessing”, since the participating experts need to usually clearly explain: • Assumptions on which the judgment is based (when would the risk/impact occur and what it is caused by); • Character of the predicted risk/impact (e.g., probability of the risk/impact, its nature and scale, and duration and reversibility); • Directly and indirectly affected geographic areas, ecosystems, or persons (e.g., particularly sensitive or important elements of the receiving environment, vulnerable social groups, non-renewable resources, endangered species, etc.); • Baseline situation (e.g., the past, present, and future actions that should be considered when judging this risk/impact and the relative importance of the expected risk/impact when compared with the baseline situation); • Key concerns associated with the predicted risk/impact (e.g., how far is the predicted impact from any established thresholds or targets); and • Magnitude of key uncertainties in this judgment. When these rules of good practice are expected, expert judgment can reflect the life-long experience and expertise of participating experts. Such judgments can be, especially in situations of significant data gaps, more precise than quantitative predictions based on incomplete data. Such expert judgments are best obtained through the canvassing of opinions from a representative set of recognized experts in a given field and their iterative discussion. Expert judgments can be formulated through simple participatory tools such as workshops, interviews, or questionnaires with a problem-solving focus (these tools are described in Annex 2.). The most sophisticated means of collective expert judgment is the Delphi technique, which is separately described in the annexes). The Chinese Provisional Measures for Public Involvement in EIA (Yuhuan, 2012), for

	instance, allow for the use of expert judgments through consulting expert opinions in written or other forms (Article 20) or through organizing evaluation meetings with relevant experts (Articles 21-23). Consulting expert opinions in written or other forms requires that the individual experts and organizations that accept such consulting arrangements provide clear opinions on consulting matters and reply in writing. Any written opinion should be signed by individual experts and affixed with the employer's seal. Any different opinions in collective expert consulting shall be described by the consulting organization in consulting replies. Evaluation meetings with relevant experts require determination of the major topics for review according to the scope and extent of environmental impact and the assessment factors, notification of the related organizations and individuals of the time, venue, and major topics of the meeting, and elaboration of the meeting record. The meeting record summarizes the different opinions based on presented facts and can be prepared in the form of the meeting minutes or the meeting conclusions. The basic rules for the use of expert judgments formulated by the US Environmental Protection Agency (U.S. Environmental Protection Agency, n.d.) may also be of interest. These can be summarized as follows: • At least five individuals need to be used in any expert judgment process, unless there is a lack or unavailability of experts. • The individuals involved in expert judgment have an appropriate level of knowledge and experience for the questions or issues addressed. • At least two-thirds of the experts involved in expert judgment are not directly employed by the proponent. • The public and relevant authorities are provided with a reasonable opportunity to comment on the scientific and technical validity of these expert judgments.
Usual application within SEA	The expert judgment can be used at any stage of the SEA process. It is usually used when: • The key issues of concern are being identified; • Periodical results or final results are prepared to check the results achieved and • Difficulties arise in the use of qualitative tools or when there are problems without solutions to collect opinions on the specific issue or to identify the solution.
Inputs and data demands	Basic information on the proposed development and affected environment, possibly complemented by a series of questions on the specific issue.
Outputs	Direct response from experts to a technical problem.
Advantages	• Expert judgment is a tool that provides quick and effective advice • It can operate in situations of significant data gaps
Disadvantages	• The quality of the outcome depends on the knowledge and competence of participating experts. • The judgment will also be affected by the comprehension of the background/briefing material. If the material is not complete or includes deficits, it will affect the conclusions. • The outcome can also be influenced by the quality of the entire process.

<table>
<tr><th colspan="2">Tool: Analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT analysis)</th></tr>
<tr><td>Description</td><td>
SWOT is used as part of the diagnosis of the current situation. It highlights the key internal issues (strength and weaknesses) and the key external issues (opportunities and threats) that should be considered in the planning or in the assessment process. The following table shows the logic of a SWOT analysis.
<table>
<tr><th></th><th>Positive</th><th>Negative</th></tr>
<tr><td>Internal</td><td>Strengths</td><td>Weaknesses</td></tr>
<tr><td>External</td><td>Opportunities</td><td>Threats</td></tr>
</table>
SWOT was originally developed in business management, but it is increasingly used in the elaboration of SPPs. Regardless of its specific application, the SWOT analysis applies the following simple sequence of tasks.

