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On the Use of Multi-Criteria Analysis in Environmental Impact Assessment in The Netherlands

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ABSTRACT

Multi-criteria analysis (MCA) is a popular tool in Dutch environmental impact assessment (EIA). This paper provides an overview of the type and complexity of decision problems supported, and the MCA approach selected to analyse these problems. Furthermore, the role of MCA in the decision process is analysed, and a special case where the MCA results were challenged in court is presented. The paper concludes with some lessons learned from the use of MCA in the Netherlands Copyright © 2001 John Wiley & Sons, Ltd.

KEY WORDS: environmental impact assessment; multi-criteria analysis; the Netherlands

1. INTRODUCTION

Environmental impact assessment (EIA) is a well-established institution in the Netherlands. All activities in the private and public sector, which are expected to cause serious environmental impacts, are required to produce an EIA. As a result, production of EIAs by environmental consultants is a flourishing industry. Comparison of alternatives is an important element of the procedure: in the scoping phase, a small number of alternatives is selected for further study from many potential alternatives, and in the final evaluation, these alternatives are evaluated in more detail. In many EIAs, multi-criteria analysis (MCA) is used to support one or both steps. Opponents to the use of MCA state that the method is prone to manipulation, is very technocratic, and provides a false sense of accuracy. Proponents claim that MCA provides a systematic, transparent approach that increases objectivity and generates results that can be reproduced (Bonte *et al.*, 1997, 1998). Cost–benefit analysis is not obligatory, and also not commonly used in Dutch EIA.

Experimental applications of MCA in the early 1980s included management problems, such as the fresh water supply for the Province of South Holland (IODZH, 1983). These early applications were very complex, not always consistent, and were used mainly on the strategic level. As a result of EIA legislation, a shift can be observed in the use of MCA in recent years from comparison of very different alternatives at the strategic level in the experimental applications to comparison of relatively similar alternatives at the project level. In the last 5–10 years, further quantification of environmental management, an increase in the size and complexity of projects, and increased public participation in the decision-making process has created the need to communicate large amounts of information in a straightforward and transparent way. This has stimulated a dramatic increase in the use of MCA. The use of MCA has made it possible to include a long list of impacts, although most of them with very small weights. This aspect of MCA suits the consensus-seeking approach in Dutch environmental decision-making, where public participation is institutionalized and all relevant parties must be heard.

In this paper, examples of the use of MCA in Dutch EIA are presented (Section 2). This list provides an overview of the type and size of these decision problems and the MCA method used. Practical issues in applying MCA are highlighted. Section 3 deals with the role of MCA in the decision process. In one example, the results of MCA were challenged in court. This special case is presented in Section 4. Finally, Section 5 presents lessons learned in the Netherlands.

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2. EXAMPLES OF MCA IN DUTCH EIA

Around 60 EIAs are completed each year. These assessments are for relatively large projects, because small projects usually do not have a legal requirement for an EIA (MER, 1994). MCA is included in some form in roughly ten EIAs per year. A representative set of examples of MCA in Dutch EIA is presented in Table I. Part of this table results from a survey commissioned by the Dutch Commission on EIA (Heidemij advies, 1997). The list of activities is dominated by large infrastructure projects, such as highways and railways. Many of the projects involve the Ministry of Transport and Waterways. This ministry has been a promoter of MCA for a long time, and has experienced provincial directorates in charge of MCA studies. The list includes a number of relatively technical studies with a low political profile, such as storage facilities (6, 9) and a fresh water

