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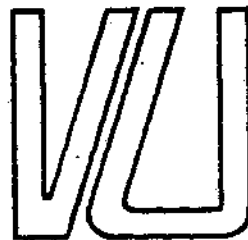
SERIE RESEARCH MEMORANDA

INTERACTIVE MULTICRITERIA DECISION SUPPORT
FOR ENVIRONMENTAL MANAGEMENT

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Researchmemorandum 1988-27 augustus 1988



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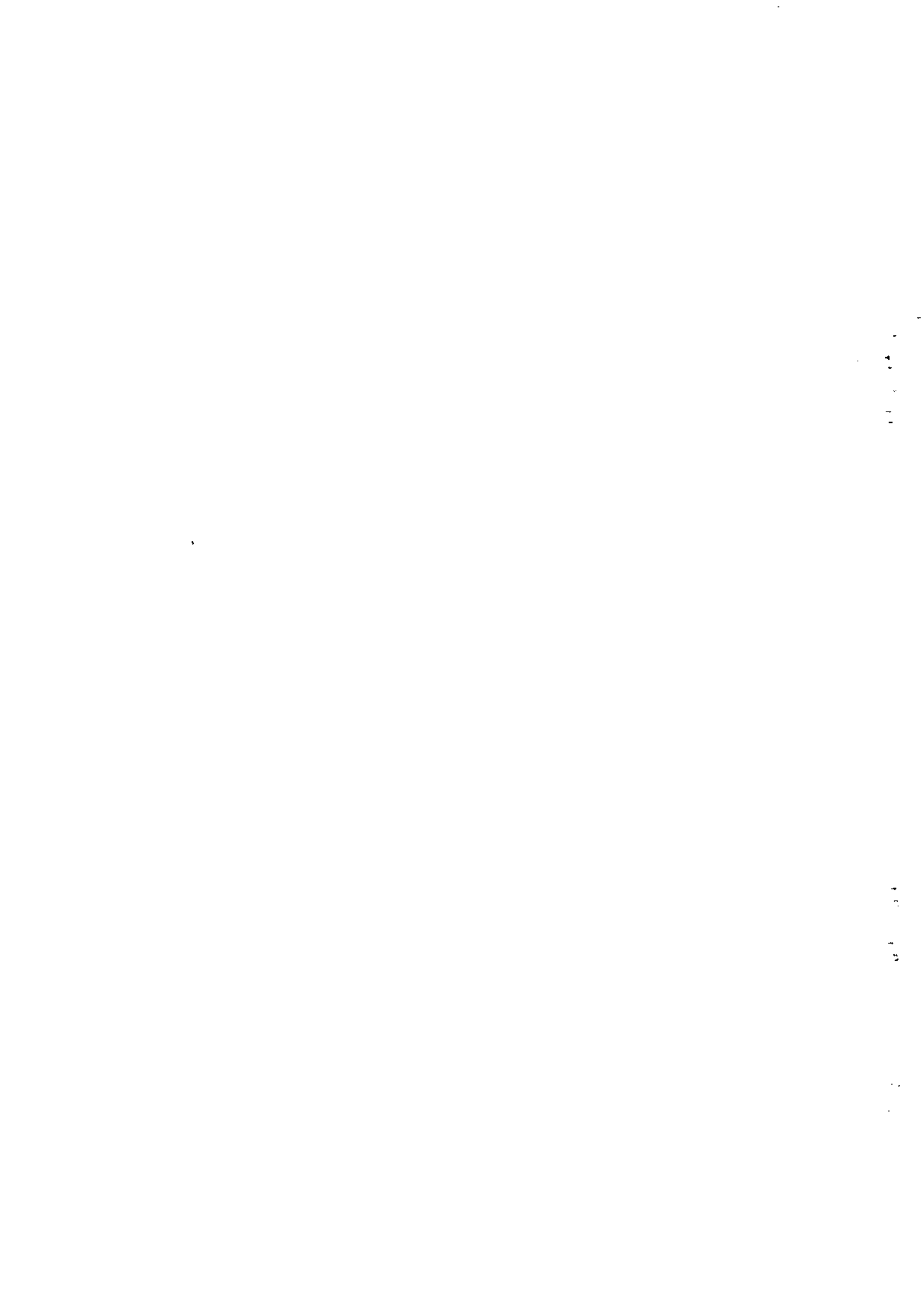
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INTERACTIVE MULTICRITERIA DECISION SUPPORT FOR ENVIRONMENTAL MANAGEMENT

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This paper provides an analytical framework for an interactive decision support system, based on multicriteria analysis. The method is illustrated by means of a computer model for environmental management in the Netherlands.