Step 1: List internal factors (what is here and now): List all strengths that exist now. Then, in turn, list all weaknesses that exist now. Be realistic, but avoid modesty.
Step 2: List external factors (what is relevant for the future developments): List all opportunities that exist in the future. Then, in turn, list all threats that exist in the future.
Step 3: Review the SWOT analysis: When the analysis has been completed, a SWOT profile can be generated and used as the basis of goal setting, strategy formulation, and implementation. The completed SWOT profile is usually arranged as follows:

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td>1.
2.
3.
…..</td><td>1.
2.
3.
…..</td></tr>
<tr><th>Opportunities</th><th>Threats</th></tr>
<tr><td>1.
2.
3.
…..</td><td>1.
2.
3.
…..</td></tr>
</table>
These tasks can be performed by planning teams as well as assessment teams. However, SWOT analysis offers a useful tool in participatory discussions and is generally more effective if it engages stakeholders with different viewpoints.
</td></tr>
<tr><td>Usual application within SEA</td><td>

Analysis context and baseline
Identification of constraints (risks) and opportunities (benefits)

</td></tr>
<tr><td>Advantages</td><td>

SWOT reduces a large quantity into a simple overview of key issues that could be considered in the planning.
SWOT is a useful tool for obtaining various viewpoints on the current situation and can be very well used in participatory processes.
Demand for data: Small: undertaking SWOT largely depends only on personal knowledge and insights of participants in the SWOT process.
Cost and time requirements: Small: SWOT can be done as a quick exercise by a single person or as a rapid appraisal process of a current situation that involves a large number of stakeholders.
Ability to deal with uncertainties: Medium to High: By examining future opportunities and threats SWOT highlights key future uncertainties.
Transparency: High: SWOT is a very transparent technique.

</td></tr>
<tr><td>Disadvantages</td><td>

SWOT has a tendency to oversimplify the situation.
Analysis of current internal situation through simple presentation of strengths and weaknesses does not explain why these strengths and weaknesses occur (their root causes) and whether there are any linkages between them.
Classification of external factors as opportunities or threats is somewhat arbitrary; the same point may feature both as a strength and as a weakness. For example, “increased exports” may be presented as a strength and “reliance on exports” as a weakness.

</td></tr>
</table>

Examples of practical application or key sources of further information	Community Tool Box, a website from the United States, has an easy to follow description of how to do a SWOT analysis (http://ctb.ku.edu/tools/en/sub_section_main_1049.htm). An example of an interesting SWOT analysis that examined key trade, poverty and environmental issues and linkages in rural development programs of the European Commission DG Development can be found at: http://europa.eu.int/comm/development/body/theme/rurpol/outputs/diagnostic/html/5.htm

Tool: Formal and informal checklists	
Description	A checklist presents a catalog of issues that might be considered when assessing particular types of plans or programs. Checklists may list: • Environmental, including health, are concerns usually associated with certain plans and programs. • Relevant environmental, including health, objectives for various development activities • Indicators or specific guiding questions that can be asked when evaluating a plan or program in certain fields
Usual application within SEA	• Analysis context and baseline • Identification of issues and impacts
Advantages	• Help remember all the information relevant to a task • Provide a simple way of identifying whether certain issues are relevant to a proposal and help to avoid overlooking potential issues
Disadvantages	• Do not offer a very analytical approach to analysis • Encourage neglect of any important effects that are not present in the checklist • May cloud judgment with irrelevant information • Do not specify the nature of cause-and-effect relationships; are prone to pigeonholing impacts into certain categories, whereas, in reality, an impact may be part of a complex system.

Tool: Matrices	
Linkages to other tools	Expert judgments
Purpose	Matrices enable identification or presentation of: • Impacts of proposed development on various elements of the environment (matrices of impacts), or • Synergies or conflicts between proposed development and the relevant environmental objectives (matrices of conflicts or synergies). Matrices visually summarize these effects in a user-friendly way. As such, can be used to quickly compare the pros and cons of proposed development options.
Description	A simple matrix can help to identify various effects of a single intervention. More complex matrices can show cumulative effects of numerous projects on various environmental issues or objectives. Basic matrices can mark the existence of impacts or conflict/synergy using simple symbols (e.g., X, XX). More elaborate matrices use various characters, numerical scores, colors, or even textual descriptions to outline the nature, scale, importance, and duration or reversibility of each effect. Presented information should be easy to verify—matrices thus need to be accompanied by a text explaining the nature of specific effects.
Usual application within SEA	Matrices belong to the most commonly used tools in SEAs in the European countries. They can be very easily used for: • Identification of effects • Presentation of effects • Comparison of alternatives