Table I. Examples of the use of MCA in Dutch EIA

Activities	Year	Problem size	MCA method
(1) Provincial sludge treatment plan: Flevoland	1992	16 criteria; 29 alternatives	Concordance method
(2) Provincial waste processing plan: Flevoland	1992	6 categories; 23 criteria; 7 alternatives	Weighted summation
(3) Wreck processing installations: Oosterhout	1992	14 criteria; 5 alternatives	Aggregation of ordinal scores
(4) Road, train and water transport in the Amsterdam–Utrecht transport corridor	1993	12 groups; 50 criteria; 9 alternatives	Graphical presentation
(5) Siting a solid waste dump in the Province of Utrecht	1993	7 categories; 52 criteria; 61 alternatives	Evamix
(6) Siting and design of a storage facility for polluted sediments in the Hollandsch Diep	1994	13 categories; 35 criteria; 5 alternatives	Evamix
(7) Siting new residential areas in Zaanstad	1994	6 categories; 20 criteria; 10 alternatives	Weighted summation
(8) Design of a fresh water reservoir in the Biesbosch	1994	5 categories; 32 criteria; 7 alternatives	Weighted summation
(9) Siting and design of a storage facility for polluted sediments: Ketelmeer	1995	6 categories; 30 criteria; 15 alternatives	Evamix
(10) Highway 73, Venlo—Sint Joost	1995	9 categories; 75 criteria; 13 alternatives	Weighted summation
(11) International business park: Friesland	1995	6 categories; 21 criteria; 4 alternatives	Weighted summation
(12) Siting and design of the helicopter training site: De Haar	1995	4 categories; 43 criteria; 4 alternatives	Weighted summation
(13) Cleaning polluted sediments in the provinces of Groningen, Friesland and Drenthe	1995	7 categories; 35 criteria; 6 alternatives	Weighted summation
(14) The Betuwe freight railway	1996	5 categories; 40 criteria; 20 alternatives	Weighted summation
(15) Highway 2, Vianen—Den Bosch	1997	5 categories; 56 criteria; 10 alternatives	Weighted summation
(16) Highway 15 Varsseveld-Enschede	1998	10 categories; 76 criteria; 16 alternatives	Weighted summation
(17) North-east link of the Betuwe freight railway	1999	13 categories; 93 criteria; 36 alternatives	Weighted summation
(18) Provincial road N219 Zevenhuizen bypass	1999	5 categories; 24 criteria; 5 alternatives	Evamix
(19) River development Zandmaas	1999	10 categories; 100 criteria; 3 alternatives	Weighted summation
(20) Hanze rail link: Lelystad-Zwolle	2000	13 categories; 92 criteria; 7 alternatives	Inefficient alternative and weighted summation
(21) Reconstruction ring road: Amsterdam (A10 west)	2000	5 categories; 28 criteria; 4 alternatives	Weighted summation

reservoir (8). However, the list also includes activities with a very high political profile, such as the Betuwe freight railway (14), Highway 73 (10) and development of the Zandmaas river (20). A common element within all projects is the large amount of information presented to decision-makers and other participants.

Almost all EIAs are conducted at the project level and initiated by the party that wants to undertake an activity. As a result, the alternatives to be compared are relatively similar. For example, alternative rail routes were compared in the Betuwe project (14), rather than, say, rail and water transport. This makes comparison easier and limits the extent to which different types of impacts need to be traded off. In these applications, MCA is used to bring forward the differences among alternatives. Unfortunately, MCA is often not used in the 'big choice' at the more strategic level. Recent experiments with the use of EIA at the strategic level may eventually change this situation. Most EIAs are produced by environmental consultants. However, if the initiator of the activity is a governmental organization, the analysis is sometimes performed within that organization, or by an *ad hoc* project group[1].

Owing to detailed legal requirements, EIA reports are usually extensive. Reports of 300 pages with five to ten background documents is the rule rather then the exception. An extreme case is the Betuwe freight line (14) with over 1450 pages of text and about 250 maps. These reports are summarized in large evaluation tables. Table I shows that the evaluation tables included between 14 and 100 criteria and between 5 and 61 alternatives. The size of these tables makes them unsuitable for direct evaluation (cf. Miller, 1956). The need to communicate the EIA results summarized in the evaluation tables to decision-makers and other participants requires their structuring and aggregation. In some cases, this is done using an executive summary, in other cases, this is done using graphics. In the examples included in Table I, MCA is used.