1. Introduction

In recent years, planning methodology has often taken resort to evaluation research. Evaluation aims at rationalizing planning and decision problems by systematically structuring all relevant aspects of policy choices (for instance the assessment of impacts of alternative choice possibilities). Evaluation is usually not a one-shot activity but takes place in all phases of decision-making, for instance, on the basis of learning principles. In addition, a systematic support to complex planning and decision problems presupposes a balanced treatment of too many details and too little information. Besides, the results of an evaluation procedure have to be transferred to policy-makers in a manageable and communicable form, particularly because the items of an evaluation problem are usually multidimensional in nature (including incommensurable or even intangible aspects). Finally, it has to be realized that the planning environment is usually highly dynamic, so that judgements regarding the political relevance of items, alternatives or impacts may exhibit sudden changes, hence requiring policy analysis to be flexible and adaptive in nature. Rigid evaluation techniques run the risk that an evaluation does not cover all planning issues in a satisfactory way (see also Nijkamp, 1981, and Voogd, 1983).

Any evaluation requires appropriate information. The aims of the evaluation, however, may be different and depend on actual institutional and administrative interest. Three broad categories of behavioural paradigms may be distinguished for public decision-making:

- 'optimizing' behaviour
- 'satisficing' behaviour
- 'justificing' behaviour

Although the majority of formal evaluation techniques is focusing attention on the first category and to a lesser extent on the second category, in policy practice evaluation is often used as a means of justifying policy decisions, even if the actual decisions are not in agreement with 'optimizing' or 'satisficing'

principles. In any case, however, relevant data for a policy judgement have to be collected. Such data should be represented in an operational form in order to make the actual choice issues as transparent as possible.

Any policy decision will affect the welfare position of individuals, regions or groups in a different way. Consequently the public support for a certain policy decision will very much depend on the distributional effects of such a decision. Thus, in general, it is advisable to design or use evaluation methods that try to assess the pros and cons of a certain choice alternative for separate groups or regions. Information on such gains and losses are not always quantitative in nature, but also qualitative, fuzzy or verbal information may provide a meaningful input for a policy analysis. Altogether, spatial and/or social referencing of information is highly desirable to make evaluation more effective.

Beside the (institutional or administrative) structure of a decision problem, the specific plan evaluation method to be used will also determine which data are requested for the policy analysis at hand. For instance, checklist approaches, cost-benefit studies, planning balance sheet techniques, goals achievement methods, multiple criteria analyses, multiple objective programming models have all their own specific data needs. Clearly, assuming a cyclical model of planning implies also that the relevance of an evaluation technique has to be judged in light of the available data. In this regard, it is worth noting that monitoring is a necessary ingredient of an adaptive evaluation methodology, so that in each phase of the planning problem both the data and the evaluation method can be critically judged. Evaluation may relate to both sectoral planning issues (transportation network planning, facilities planning, e.g.) and integrated planning (comprehensive regional or urban planning, e.g.). In all cases, there should be a close agreement between available information and evaluation. This will be discussed in the next section.



2. Information and Planning

Information has a much deeper meaning than just a set of data. Data are only numerical representations of attributes of people, organizations, objects or events. Information may be defined as a collection of organized data (for instance, by means of statistical techniques, modelling or transformation) so as to provide structured and systematic insight regarding a phenomenon. In this regard, an information system means any kind of systematic and coherent analytic or decision support system for planners and policy makers. Such a system serves to contribute to solving, organizing or rationalizing complex choice and decision problems.

Several aims of an information system may be mentioned in this context:

- an aid to integrated or multidisciplinary analysis
- a contribution to operational and empirically-oriented scientific research
- an increase to the effectiveness of policy making and planning
- a contribution to building, testing and using practical models
- a rationalization of conflicting interests between groups or decision agencies.

It is evident that the design and maintenance of an information system is a far from easy task, as there are many costs involved, depending on the accuracy, adaptability and availability of the necessary information. On the other hand, the relevance of information systems has also to be judged on the basis of their benefits to improved decision-making (in terms of risk avoidance, higher effectiveness, multiple purpose use, or higher efficiency). Inadequate information may render economic planning models ineffective, may lead to a misinterpretation of socio-economic processes, may cause inconsistent or incoherent decisions and may hamper the necessary communication between policy makers and experts (cf. Wheeler and Janiss, 1980, and Wright, 1985).

