(Multi-criteria analysis)
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Multi–Criteria Analysis tools

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Introduction

Multi–criteria analysis (MCA) tools are tools that support comparison of e.g. different policy options on the basis of a set of criteria. They are very effectively in supporting the assessment of and decision making on complex sustainability issues because they can integrate a diversity of criteria in a multidimensional guise and they can be adapted to a large variety of contexts. The procedures and results obtained from MCA can be improved with the interaction of stakeholders.

The robustness of an MCA result depends on the (un)certainty of the information feeding into the selected criteria, on the priorities given to the criteria (the weights or importance) and the extent to which these weights are commonly agreed upon by stakeholders. Sensitivity analysis can be used to check the robustness of the result for changes in scores and/or weights. Most computer programs that provide the use of one or more MCA methods also provide the use of sensitivity analysis.

Role of multi–criteria analysis tools in an integrated assessment

MCA plays its main role in Phase III of an integrated assessment, i.e. analysis. Here MCA can be used to compare the policy options, to identify the effects of these options and to identify the trade–offs to be made. MCA could be considered to play a role in Phase II (finding options) as well, when it is used to evaluate a series of options to eliminate the most undesired or unrealistic ones. However, such application is considered to be done to converge (considered part of Phase III) rather then to diverge (considered part of Phase II).

There is no particular role for MCA in Phase I (problem analysis) and IV (follow–up) of an integrated assessment. However, in order to apply a MCA effectively in an integrated assessment, first the objectives have to be made clear and the problem has to be structured in a specific way. So, Phase I of an integrated assessment has to be done (properly) in order to successfully apply an MCA in Phase III.

Choosing between multi–criteria analysis tools

A large number of MCA methods exist to rank, compare and/or select the most suitable policy options according to the chosen criteria. These methods distinguish themselves through the decision rule used (compensatory, partial–compensatory and non–compensatory) and through the type of data they can handle (quantitative, qualitative or mixed). So the method to choose to apply MCA depends of the decision rule preferred and the type of data available (see Table 1).

Table 1. Selection criteria for methods for multi–criteria analysis

<table>
<thead>
<tr>
<th>Method</th>
<th>Compensatory</th>
<th>Partial–compensatory</th>
<th>Non–compensatory</th>
<th>Quantitative data</th>
<th>Qualitative data</th>
<th>Mixed data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi–Attribute Value Theory</td>
<td>V</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighted Summation</td>
<td>V</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analytic Hierarchy Process</td>
<td>V</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Decision rules**

A decision rule is a procedure that allows for ordering alternative policies (Starr and Zeleny, 1977; Greco et al., 2005). It integrates the data and information on alternatives and decision maker’s preferences into an overall assessment of the alternatives. The concept of compensability is an important factor in these decision rules. Compensability refers to the possibility of compensating what is considered to be a ‘bad’ performance of a criterion (for example a high environmental impact) with a ‘good’ performance of another criterion (for example a high income). According to the extent different criteria can be compensated by other criteria, three main types of methods can be distinguished in MCA: compensatory, partial–compensatory and non–compensatory methods. Within a compensatory method a weak performance of one criterion can be totally compensated by a good performance of another criterion. Within a partial–compensatory method a limit is set to the allowance to compensate weak performances by good ones. A non–compensatory method finally does not allow compensation at all.

**Type of data**

In principle each criterion to order policy alternatives can be measured qualitatively or quantitatively. Some MCA methods are designed to process only quantitative information on criteria (Weighted Summation). In practice, this disadvantage is not very significant because the pluses and minuses used for qualitative assessments are often derived from underlying classes of quantitative data. With a well–chosen method of standardisation such as goal standardisation this underlying quantitative scale can be used in the weighted summation of these scores. Other methods are designed to process qualitative data (Dominance method, Regime). Finally there is a group of MCA methods that can handle data according to the way it is measured (those with a tick mark under the heading ‘mixed data’ in Table 6).

**References**
