Using AHP and SWOT analyses in assessing priorities of alternative strategies in forest planning

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Abstract

SWOT analysis is a widely applied tool and provides valuable information for strategic decision making. In addition to its common use in enterprise level, it has been applied also in forest planning. A main weakness of SWOT analysis is, that its results are not usually quantitative. SWOT mainly states qualitatively Strengths, Weaknesses, Opportunities and Threats relevant in a specific decision making situation. Therefore, the use of SWOT's results in further strategic planning process can be poor. This paper presents a hybrid method able to improve SWOT's usability in strategic planning: a decision analysis method, the Analytic Hierarchy Process (AHP), and its eigenvalue calculation framework are integrated with the strategic planning process. First, this operation yields analytically determined priorities for the factors included in SWOT analysis and makes them commensurable. Second, alternative strategies can be assessed with regard to factors of internal and external environments. The result is a comprehensive priority for each strategy alternative with respect to the enterprise's operational environment. The applicability of the method is tested in a strategic planning situation of the Finnish Forest and Park Service.

Keywords: decision analysis, forest planning, alternative strategies, strategic planning

1 Introduction

Finnish Forest and Park Service (FPS) practices strategic natural resource planning at the regional level. The resulting natural resource plan aims to cover different land use class allocations and multiple objectives of different interest groups and to secure social, ecological and economic sustainability (Heinonen et al. 1997). To implement the planning process, FPS has adopted participatory planning as a planning philosophy. To contribute to the planning process, interactive decision analysis tools have been applied. E.g. Pykäläinen et al. (1998) presented an application, which is based on multi-attribute utility theory and was used to give decision support for constructing a forest strategy which synthesizes national and regional obligations and goals of FPS and objectives of the local interest groups and citizens.

The strategic planning process of FPS includes an analysis of the present state of natural resources, SWOT (the acronym standing for Strengths, Weaknesses, Opportunities and Threats) analysis, definitions of criteria and indicators of sustainability, objective analysis of different interest groups, the production of alternative strategies and the assessment of their overall importancies. The selected strategy is further utilized in more accurate tactical (carried out as landscape ecological planning) and operational planning and its implementation is controlled (Heinonen et al. 1997).

SWOT analysis is a commonly used tool for analyzing operational (internal and external) environment in order to attain a systematic approach and support for strategic planning and decision-making situations (e.g. Kotler 1988, Wheelen & Hunger 1995). Internal and external factors that are the most important to the enterprise's future are referred to as strategic factors and they are summarized within the SWOT analysis. The final goal of strategic planning process, of which SWOT is an early stage, is to develop and adopt a strategy resulting in a good fit between internal and external factors.

If used correctly, SWOT can provide a good basis for successful strategy formulation. Nevertheless, it is rarely used efficiently (McDonald 1993). SWOT analysis lacks the possibility of comprehensively appraising the strategic decision-making situation; it does not include an analytical tool to define the weights of the different factors nor method to compare or assess the overall priorities of alternative strategies subject to SWOT factors. Some examples of weighting and subdividing SWOT lists have been presented (Kotler 1988, Hemmi 1995, Wheelen & Hunger 1995). However, none of these approaches presented a systematic technique for determining the importancies. The further utilization of SWOT is, thus, mainly based on the qualitative analysis, capabilities and expertise of the persons participating in the planning process. As planning processes are often complicated by numerous criteria and interdependencies, it may be that the utilization of SWOT is insufficient. In their study, Hill and Westbrook (1997) found that none of the twenty case companies prioritized individual

SWOT factors, one grouped factors further into subcategories, and only three companies used SWOT analysis as an input for a new mission statement. In addition, the expression of individual factors was of a very general nature and brief. Thus, it can be concluded that the result of SWOT analysis is too often only a superficial and imprecise listing or an incomplete qualitative examination of internal and external factors.