Inputs and data demands	Basic information on the proposed development: a simple list of proposed development objectives or development activities. Basic information on the local environment: a simple list of relevant environmental issues or relevant environmental objectives in the study area.
Outputs	Visual summary of impacts or conflicts/synergies
Advantages and disadvantages	• Matrices help to systematically identify impacts or conflicts/synergies • They can easily present outcomes of qualitative or quantitative assessments • They generally do not consider spatial issues and local territorial issues • They force users to consider many potential interactions; this may divert attention to minor impacts.
Further reading	Further information on the various uses of matrices can be found at: http://en.wikipedia.org/wiki/Matrix_methods

Tool: Spatial analyses: Overlay Mapping and Geographical Information Systems (GIS)	
Linkages to other tools	-
Purpose	To illustrate the spatial distribution of relevant issues and impacts.
Description	Spatial analyses are undertaken through the preparation of maps with different information that is relevant to the SEA. When these maps are laid over each other, they can: • Provide a composite picture of the receiving environment (e.g., sensitive areas or resources, current pressures, etc.) and resulting development opportunities and constraints • Present impacts of previous developments and show linkages between different issues (e.g., correlation between air pollution concentrations and development of transport networks, correlation between water pollution and sitting of industrial facilities, etc.) • Identify potential impacts of future activities. Outline cumulative impacts of different activities on one issue (e.g., impacts of agricultural developments, new housing, and new industrial zones on water quality.) • Indicate spatial concentrations of different environmental impacts (e.g., map showing specific areas that will be subject to excessive air pollution, water pollution, and noise pollution). Spatial analyses can be based on manual elaboration of transparent maps (overlay mapping) or elaboration and processing of electronic maps (Geographical Information Systems, GIS). While overlay mapping may be a simpler form of the analysis, it delivers only one series of maps and overlays. Elaboration of base maps for GIS is more demanding; however, once these maps have been prepared, GIS allows users to easily add further information or to flexibly amend existing maps within the GIS.
Usual application within SEA	• Analysis of context and baseline • Identification of issues and impacts, including cumulative and synergistic impacts • Development and comparison of alternatives
Inputs and data demands	• Base maps of appropriate scale (e.g., topography, land uses, etc.) • Maps indicating location of key development initiatives or spatial distribution of relevant environmental issues (e.g., air quality, water quality).
Outputs	• Maps showing spatial distribution of key issues or impacts. • These maps can be developed to visualize past, present, and future situations.
Advantages and disadvantages	• Spatial analyses can consider topography and local territorial issues, • If the relevant maps are not readily available, spatial analyses can be expensive and time-consuming.
Further reading	British Geological Survey report (2004) on Strategic environmental assessment (SEA) and future aggregates extraction in the East Midlands Region presents a number of GIS usage methods and approaches: http://www.mineralsuk.com/britmin/CR_04_003N.pdf.

Tool: Trend analysis and extrapolation	
Description	Accurate trend analysis is one of the most important aspects of any strategic assessment. In the context of an SEA, it can be defined as an interpretation of environmental pressures and changes in the state of the environment, including health, over time. Trend analysis uses data sets and helps to trace any trends or patterns. Trends can be linear, exponential, or cyclical, and they should, where possible, be analyzed over a correct temporal scale. The presentation of trends can be fairly simple, e.g., a line graph, or quite complex, e.g., using three-dimensional graphics or video simulation. There are numerous computer programs that facilitate trend analysis (e.g., the simplest ones being computer spreadsheet software, more advanced ones including RATS, GAUSS, JMP, etc.). Trend analysis facilitates the presentation of the main linkages between environmental pressures and corresponding (sometime delayed) changes in the state of the environment. As such, it can also assist in predictions of future impacts. Some trends can be safely extrapolated on the assumption that the trend is going to continue in the same dynamic. When doing so, it is important to realize that virtually every trend has a corresponding counter-trend. Oversimplified extrapolation that does not consider how the trend will evolve once it reaches a key breaking point (e.g., when carrying capacity of the surrounding environment has been reached or exceeded) or once the counter-trend becomes stronger may be misleading. Trend extrapolation can thus play an important role in medium-to-short-term forecasts when no major counter-trends or breaking points are expected. Long-term trends can be precisely determined only through modelling, if at all.
Usual application within SEA	• Analysis of context and baseline • Assessment of impacts
Advantages	• Can greatly assist in the quantification of cumulative impacts in cases where environmental data are available over long periods of time
Disadvantages	• There are often situations where it is not possible to obtain relevant or sufficient data on specific environmental pressures. • In cases where there are gaps in data, it becomes important to use appropriate statistical methods to ensure the proper interpretation of trends. Such analysis may be quite cumbersome.
Examples of practical application or key sources of further information	Different examples of trend analysis are presented in the Transport Analysis Guidance on *SEA for Transport Plans and Programmes* (2004) by UK Department for Transport, available at http://www.webtag.org.uk/webdocuments/2_Project_Manager/11_SEA/2.11.pdf.