In general, an information system aims at increasing our knowledge regarding a complex phenomenon. In general information brings more order to an otherwise less organized complex system, so that a rise in the information content removes uncertainty and reduces the entropy of a system ('negentropy').

Information means a treatment and transformation of data. Examples of such operations are: collecting, verifying, classifying, arranging, summarizing, calculating, forecasting, simulating, storing, retrieving and communicating. Clearly, data can be transformed toward various aggregation levels (groups or regions e.g.). At any level of aggregation, systems may in principle be used for three purposes (or stages) of policy analysis:

- * description: a structural representation of a complex system (for instance, by means of multidimensional profiles, statistical tools or models)
- * impact analysis: an assessment of effects of policy measures (for instance, by means of simulation models, qualitative effectiveness analysis, etc.)
- * evaluation: an assessment of the merits of alternative courses of action (for instance, by means of cost-benefit analysis, multiple criteria analysis, etc.).

If one adopts a procedural view of planning, in which decision-making is regarded as a process, information systems have to be flexible, so as to provide at any desired moment decision agencies with specific tailor-made information. This procedural view of planning leads thus in essence to the design of adaptive information systems, which have gained much popularity in recent years. This tendency runs parallel to the recent design of interactive user-oriented multiple criteria decision models. A brief introduction to such models is given in the next section.

3. Adaptive Multiple Criteria Evaluation Models

Plan and project evaluation has become a major component of modern public planning and administration. The history of plan and project evaluation however, has not exhibited a rectilinear trajectory, but a development path marked by various phases.

The history of plan and project evaluation before World War II showed a strong tendency toward a financial trade-off analysis.

Later on much attention was focused on the judgement of alternative American military defense systems, based inter alia on cost-effectiveness principles. After World War II social cost-benefit analysis gained increasing popularity in public policy evaluation. The cost-benefit methodology became the leading evaluation instrument until the seventies, especially in countries with a market economy or a mixed economy. Several limitations inherent in cost-benefit analysis were relaxed by introducing amendments such as planning-balance methods and goals-achievement methods.

From the seventies onwards a new class of evaluation methods arose, called multiple criteria analysis. Many origins of the class of multiple criteria methods can be found in France. Especially the wellknown ELECTRE-techniques (or concordance techniques) have become a mainstream in current evaluation methodology.

The following reasons can be mentioned for the increasing influence of multiple criteria

evaluation techniques:

- the impossibility of including intangible and incommensurable effects in the conventional evaluation techniques,
- the conflict nature of modern planning problems, so that - instead of a single decision-maker - various (multi-level) formal and informal decision agencies determine a final choice,
- the shift from conventional 'one-shot' decision-taking to institutional and procedural decision-making where many political aspects play a major role,
- the desire in modern public decision analysis not to be confronted with a single and 'forced' solution but with a spectrum of feasible solutions.

All these reasons have led to the current popularity of multiple criteria analysis in public planning. In the seventies and the beginning of the eighties a real avalanche of multiple criteria methods has taken place, so that at the moment there is a wide array of various multiple criteria evaluation methods (cf. Hafkamp and Janssen, 1985, Janssen and Nijkamp, 1984 and Janssen and Rietveld, 1985).

Multicriteria methods have their own indigenous value as multidimensional evaluation tools, but are also particularly appropriate vehicles in adaptive information systems or - in a broader context - adaptive decision support systems. In this framework, multicriteria techniques provide analytical support for a whole evaluation procedure (including evaluation of alternatives, generation of choice options, and structuring of choice procedures), with a particular emphasis on feedback (or interactive) processes in all phases of decision-making. The latter type of approach will be dealt with in the present paper.

Completeness of relevant information and inter-activeness of evaluation tools are two criteria which are often regarded as a *sine qua non* for the acceptance of a certain decision support method (or system). Lack of acceptance or confidence may be caused by various factors, but especially two factors are important here:

- labour intensive (or in general costly) computational work; this problem may lead to the following undesirable consequences:
 - neglect of a suitable evaluation methodology
 - use of an inappropriate evaluation method
 - neglect of complementary analyses (e.g., sensitivity tests)
 - use of a rigid evaluation method
 - imbalance between computational work and problem specification/solution
- technical complexity of evaluation analysis; this problem may have the following consequences:
 - lack of accessibility to (and hence less optimal use of) evaluation results
 - selective use of evaluation method by experts only

- unsatisfactory learning aspects of the method at hand
- over-emphasis on technicalities instead of on substance

In view of the previous caveats, it is plausible to impose the following characteristics on an appropriate interactive multicriteria decision support model:

- user friendliness
- high speed
- flexibility
- reliability

The decision support methodology described in this paper aims at fulfilling these desiderata.