In this study, the development of SWOT analysis is connected to a practical strategic forest planning situation. Our object is to look into SWOT analysis in greater detail and more systematically, and by doing so, to increase SWOT's usability. SWOT analysis, as it was performed as a part of the FPS's natural resource planning process in Western Finland, is used, and novel decision support is produced from the operational environment's point of view. Additional value from SWOT analysis is derived by performing pairwise comparisons between SWOT factors and by analyzing them by means of the eigenvalue technique as applied in the AHP. In addition, the fit between alternative strategies and SWOT factors and the resulting overall priority of these alternatives is defined.

2 Outline for applying AHP in SWOT analysis

When applying AHP, a hierarchical decision scheme is constructed by decomposing the decision problem into its decision elements. The structure of SWOT offers a quite natural decision hierarchy to be used (Fig. 1). The following definitions help to get a grasp of our application: SWOT groups refer to four entities (i.e. strengths, weaknesses, opportunities and threats) and SWOT factors refer to the individual factors underlying these groups. The method introduced

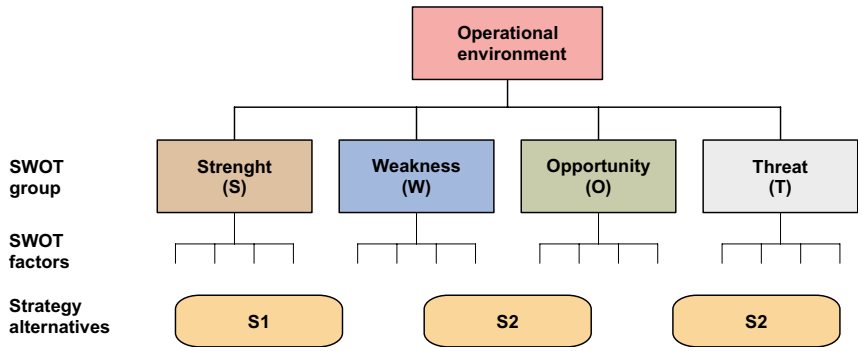

Figure 1. The hierarchical presentation of SWOT analysis.

is an extension of the study of Kurttila et al. (1998) and proceeds as follows:

Step 1. SWOT analysis is carried out. The relevant factors of the external and internal environment are identified and included in SWOT analysis. When standard AHP is applied, it is recommended that the number of factors within a SWOT group should not exceed 10 because the number of pairwise comparisons needed in the analysis increases rapidly (for detailed information on AHP, readers are referred to Saaty (1980)).

Step 2. Pairwise comparisons between SWOT factors are carried out within every SWOT group. When making the comparisons, the questions at stake are, 1) which of the two factors compared is a greater strength (opportunity, weakness or threat) and 2) how much greater. With these comparisons as the input, the relative local priorities of the factors are computed using the eigenvalue method as applied in AHP. These priorities reflect the decision maker's perception of the relative importance of the factors.

Step 3. Pairwise comparisons are made between the four SWOT groups. The factor with the highest local priority is chosen from each group to represent the group. These four factors are then compared and their relative priorities are calculated as in Step 2. These are the scaling factors of the four SWOT groups and they are used to calculate the global priorities of the independent factors within them. This is done by multiplying the factors' local priorities (defined in Step 2) by the value of the corresponding scaling factor of the SWOT group.

Step 4. Pairwise comparisons are made between alternative strategies subject to all SWOT factors. When making the comparisons, the questions at stake are 1) which one of the two strategy alternatives is better in maximizing or responding to the specific factor (when a factor in question is strength or opportunity), or which one of the two alternatives is better in minimizing or avoiding the SWOT factor (respectively, weakness or threat), and 2) how much better. Now, the overall importancies of the strategy alternatives can be computed.

3 A case study – FPS's natural resource planning process in Western Finland

During the FPS's natural resource planning process in Western Finland SWOT analysis was carried out separately by three business units of FPS (forestry, recreation and nature protection) and with respect to three dimensions of sustainability (economic, social and ecological) (Heinonen et al. 1997). For the purposes of this study, SWOT was slightly compressed by combining and removing some SWOT factors. In addition, the dimensions of sustainability were not included in the decision hierarchy as an additional level, although this could have been done.