Tool: Networks and Flow diagrams	
Linkages to other tools	Modelling
Purpose	Networks and flow diagrams (sometimes also called system diagrams) can be in SEA used to illustrate: • Implications of the proposed decisions on the subsequent decisions and their knock-on effects on other developments (decision trees); or • A gradual progression from direct immediate effects to indirect, longer-term, or delayed effects (effect networks).
Description	Steps for constructing a decision tree might comprise: • List the proposed developments. • Identify the effects of these proposals on other decisions or developments. • Identify secondary knock-on effects of these decisions or developments, illustrating their

	wider indirect implications. Steps for constructing an effect network might comprise: • List the proposed developments. • Identify effects of these proposed developments on the directly affected elements of the environment. • Identify secondary knock-on effects on other elements of the environment, including health, illustrating pathways from direct effects to indirect effects. • When doing so, determine whether any cumulative effects on the same element of the environment, including health, occur. • If appropriate, consider a loop to show any feedback. • If appropriate, use quantitative techniques as a simple form of modelling to evaluate the effects. This approach constitutes a simple form of modelling and allows the evaluation of effects (see more on modelling).
Usual application within SEA	• Identification of issues and effects. • Assessment of effects. • Development and comparison of alternatives.
Inputs and data demands	• Basic information on the proposed developments. • Basic information on the local environment—a simple list of relevant elements of environment in the study area.
Outputs	• Illustration of the cause-effect relationships
Advantages	• Flow diagrams help identify indirect and delayed effects. • They clearly illustrate the interaction pathways; the mechanism of cause and effect is made explicit • Flow diagrams provide a good basis for choosing which processes could be quantified or modelled in further detail.
Disadvantages	• Flow diagrams do not illustrate spatial or temporal scales of impacts. • They use a holistic approach to impact assessment, so it may require a considerable effort to complete. • They can become too complex.

Tool: Delphi Technique	
Linkages to other tools	Expert judgments
Purpose	Delphi Technique enables identification of prevailing judgment within a large group of experts who do not directly interact with each other.
Description	The Delphi technique represents the systematic and powerful tool for formulation of collective expert judgments. It is based on the following principles: • There is no face-to-face interaction; • Each participant is given time for thought and an equal opportunity to contribute; and • In particular, disagreements are recorded to examine different points of view and to increase understanding. The Delphi technique is based on the following key steps: • Clarify what information is needed, design the questions, and determine the timeline of the process. • Identify the appropriate number of experts to serve on the Delphi panel and explain the tasks. • Prepare and distribute the initial set of open-ended or closed-ended questions. • Collect and analyze the first responses and compile the responses. If open-ended questions were used extensively, analyze and present the first set of responses within an appropriate theoretical framework. • Send the same question out to the same panelists a second and third time. The process may be repeated with additional waves, if necessary. Include the responses with the question so that panelists can read the other opinions and adjust their own opinions. Respondents will read each other's ideas and answer the question again. As information is exchanged, people incorporate each other's perspectives and information into their