In the next section, the above mentioned criteria will be used to discuss more in detail the design of interactive multicriteria decision support models.

4. Design of Interactive Multicriteria Decision Support Models

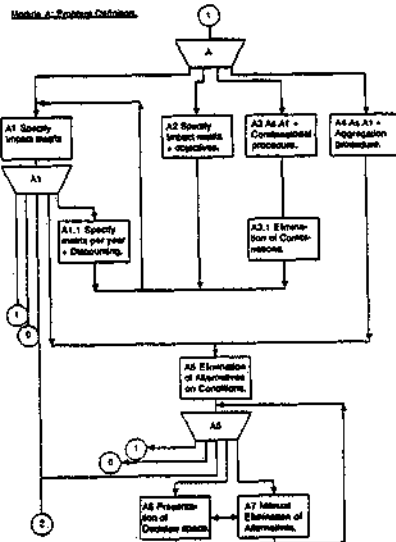
Interaction decision support methods aim at providing a decision-maker with relevant information in each stage of a decision process. Such relevant information may refer to the design stage (e.g., generating alternatives, identification of constraints, structuring a complex choice problem), the analytical stage (e.g., impact analysis, survey tables, graphical presentation), or the judgement stage (e.g., heuristic choice rules, multicriteria techniques, sensitivity tests), allowing for the possibility of feedback mechanisms.

In the present section, four subsequent tasks (or functions), to be considered in an evaluation or decision support - procedure will briefly be presented - and discussed. These tasks are:

- A. problem definition
- B. problem presentation
- C. problem evaluation
- D. sensitivity analysis

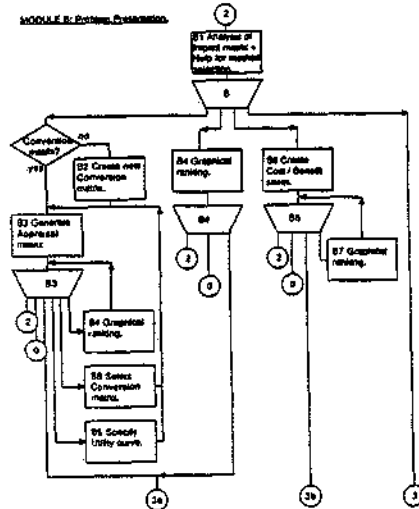
Each of these tasks will briefly be described here by means of a graphical presentation (via 4 modules A-D) and a concise clarifying text. Prior to these 4 modules there is a main menu through which one can enter the system and its modules.

In general, it is desirable to have an interactive multicriteria decision support model - to be used in adaptive planning procedures - available on a PC, so that decision-makers, planners and analysts have a direct access to the computational part of an evaluation problem. This also ensures flexibility, communicability, just-in-time (JIT) delivery of results, and transferability.



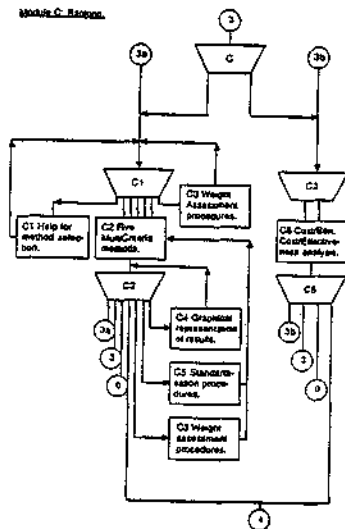
Module A: Problem definition

- A1 Introduce alternatives, impact categories and impact scores on a spreadsheet. Produce text file for each alternative. Impact scores can be measured on a ratio, interval, ordinal or nominal scale.
- A1.1 As A1. The time option relating impact scores to years, months, etc. is added. A discount procedure to transform all scores to a base year may also be added.
- A2 Introduce more information on alternatives, impact scores by using a question and answer procedure with user. User can specify a hierarchy of objectives, goals and impact categories.
- A3 Specify all relevant aspects of alternatives. Generate and present all possible combinations of these aspects.
- A3.1 Eliminate irrelevant combinations.
- A4 Classify relevant elements of remaining alternatives, impact categories and impact scores. The system aggregates these elements into alternatives according to decision rules specified by the user.
- A5 Specify constraints. The system eliminates unsatisfactory alternatives and alternatives violating the constraints.
- A6 Systematic examination of the decision space.
- A7 System presents decision space to the user. User eliminates inefficient alternatives.