Four alternative strategies were produced during the planning process. Each of the before mentioned FPS's business units created a strategy, that fulfilled its strategic land use objectives of. The alternatives produced were Forestry Strategy (emphasis on sustainable economic use of forests), Recreation Strategy (emphasis on recreational use of forests and social and economic sustainability), Protection Strategy (emphasis on nature protection and ecological sustainability) and the Basic Strategy (current land allocation and forestry practicing principles). However, all these alternatives were produced in such a way, that they could be considered practically feasible. The main differences between these alternatives were caused by land use allocation principles (e.g. between forestry areas, protected and recreational areas and areas having specific environmental values) and allowed treatments specified for these areas (Heinonen et al. 1997) (Table 1). These four strategies were taken under closer examination in order to clarify their fit into the operational environment.

Having completed these phases, the priorities of SWOT factors and the fit of the alternative strategies subject to these factors were estimated by pairwise comparisons following the steps presented above. When the weights of the business units were determined, forestry got the weight 0.5, and recreation and nature protection both got the weight 0.25.

In all business units, opportunities, determined by the priorities of the scaling factors, have the highest weight. However, in the nature protection business unit, threats got the same weight as opportunities and also weaknesses are more dominating than in other business units (Fig. 2). The most important internal factors are strengths (know-how, land and water property and planning techniques), but there exist also a few

Table 1. The outcomes of alternative strategies.

	Forestry strategy	Recreation strategy	Protection strategy	Basic strategy
Net income (mill. FIM/year)	109	93	77	101
Commercial forests (1000 ha)	232	216	163	231
Cutting volumes (1000 m^3/year)	882	814	648	860
Labor input in forestry (working years)	130	108	86	120
Forests age > 60 years (1000 ha)	93	111	112	103
Forests age > 100 years (1000 ha)	25	32	33	30
Recreational index	5.74	6.62	6.39	6.17
Volume of dead wood (1000 m^3)	52	47	56	47
Protected areas (1000 ha)	37	37	58	37
Forests with specific natural values (ha)	6 500	21 400	53 800	6 500

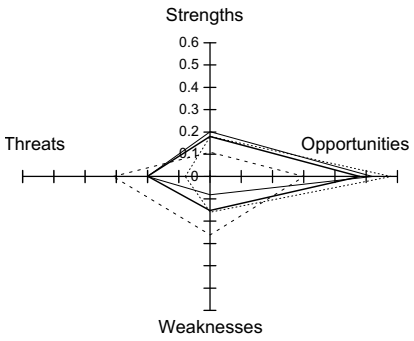

Figure 2. The relationships of SWOT groups by FPS's business units determined by the priorities of the scaling factors.

important weaknesses (lacking information concerning biodiversity due to insufficient planning resources, age and development class structures of forests and negative public image of FPS). Amongst the opportunities, the new planning techniques and new recreational areas are the most emphasized. The most important threat is lack of resources, i.e. the possibility for funding to be cut down (appendix 1). The overall weights of alternative strategies reveal, that recreation strategy obtained the highest priority, followed by protection strategy. In the business units forestry and recreation, the recreation strategy was the most preferred, but in business unit nature protection, protection strategy achieved the highest global priority (Fig. 3).