	thinking and arrive at a fairly accurate understanding of the critical issues to consider in their decision-making process. • Always prepare and distribute a final report to panelists. One of the motivations for participating in a Delphi panel, particularly for specialists, is to learn first-hand, before others, what the results of the Delphi study are. It processes identification of prevailing judgment within a large group of experts who do not meet and who may not even know each other's identity in order to minimize personal influences. It thus enables the participation of experts from geographically dispersed locations. The approach used in the Delphi technique also defines some useful principles and steps for the formulation of expert judgment through other less time-consuming techniques (e.g., workshops, conferences, etc.).
Usual application within SEA	• Identification of effects • Assessment of effects • Comparison of alternatives
Inputs and data demands	• Basic information on the proposed development. • Basic information on the receiving environment.
Outputs	• Prevailing professional judgment from a large group of experts.
Advantages	• Delphi technique can deal with quite technical or complex issues. • It allows sharing of ideas and consensus in decision-making by a large number of stakeholders who do not know each other's identity and can be even geographically distanced. • It is convenient to participants, as they can contribute from their own office or home.
Disadvantages	• It takes time for the organizers (can run for several months). • Participant commitment may falter if the process takes too long or they have other commitments. • Large amounts of data need to be carefully assessed and distributed, so the process can be expensive to manage.
Further reading	Nehiley, J. M. (2001) *How to Conduct a Delphi Study.* Dick, B. (2000), *Delphi face to face* (http://www.uq.net.au/action_research/arp/delphi.html).

Tool: Modelling	
Linkages to other tools	• Networks and flow diagrams • Spatial analyses
Purpose	Models facilitate simulation of environmental impacts.
Description	Modelling generally tends to be used in SEA only when other analytical tools would provide insufficient predictions. Models of relevance to SEA are mainly those developed to simulate specific environmental impacts. Environmental modeling typically includes the following basic steps: • Define the very specific issues and interactions that need to be modeled; • Define key assumptions and boundaries of the modelling; • Identify the suitable model and fine-tune it to fit the local situation and data availability; • Collect the basic data on the local environment (e.g., topography, wind speed and direction, flow regimes, etc.). • Collect the input data for the past and current situations (e.g., emission levels) and run the model to enable its verification and calibration; • Run the model for the different scenarios that are considered in the assessment (e.g., emissions from the different proposed project and from other actions that are considered during the assessment). Developing a new model is generally very costly. Established and accepted models can be used if they are carefully calibrated to ensure that the simulation fits the specific features of

	the study area. The most common models include: **Air Quality Models** can simulate the cumulative impacts of a number of projects on the local air quality. They typically consider factors such as the wind direction and speed, air quality and humidity, details of the topography of an area, and location of developments that emit air pollutants. **Water Quality Models** can simulate the dispersion of various pollutants under different flow or tidal conditions. They require data on flow regimes (and/or tidal conditions) and can typically predict changes in the dissolved oxygen, coliform bacteria, sediment, or chemical concentrations. Other water quality models can simulate the behavior of pollutants in a lake environment. These models normally consider various inputs of chemicals (e.g., discharge, inflow in rivers, and deposition from the atmosphere) and their removal factors (e.g., irreversible reaction in the water and sediment, outflow in the water, and sediment burial). They typically yield mass balance equations for the water columns and the bottom sediments, but they may also consider pollutant transfer through sediment-water exchanges (e.g., by diffusion and deposition). **Soil Quality Models** can calculate soil degradation (e.g., erosion, degradation of the organic matter, etc.) or leaching and accumulation of chemicals (fertilizers, pesticides, heavy metals) applied to soil. They typically consider the physical-chemical properties of the soil and the chemical behavior of the applied chemicals in a soil environment. **Noise Models** can consider the cumulative noise levels from more than one source. They typically consider details of the topography of an area and locations of noise emitters.
Usual application within SEA	• Assessment of impacts • Development and compassion of alternatives
Inputs and data demands	Use of models typically requires the following input data: • Specific impact that needs to be modeled; • Key assumptions and boundaries of the assessment; • Data on the local environment (e.g., topography, wind speed and direction, flow regimes, etc.); • Input data on relevant emissions from the proposed project and from other actions that are considered during the assessment.
Outputs	• Simulation that quantifies the expected impacts.
Advantages	• Models can be relatively easily manipulated through assumptions made in their design or adaptation. • Models, once constructed, can simulate effects over time and in space. • It can facilitate numerous simulations based on different assumptions and input data. • Modelling results can be effectively combined with GIS.
Disadvantages	• No model can realistically address every intricacy of the natural system. • The accuracy of a model totally relies on the quality of baseline data. • Construction or calibration and running model is usually very demanding in terms of cost, expertise, and time.
Further reading	The Canadian Environmental Modelling Centre at Trent University develops, validates, and disseminates mass balance models, which describe the fate of various chemicals in the environment. Their site https://www.trentu.ca/cemc/resources-and-models offers (as of 2025) freeware models that can be used for basic modelling of air, water and soil quality. International Environmental Modelling and Software Society is a global not-for-profit association dealing with environmental modelling. Its website http://www.iemss.org offers comprehensive information on various aspects of environmental modelling, software, and related topics.