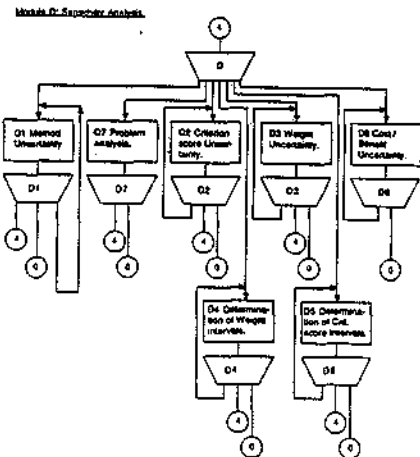
Module B: Problem presentation

- B1 Analysis of the impact matrix: number and type of alternatives, scores etc. Based on this analysis, the system supports the choice of an evaluation method or a presentation form.
- B2 Specification of a linear relation between impact categories and a limited number of appraisal categories.
- B3 Transformation of the impact matrix into an appraisal matrix.
- B4 Graphical presentation of a matrix. System produces a tentative ranking of alternatives based on user priorities and performance of the alternatives.
- B5 Specification - per impact category - of a relation between score and marginal utility.
- B6 Transformation of the impact matrix into a cost-benefit sheet. User specifies, if possible, a price for each physical and monetary presentations of the balance sheet. User specifies, if relevant, the timing of the impacts and the discount rate to be used.
- B7 Graphical presentation of the cost/benefit ratios.



Module C: Problem evaluation

- C1 Analysis of impact matrix: number and type of alternatives, scores etc. Based on this analysis the system supports the choice of an evaluation method or a presentation form.
- C2 User selects one or more of the following multicriteria methods, for instance:
- Weighted summation
 - Concordance analysis
 - Regime method
 - Expected value method
 - Evamix method
- System produces total scores and rankings of the alternatives.
- C3 User selects one or more of the methods below to transform user preferences into weights required by the selected multicriteria method.
- Expected value method
 - Eigenvalue method
 - Extreme weights method
- C4 Graphical presentation of MCA results.
- C5 The system applies a standardization procedure to all impact scores according to the measurement scale of the scores and the MCA method selected. User can alter this procedure by including one of the following standardisation procedures:
- Replace by rank number
 - Divide by row maximum
 - Divide by row total
 - Divide by ideal value
 - Vector normalisation
 - Interval standardisation
- C6 Calculation of various cost-benefit and cost-effectiveness indices. Ranking of the alternatives according to these indices.



Module D: Sensitivity analysis

- D1 Influence of method selection on rankings produced.
- D2 Sensitivity of rankings to random changes of impacts.
- D3 Impacts of random changes of weights on rankings.
- D4 Determination of robustness intervals for impacts; within a robustness interval the ranking is not altered by changes in the score considered.
- D5 Determination of robustness intervals for criterion weights; within a robustness interval the ranking is not altered by changes in the weight considered.
- D6 Sensitivity of cost-benefit analysis to random changes in impacts, prices and discount rates.
- D7 All results in relation to the impact matrix. System advises user on supplementary analysis or on alterations of the impact matrix.
5. An Interactive Model for Environmental Management

In this section an interactive model will be presented which may serve as a multicriteria decision support system for environmental management for the Netherlands. This Environmental Assessment System (EAS) is a decision support system which assists decision-makers in the assessment and evaluation of alternative strategies in electricity production. This system can be used to compare different combinations of conversion systems (e.g., combinations of coal, nuclear power, and oil) regarding their environmental effects (in terms of their contribution to acidification, deforestation etc).

The decision on the best electricity generation mix can be described as semi-structured. Even when there would be a consensus on the type of impact method to be used, the measurement of information, the choice of alternative options, and the type of appraisal criteria, there is in general no consensus on the exact specification of choice options, the damage categories to be considered, the level of threshold values for damage, the relative importance attached to the various categories, etc.

The main features of EASY will be described here in relation to problem formulation, impact assessment and evaluation (see also Figure 1). In EASY, the problem formulation concerns the identification of alternatives, attributes of the alternatives and appraisal criteria. The alternatives are formed by including individual conversion units, such as a coal unit, a nuclear unit, etc., into different combinations adding up to a specified production capacity. Attributes of the alternatives include location, emissions and land use. Examples of appraisal criteria are: forest damage, health damage and agricultural damage. Impact analysis in EASY deals with effect scores, preferably in combination with the distribution of the effects in time and space. Environmental quality is calculated for 20 regions in the Netherlands and for 5 specified time points. Environmental quality includes concentrations, percentiles and depositions of SO_2 and NO_x , waste production, land use, etc.