4 Discussion

In forest planning, most of the concern has traditionally been placed on the internal environment assuming the external environment to be stable. Recently, applications and methods dealing with changes arising from external environment have been presented and applied in forest planning. These are, for example, connecting the exogenous timber-demand factor and lagged price adjustment to a timber management planning model (Mykkänen 1995), participatory planning (Kangas et al. 1996, Pykäläinen et al. 1998) and including stochasticity with forest planning by using risk and scenario techniques (Pukkala & Kangas 1996). In strategic forest planning, it is sufficient to produce a few dif-

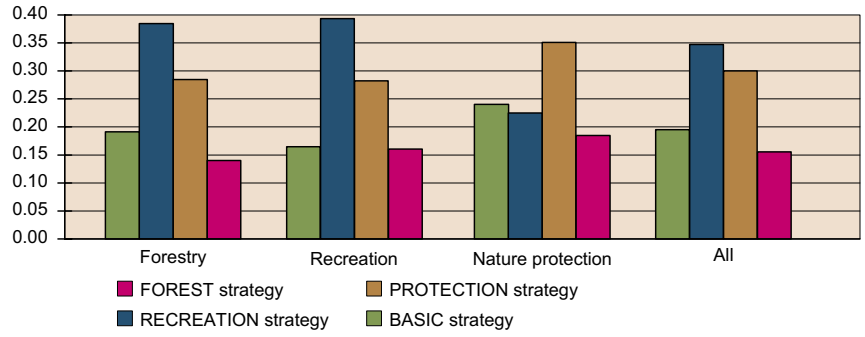

Figure 3. The overall priorities of alternative strategies by FPS's business units.

ferent alternatives that emphasize the main possible courses of action (e.g. Pesonen 1996, Pykäläinen et al. 1998). These alternatives can then be evaluated from different perspectives.

This study presented an application of commonly used strategic planning tool (SWOT) combined with a decision analysis method (AHP). The most important factors being affective in the operational environment were used systematically to give decision support for strategy evaluation. The analysis yielded quantitative values for the SWOT factors and a strategy recommendation, expressed as a quantitative value indicating the overall priority or preference of each strategy option.

The result of our case study should be seen as an illustrative application of the presented method because of the following reasons: (1) SWOT factors were compressed more or less subjectively, (2) all the comparisons were carried out by the same person and (3) our case study was performed after the actual planning process was completed. In practical use, the presented approach should be connected tightly to strategic planning process. The case study, however, proved the usability of the approach and FPS intends to apply a similar method in its future planning processes.

The presented method contributes to the strategic planning and decision making process by quantifying the SWOT factors and by determining the priorities of the alternative strategies. The results from steps 1 to 3 can be utilized when creating strategy alternatives. New goals may be set, strategies defined and implementations planned with respect to the most important factors. The results from step 4 can support decision making in the strategy selection and evaluation process. The suggested strategy alternative can be compared for example to the strategy that has been suggested by participatory planning process. The strategies may emerge not to be the same. However, certain similarities between them may exist and probably new alternatives, having characteristics of both, should be generated.

In practical planning situations SWOT can include numerous factors. The recommendation is that the number of factors within the strengths, weaknesses, opportunities or threats should be limited to ten because of increasing number of pairwise comparisons. However, this probably induces the user to avoid overlapping and carelessness when constructing SWOT lists. On the other hand, the limitation is not so strict, and the problem of having a large number of comparisons can be avoided by at least two different techniques. Firstly, by grouping the factors and adding a new level to the decision hierarchy (Saaty 1980). This was used in this study by performing individual SWOT analysis and comparisons for each FPS's business unit. Secondly, new data recording and analysis techniques offer possibilities to include more factors in decision analysis (e.g. Alho et al. 1996, Alho & Kangas 1997).

One approach to dealing with uncertainties involved in the assessment of future development might be

the application of scenario modeling. In this approach, each possible future scenario would have its own SWOT analysis and AHP comparisons. Appraising the probabilities to scenarios and weighting the SWOT factors and alternative strategies with them could yield a more comprehensive picture of the effects of the various future outcomes. Also Weihrich (1982) proposed a dynamic SWOT analysis, where changes in internal and external factors over time are included by preparing TOWS matrixes at different points of time.