Tool: Multi-criteria analysis	
Linkages to other tools	Expert judgments
Purpose	Numerically evaluates all alternative options against several criteria and combines these separate evaluations into one overall evaluation. It can be used to identify a single most preferred option, to rank options, or simply to distinguish acceptable and unacceptable options so that a limited number of options can be shortlisted for a detailed appraisal.
Description	Multi-criteria analysis (MCA) helps to manage complexity in decision-making by converting the evaluation to a numerical score. All MCA approaches incorporate judgments that are expressed in weights of criteria and in performance evaluations of each option. Usual steps in a multi-criteria analysis are as follows: *1. Identify assessment criteria* so that they can measure key consequences of proposed alternative options. The proposed set of criteria should be carefully examined to ensure that: • The set of criteria is complete (no significant criteria are missing). • There are no redundant criteria (these may include insignificant criteria or criteria where all options perform equally). • Criteria are measurable (it must be possible to assess, at least qualitatively, how well each option performs in relation to the criterion). • Criteria are mutually independent (there is no double counting). *2. Analyze the relative importance of criteria (weighting).* Most MCA techniques determine the relative weights of each criterion in the decision-making. Methods of weighting vary from simple techniques (e.g., comparing criteria against each other to determine their relative weight) to complex methods (e.g., sociological surveys to determine the importance of each criterion in the affected community). *3. Analyze performance (scoring).* Determine what constitutes the best and the worst performance in the given context. Then, score the performance of each option with regard to each assessment criteria. Scoring can be basically done through three means: • Expert judgments that assign scores to show performance of each option when it comes to each assessment criteria (e.g., 0-100-point scale) • Compare options against each other. These methods vary from simple mutual comparison of options (e.g., on criterion 1, the option A scores best, C second, and B third) to more complex comparisons (e.g., programs based on fuzzy sets that turn linguistic evaluations into numerical scores). • Performance is determined on the basis of a criterion-specific curve that defines gradual progression from the worst to the best performance. *4. Multiply weights and scores for each of the options and derivation of their overall scores.* Each option’s performance on a criterion is multiplied by the weight of the respective criterion—this is done for all the criteria. The sum yields the overall relative score for the given option. The results for all the options are compared and discussed. *5. Analyze sensitivity to changes in scores or weights.* Sensitivity shows how changes in the scores or weight affect the results of MCA. Such analysis may be essential if: • There are serious uncertainties about the performance of some options against selected criteria, or • If decision-makers or stakeholders argue about the relative weights of criteria used in MCA.
Usual application within SEA	• Determination of relative importance of impacts • Assessment of impacts • Comparison of alternatives
Inputs and data demands	• Carefully identified assessment criteria reflecting the key environmental consequences of all proposed alternative options • Judgments on relative importance/weights of these criteria • Judgments on the performance of each option with regard to all criteria

Outputs	• Conversion of assessment into numerical scoring
Advantages	• MCA takes into account different criteria at the same time (i.e., they avoid decision-making processes based on a single criterion); • MCA may be used to bring together the views of the different stakeholders in the evaluation; • MCA is transparent and explicit (the scores and weights are recorded and easy to audit); • MCA may facilitate communication with decision-maker and sometimes with the wider community. • MCA reduces rational debate about various pros and cons of proposed alternative options into discussion about abstract numbers (scores and weights)
Disadvantages	• MCA cannot facilitate consensus on very controversial decisions; • By presenting quantitative information (aggregated scores), MCA may create a false impression of accuracy. This sometimes hides the fact that all MCAs heavily depend on a value judgment; • MCA may be easily manipulated by those who perform it (i.e., simple sensitivity analyses that are normally performed within MCA show criteria that best influence outcomes; this knowledge can be used to manipulate the entire analysis).
Further reading	Multi-criteria Analysis Manual of the UK Government, available at http://www.odpm.gov.uk/index.asp?id=1142251. The Journal of Multi-Criteria Decision Analysis (ISSN: 1099-1360). By subscription only. More information can be obtained from the editor val@mansci.strath.ac.uk or at http://www.interscience.wiley.com/jpages/1057-9214/. Department of the Environment, Transport and the Regions, *Review of Technical Guidance on Environmental Appraisal:* A Report by EFTEC (Economics for the Environment Consultancy) at http://www.defra.gov.uk/environment/economics/rtgea/1.htm.