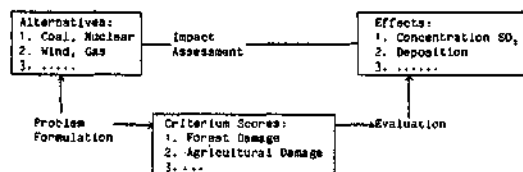


Fig. 1. Functions of an environmental DSS

Evaluation results in an appraisal table and/or in a ranking of the alternatives. In EASY appraisal scores are calculated by relating effect scores to effect-thresholds and damage categories. The ranking of the alternatives is based on an assessment of the relative importance of damage categories (see also section 3). To perform these three functions EASY contains three main elements: the data base (including attribute values of relevant conversion units, features of receptor areas, effect thresholds etc) controlled by the data base management system (DBMS); the model base (including effect prediction models and evaluation models) controlled by the model base management system (MBMS); and the user interface (including e.g. visual presentation results) (cf. Ginzberg and Stöhr, 1982).

At present EASY contains a dispersion model to predict environmental quality, a multicriteria method and various aggregation procedures. Dispersion is calculated through the use of source-receptor matrices. This is computationally simple and accurate enough for the purposes of EASY, viz. to compare different choice alternatives. The Model Base Management System selects the appropriate model, requests the relevant user instructions and data, and supplies the results.

6. Evaluation in EASY

Impact analysis results usually in a relatively large amount of diverse information. Since the human mind can only handle a limited amount of information simultaneously (cf. Miller, 1956), it is usually impossible to make an appropriate comparison of alternatives. The aim of evaluation is to structure, condense and present the information in a way that facilitates comparison of choice alternatives.

EASY generates a 3-dimensional effect matrix containing 5 alternatives, 40 effects (effects include concentrations, depositions and land use) and 20 regions. Part of this matrix is illustrated in tables 1 and 2.

Regions	Background levels	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5
Gron.	54.8	81.1	55.4	55.6	54.9	54.8
Friesland.	43.5	65.1	43.9	44.0	43.6	43.5
Drenthe	53.4	69.2	53.9	54.2	53.5	53.0
K. v. Over.	54.9	69.8	54.8	54.9	54.5	54.4
Twente	60.4	69.1	60.7	60.7	60.5	60.4
Veluwe	58.6	70.5	58.8	58.9	58.7	58.6
Lotharh.	72.4	81.3	72.8	72.7	72.5	72.4
Beluwe	62.3	71.6	62.6	62.7	62.5	62.3
Utrecht	59.2	72.4	59.4	59.5	59.4	59.2
K. v. N.H.	59.2	83.3	59.8	59.6	59.3	59.2
Zaanatr.	67.0	90.0	67.2	67.4	67.2	67.0
Leiden	82.6	102.3	82.8	83.0	82.9	82.6
Rijnmond	65.0	81.2	65.1	65.5	65.3	65.0

Table 1. Alternatives and Regions for Effect: Concentration NO_x

Pollutants	Threshold levels	Background levels	ALT 1	ALT 2	ALT 3	ALT 4
SO_2		27.7	41.8	27.2	28.0	27.9
SO_2P50	75.0	20.5	30.9	20.5	20.7	20.7
SO_2P95	200.0	77.2	116.6	77.4	78.1	77.9
SO_2P98	250.0	100.7	152.1	100.9	101.8	101.7
SO_2D		1182.1	1136.2	1184.8	1198.7	1195.2
NO_x		403.2	585.3	403.8	410.5	407.1
NO_xD		1585.2	2423.5	1588.6	1609.2	1602.3
SO_x		7.7	9.1	7.7	7.7	7.7
NO_x		28.1	39.3	28.2	28.5	28.3
NO_2		30.5	38.1	30.6	30.7	30.6
NO_2P50		28.1	35.1	28.1	28.3	28.2
NO_2P98		18.1	27.5	18.2	18.7	18.4
NO_2P98	135.0	65.0	81.2	65.1	65.5	65.3

Table 2. Alternatives and Effects for Region: Rijnmond

A fourth dimension may be added if time is included. It will be clear that such a large effect matrix is not suitable for a comparison of alternatives. Therefore, it is plausible to evaluate effects by restructuring the information - viz. by aggregation and by presentation -

depending on the type of comparison required. Presentation results in maps, graphs and figures. Aggregation results in a limited matrix or in a ranking of the alternatives (see Figure 2).