According to the experiences got from this study, the results of the combined use of AHP and SWOT analysis were promising. Making pairwise comparisons forces the decision maker to weight the factors properly and to analyze the situation more precisely and in more depth. The hybrid method of AHP and SWOT increases and improves the information basis of strategic planning processes. This new information should be utilized particularly when creating or reshaping strategy alternatives. Expanding the presented method to cover a wider range of decision makers and experts would give access to their ideas and judgements. The Delphi technique could be one means to do this (e.g. Kangas et al. 1997).

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Appendix 1. The compressed SWOT analysis of FPS's natural resource planning process in Western Finland and priorities of the SWOT factors and groups.

SWOT groups	Business unit	Local priority	SWOT-factors	Local priorities
Strengths	Forestry	0.200	– benefits from large-scale forestry	0.074
			– organizational efficiency and long customer relations	0.301
			– versatile interest groups	0.169
			– versatile know-how	0.338
			– protected areas and wilderness areas	0.118
	Recreation	0.180	– large land and water property	0.374
			– areas for sportfishing	0.089
			– hiking areas	0.291
			– game (epecially forest grouse and moose)	0.245
	Nature protection	0.113	– regional policy importance, e.g. as an employer	0.117
			– landscape ecological planning	0.395
			– participatory planning	0.257
			– many attractive recreation areas	0.078
			– good knowledge from the areas	0.153
Weaknesses	Forestry	0.078	– contradictory objectives and political control	0.208
			– infertile growing sites	0.061
			– age and development class structures of forests	0.177
			– internal cooperation poor	0.102
			– negative image and historical burden (e.g. practised efficient, timber production oriented forestry)	0.452
	Recreation	0.160	– infertile growing sites	0.110
			– age and development class structures of forests (not many old forests)	0.401
			– operations at large areas increase costs, e.g. at waste disposal	0.203
			– recreational areas at outlying districts	0.182
			– not many suitable areas for hunting of waterfowl and field game	0.104
	Nature protection	0.277	– lacking information concerning biodiversity due to insufficient planning resources	0.549
			– fragmented areas	
			– excessive organizational fractionizing (internal cooperation poor)	0.090 0.131
			– long practised efficient, timber production oriented forestry	0.230

SWOT groups	Business unit	Local priority	SWOT-factors	Local priorities
Opportunities	Forestry	0.522	– new planning methods (natural resource planning, landscape ecological planning, participatory planning)	0.332
			– improvement in profitability and effectiviness	0.061
			– original and multi-objective forestry	0.188
			– broad domestic and international importance	0.136
			– communication and marketing	0.282
	Recreation	0.577	– "multiple use model area": customers due to diverseness and game	0.302
			– new recreational areas	0.336
			– nature protection areas	0.110
			– concentration of operations	0.174
			– a lot of young forests: good future	0.078
	Nature protection	0.305	– multi-objective forestry	0.103
			– increase in the level of biodiversity	0.141
			– "forest continents" and acquisition of new areas	0.235
			– new planning methods (natural resource planning, landscape ecological planning. Participatory planning)	0.103
			– resources	0.417
Threats	Forestry	0.200	– decrease in the area of usable forests	0.362
			– economic pressures for the utilization of forests	0.103
			– organizational incoherence of FPS	0.232
			– decreasing timber sales incomes (development of price level, decreasing amounts of sold wood, increasing harvesting costs)	0.123
			– homogenization of forest nature	0.180
	Recreation	0.083	– under-estimation of the meaning of commercial forests (their ownership changes from FPS to outsider)	0.320
			– run out of old forests	0.144
			– wear and tear, hullaballoos and unpleasantness have negative influence to users of recreational and protected areas	0.392
			– decline in the amount of forest grouses	0.144
	Nature protection	0.305	– decrease in the area of FPS's forests	0.148
			– lack of resources: staff and funds	0.565
			– economic pressures concerning the utilization of FPS's forests	0.148
			– utilization of non-renewable natural resources	0.065
			– "timber production organization" does not pay attention to the natural values	0.074