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Making use of MCDS methods in SWOT analysis—Lessons learnt in strategic natural resources management

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ABSTRACT

Connecting Multiple Criteria Decision Support (MCDS) methods with SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis yields analytical priorities for the SWOT factors and makes them commensurable. Decision alternatives can also be evaluated with respect to each SWOT factor. SWOT analysis provides the basic frame for analyses of operational environments to support strategic decision-making. MCDS methods enhance SWOT analysis and its results so that alternative strategic decisions can be prioritised overall. This benefits the utilisation of the SWOT-results in the decision making process. The methods also help in defining the action line alternatives that are based on the recognition of the most important operational environmental factors and their possible interdependencies. The MCDS method applied initially and most often within the SWOT framework has been the Analytic Hierarchy Process (AHP), and the hybrid approach has been called the A'WOT. Any MCDS method, and its prioritisation principles, can, however, be applied and the existence of different techniques allows the adaptation of use of the MCDS method according to the needs of the decision-maker and the specific planning situation. This paper reviews the evolution of the A'WOT method with AHP, SMART and SMAA-O techniques applied within SWOT, and studies their applicability and the MCDS methods more generally, through required assessment techniques of decision-makers' preferences. The usability of the techniques is analysed with case studies in the field of strategic natural resources management planning. The article focuses mainly on analysis of the differences in MCDS methods from the perspective of the planning situation approached by SWOT.

1. Introduction

Strategic planning focusing on natural resource management is based on adjustment to changes in the operational environment subject to the goals set for the use of resources and the development of these resources. Consequently, a wide range of planning methods has been developed to analyse the interactions of both external and internal environments. SWOT analysis is a commonly-used tool for analysing environments to attain both a systematic approach and support for a decision situation (Kotler, 1988; Wheelen and Hunger, 1995). The internal and external factors most important for the future are referred to as strategic factors. In SWOT analysis, these factors are grouped into four categories called SWOT groups: strengths, weaknesses, opportunities and threats. The purpose of applying SWOT to a strategic planning process is usually to develop and adopt a strategy resulting in a good fit between the internal and external factors. The chosen strategy must also be in line with the objectives of the decision-makers.

SWOT could, however, be used more efficiently than has normally been the case in its applications (McDonald, 1993). When SWOT is used, analysis cannot comprehensively appraise the strategic decision-making situation. It remains at the level of merely pinpointing the factors. In addition, the expression of individual factors is often of a very general and brief nature (Hill and Westbrook, 1997a). Furthermore, SWOT includes no means for analytically determining the importance of the factors or assessing the decision alternatives with respect to the factors. The further utilisation of SWOT alone is thus mainly based on the qualitative analysis made in the planning process, and on the capabilities and expertise of the persons participating. All in all, the result of SWOT analysis is all too often only a listing or an incomplete qualitative examination of internal and external factors without concrete end-use in the decision making process. A recent interesting analysis of the developments in the use of the SWOT analysis can be found from Helms and Nixon (2010), where the authors e.g. note that research has supported the use of SWOT as a practical planning tool in many ways e.g. by connecting other strategic planning tools to it.

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The idea in using Multiple Criteria Decision Support (MCDS) methods within a SWOT framework is to evaluate systematically the SWOT factors and make them commensurable as regards their intensities (Kurttila et al., 2000). SWOT provides the basic frame within which an analysis of the decision situation can be performed and the applied MCDS method enables a more analytical SWOT procedure. One hybrid method that has been developed is A'WOT, in which the Analytic Hierarchy Process (AHP) (Saaty, 1977, 1980) and SWOT are combined. After the assessments required by the AHP have been carried out, useful quantitative information can be obtained about the decision-making situation. On the basis of comparisons of the SWOT factors and groups one can analyse, for example, whether there is a specific weakness requiring most of the attention, or if the company is expected to be faced with future threats exceeding the company's combined opportunities (Kurttila et al., 2000). In addition, use of A'WOT enables choice alternatives to be evaluated with respect to each SWOT factor and to each SWOT group (Pesonen et al., 2001). When the importance of different SWOT groups has also been determined, the choice alternatives can, in principle, be prioritised with respect to the strategic choice situation as a whole.

SWOT has been, and still is, an essential tool for strategic decision-making and the method has been developed in various contexts (Chang and Huang, 2006; Feglar et al., 2006; Hill and Westbrook, 1997b; Ip and Koo, 2004). In particular, SWOT can greatly benefit from further analysis of the SWOT factors by MCDS methods (Belton et al., 1997; Kangas and Kangas, 2002; Pesonen et al., 2001). The overwhelming assortment of the MCDS methods is both a benefit and a disadvantage. On the one hand, the applied MCDS method can be selected on the basis of the decision situation at hand and according to the wishes and qualities of the decision-maker(s). However, general recommendations for the use of a specific MCDS method are not easily obtainable.