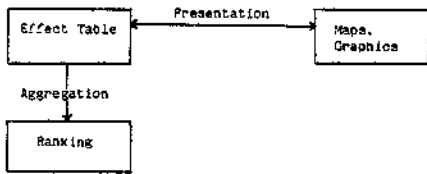


Fig. 2 Two evaluation approaches

Presentation is especially suited to compare a number of elements (alternatives, regions) on one or two dimensions. Since the aim of presentation is to compare alternatives, the replacement of exact values by symbols, bars or points usually does not result in a serious loss of information (see Tufte, 1985 and Bertin, 1981). Aggregation involves comparison, grouping and summation of information; it reduces the level of detail and therefore the amount of information. However, it can also greatly improve the usefulness of the information, depending on the type of comparison to be made. Since aggregation involves judgement, it is essential to give the system user direct access to the aggregation rules.

Figure 3 shows how aggregation and presentation can be used in EASY. It can be seen that three levels of aggregation coincide with three levels of comparison, viz:

- Comparison of alternatives by effects
 - Comparison of alternatives by damage categories
 - Overall comparison of alternatives.
- Aggregation and presentation procedures are described below under these three headings.

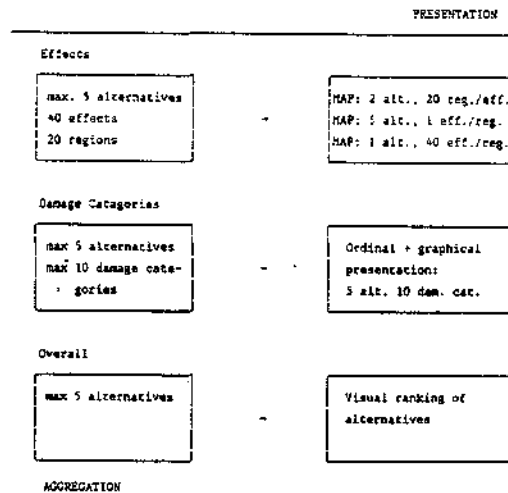
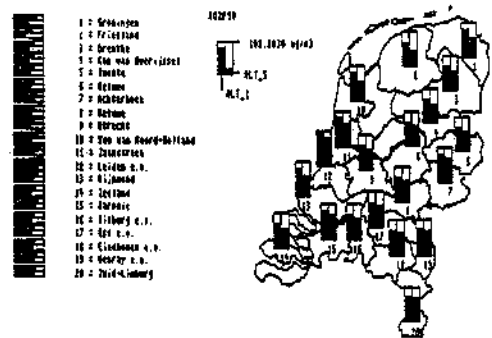


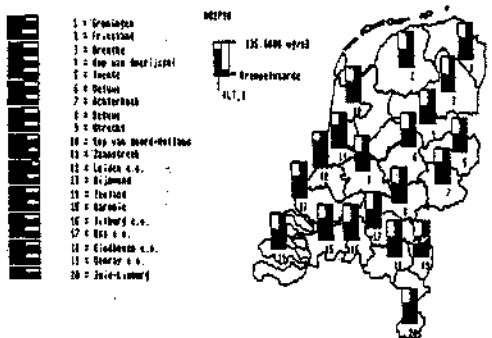
Fig. 3 Aggregation and presentation in EASY

Comparison of alternatives by effects

The effect scores are best presented on maps of the Netherlands because effects are calculated for each region and their spatial distribution can be relevant for certain comparisons. Two alternatives can be separately compared for each effect (see Map 1). Another option is to relate effects to effect thresholds (see Map 2). A system user can make new additions or alterations to these thresholds. Presenting all regions on one map allows only for pair-wise comparison of alternatives. By focussing on one region at the time all alternatives can be shown for one effect or all effects for one alternative. In the second case effects are standardized according to two times the specified thresholds (see Map 3).



Map 1. Concentration NO₂ (98 percentile): comparison of two alternatives



Map 2. Concentration NO₂ (98 percentile): comparison of an alternative with an effect threshold



Map 3. Region 13 (Rijnnoord); alternative 3; all effects (only effects with a threshold are listed)

Comparison of alternatives by damage categories

Effects, thresholds and regional attributes can also be aggregated into damage measures for various receptor. This results in an appraisal table as shown in table 3.

	ALT.1	ALT.2	ALT.3	ALT.4	ALT.5
Health x 1000 pop.	3982	5020	3000	7000	9050
Forest km ²	186	158	100	800	1025
Surface water km ²	458	500	400	1250	1650
Heath km ²	92	92	50	160	225
Wetlands km ²	94	94	60	300	350
Agriculture km ²	2672	2672	2080	9050	5050
Risk km ²	1600	0	8000	0	0

Table 3. Appraisal table: Total damage per category

A graphical presentation of the appraisal table is shown in Fig. 4. Appraisal scores are standardised between 0 (best outcome) and 1 (worst outcome). This presentation facilitates comparison of the alternatives and provides a good overall impression of the various options. A disadvantage is that the scores have only a relative meaning; the physical dimension and the interpretation of the absolute value are lost.

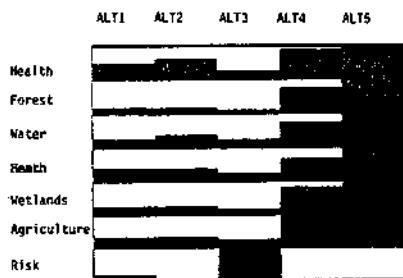


Fig. 4 Appraisal table: relative damage per category

Overall comparison of alternatives.

An optional final step is to aggregate all relevant information into an overall ranking of the alternatives. Useful methods for this purpose are multicriteria methods. In order to be able to apply multicriteria methods, it is not sufficient to have effect scores for each alternative: information is also required on the relative importance of effects, i.e. the weights assigned to each of the effects.

For the Netherlands these weights are neither absolute, nor can they be derived from published policy plans. Consequently, the weighting of criteria is a responsibility of the decision-maker (or group of decision-makers). EASY is equipped with procedures that assist the decision-maker in (explicitly or implicitly) assigning weights. Ordinal weights can be obtained by asking the decision-maker to rank the damage categories in Fig. 4 from most important (top row) to least important (bottom row). By using a combination of two methods - in this case, an expected value and a weighted summation method - a fairly robust ranking of the alternatives can be derived from this ranked appraisal table. The expected value method is used to transform the priority orders into quantitative weights. It is assumed that these weights are uniformly distributed within the plane delimited by the ordinal rankings of the weights; also these weights add up to one (see Rietveld, 1980). The weighted summation method is used to amalgamate the effect scores in combination with their quantitative weights to calculate an overall score for each alternative. These scores are used to derive overall rankings of the alternatives. Rankings of the alternatives resulting from two priority orders are shown in Fig. 5.

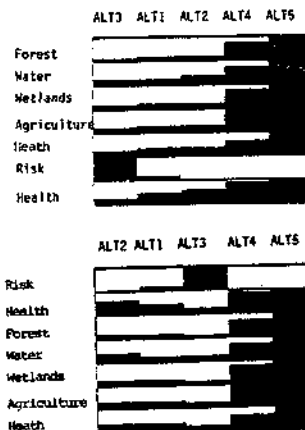


Fig. 5 Ranking of alternatives for two priority orders

The appraisal table can also be presented in ordinal form and by using a symbolic representation of the scores.

By using a graph like Fig. 5, the ranking of alternatives can be presented together with the underlying scores. This allows for easy elimination of inefficient alternatives and also for identification of dominance among alternatives. It presents an overview of the interdependence between ranking and priority order. It can be seen for example that the ordering within the ecological damage categories (Forest-Heath) will not influence the ranking. The ranking of alternatives 1 and 2 is reversed by assigning a high priority to risk and health. Finally, the ranking of alternatives 3, 4 and 5 is independent of the priority order.

7. Conclusions

The use of EASY in environmental decision-making has several advantages:

- The use of an interactive computer program and more specifically the feedback from evaluation results to problem formulation stimulates 'learning-by-doing'. This will appeal to decision-makers with a dynamic learning style (see for a discussion of different learning styles also Sutton, 1985).
- EASY can be used to analyze the influence of data changes and assumptions on the relative importance of alternatives. This is specifically useful in group decision-making with conflicts where there is usually no agreement on the problem formulation. The use of EASY can structure the debate and focus discussions on crucial issues (see also Janssen and Hafkamp, 1986).
- By offering various prediction levels and various aggregation and presentation procedures, the decision-maker can select a procedure (or combination of procedures) that suits the problem best. This allows for backward reasoning, from results to underlying data.

EASY can be seen as a shell for environmental management in which emissions and dispersion play a central role. By adjusting the data base, the system can easily be applied to other areas and to activities other than electricity generation.

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