This paper presents combinations of SWOT and different MCDS techniques used in different strategy processes dealing with natural resources management and research aspects. The evolution of including MCDS methods in SWOT analysis is illustrated through case study examples, which show the utilisation possibilities for practitioners. The MCDS methods reviewed are AHP (Saaty, 1977, 1980), SMART (Edwards and Barron, 1994) and SMAA-O (Lahdelma et al., 2003; Miettinen et al., 1999), which have been combined with SWOT analysis. The applicability of the MCDS methods through required preference assessment techniques is studied. In particular, pairwise comparison techniques are compared with the holistic assessments, and cardinal measurement scales are compared with ordinal measurements.

2. Methodology

2.1. Basic steps of the hybrid methods

In general, the hybrid methods that combine SWOT and MCDS proceed as follows:

(i) The SWOT analysis is carried out. The relevant factors of the external and internal environment are identified and included in SWOT analysis.
(ii) The relative importance of the SWOT factors is determined separately within each SWOT group. Any Multiple Criteria Decision Support (MCDS) method, and its comparison principles, can be applied.
(iii) The relative importance of the SWOT groups is determined. There are several principles of doing this and also here any MCDS method can be applied.
(iv) The decision alternatives are evaluated with respect to each SWOT factor according to the comparison rules of the applied MCDS method. The alternatives can be defined beforehand as in so-called discrete choice problems, or they can be generated during the planning process e.g. by using forest planning systems (see e.g. Kangas et al., 2006).
(v) Global priorities can now be calculated for the decision alternatives in accordance with the MCDS aggregation techniques.

2.2. Alternative MCDS methods

This section reviews three popular MCDS methods that can be used to assess the importance of the SWOT factors in the framework of Section 2.1.

2.2.1. AHP

The central characteristics of the AHP include ratio scale pairwise comparisons of the SWOT factors, and/or pairwise comparisons of the decision alternatives. Let r_{ij} denote the relative value of SWOT factor i compared with SWOT factor j given by the decision-maker with respect to a single SWOT group. In the original AHP, the r_{ij} s are assessed by a discrete and verbal measurement scale with numerical counterparts 1/9, 1/8, …, 1/2, 1/1, 2/1, …, 8/1, 9/1. For example, $r_{ij}=1/9$ means that the value of factor i is equal to 1/9 times the value of factor j. It is also possible, however, to change the arithmetic measurement scale used in the original AHP to a geometric measurement scale, for example. In that case, the numerical values would be assessed according to $\exp(s\delta_{ij})$, where $s>0$ is the scale parameter, and $\delta_{ij}=-8,-7,\ldots,-1,0,1,\ldots,7,8$ is an index for the verbal judgements (Leskinen, 2000, 2001). For example, $s=\log(256)/8$ will give numerical values 1/256, 1/128, …, 1/2, 1/1, 2/1, …, 128/1, 256/1 for ratio scale pairwise comparisons of the SWOT factors.

In the original AHP, the ratio scale priorities describing the relative values of the SWOT factors, or the decision alternatives, are estimated by use of the so-called eigenvalue technique (Saaty, 1977, 1980). The ratio scale pairwise comparisons data can also be analysed, however, through regression techniques (Crawford and Williams, 1985; De Jong, 1984). In many cases, these two estimation methods give very similar numerical results, but the advantages of the regression approach include versatile possibilities to analyse the inherent uncertainties of the estimated preferences (Alho et al., 1996, 2001; Alho and Kangas, 1997; Leskinen and Kangas, 1998).

2.2.2. SMART

In the SMART method (Edwards, 1971) and its simple rating version, the importance of the SWOT factors can be defined as follows: one hundred points is given to the most important SWOT factor inside the examined SWOT group and the importance of other SWOT factors is determined with respect to the most important factor. It is also possible to define the importance of the SWOT factors so that a total of 100 points is allocated for SWOT factors according to their importance separately in each SWOT group.

In addition to these fundamental versions, there is a collection of different SMART techniques and modifications, and one can recognise a methodological SMART family (von Winterfeldt and Edwards, 1986). The original SMART makes use of an additive model, but non-additive versions have also been presented (Barzilai and Lootsma, 1997). More recent modifications include two approximate methods called SMARTS and SMARTER (Edwards and Barron, 1994).

2.2.3. SMAA-O

SMAA-O belongs to the family of SMAA methods (Stochastic Multicriteria Acceptability Analysis), which have been developed for discrete multicriteria problems where criteria data are uncertain or inaccurate (Hokkanen et al., 1999; Lahdelma et al., 1998; Lahdelma and Salminen, 2001; Miettinen et al., 1999). In SMAA-O it is possible to analyse ordinal as well as cardinal preference information (Lahdelma et al., 2003; Miettinen et al., 1999). When one uses SMAA-O in SWOT, it is enough just to rank the SWOT factors instead