2.1. Alternatives

Generating a complete set of relevant alternatives proves to be a complex task. This set includes the alternatives relevant to the initiator of the activity, and usually a 'do nothing' alternative (zero) and an alternative with only small adjustments to this current situation (zero plus). By law, the environmentally most friendly alternative (EMFA), the alternative with the smallest impact on the environment within reasonable constraints, must also be included. Political reasons, bad practice or the pressures of time may lead to an incomplete set. This can cause substantial delay because external pressure may force the decision-maker to include additional alternatives at a later stage of the process; this happened in the Hollandsch Diep (6) and the Betuwe freight line (14) examples.

Many alternatives are constructed from building blocks or elements. The total route for a highway can be divided into sections, and alternatives are defined for each section. The overall alternative is some combination of these different alternatives per section. The same procedure is followed for dike improvement projects. To make the problem manageable, the alternatives may be ranked per section and the best overall alternative found by combining the best-ranked alternatives of each section. This approach may result in sub-optimal solutions if dependencies between sections exist: For example, the decision to construct or not construct a bicycle path on the dike top should be the same for all sections.

Another procedure that can easily result in sub-optimal solutions is to separate different aspects of an alternative, for example, location and design. The best location is selected, and in a second round, the best design is selected. However, this is permissible only if both aspects are independent which, unfortunately, is often not the case. For example, the visual damage to a location cannot be estimated if the dimensions of a facility are not known.

If the decision-maker is only interested in the best alternative, excluding inefficient alternatives can be worthwhile. In the Hanze rail link study (20) the objective was to select a limited number of alternatives for further design (scoping) rather than to provide a full ranking. This was achieved by systematically eliminating inefficient alternatives using different sections and combination of sections of the total rail link (NS Railinfrabeheer, 1998).

2.2. Criteria, scores and weights

The number of criteria included in the evaluation is large in all examples from Table I. This follows from the practice of anticipating or reacting to requests from all interested parties. The objectives of these parties are often implicit, and no attempt may be made to construct a systematic evaluation framework. The list of criteria becomes simply an addition of requests from all stakeholders, rather than the result of a systematic value tree. This practice produces evaluation tables that include many criteria with only a minor influence on the final ranking and that are far too large to support a direct comparison of the alternatives. A survey of evaluation tables shows that the absence of a consistent evaluation framework leads to double-counting, confusion between means and ends in the criteria, dependencies among criteria, missing criteria, and inconsistencies in spatial and temporal scales (Eck, 1999).

Almost all examples listed in Table I include a mixture of quantitative and qualitative scores. Qualitative scores are usually scores measured on a plus and minus $(---/+++)$ scale. In many cases, this scale is used as a representation of an underlying classification of quantitative scores. The plusses and minuses are linked to different ranges in this classification. This is not a real ordinal scale, as the number of plusses or minuses reflects the size of the impact, and not just the order. Real ordinal scores are not found in any of the studies. All studies add a simple legend to the plusses and minuses describing, for example, $+++$ as a very large positive effect, 0 as no effect and $---$ as a very large negative effect. Most studies link these size classes to quantitative ranges or verbal descriptions, but some studies provide no further specification. The $(---/+++)$ scale is often used too loosely as for the Zandmaas (19) example, where criteria are scored on $(---/0)$, $(--/0)$, $(0/++)$, $(0/+++)$ and $(---/+++)$ scales. This can easily lead to a biased perception of the evaluation table, because readers of the table may expect that $+++$ always represents the best possible score and, therefore, undervalue a score of $++$ on a $0/++$ scale.

Geographical information systems (GIS) play an increasingly important role in EIA. Geo-referenced impacts of the alternatives can be stored, analysed and aggregated within a GIS. The results can be used as input to an MCA (Herwijnen, 1999). In some cases, the use of GIS results in quantification of qualitative criteria, such as visual quality of the landscape. In these cases, counting point and line elements and calculating area sizes in the landscape replace the subjective, but holistic assessment of landscape architects.

Criteria are grouped into categories or 'themes' in almost all studies. These categories help the reader to get a better overview of the impacts. Criteria within a category relate to a common element, for example, a category for impacts on water quality or a category for impacts on mobility. These categories are usually implicitly linked to policy objectives. The grouping is used to perform a two-step evaluation: first a ranking for each category, and second, a final ranking. In most cases, weights within a category are attributed by experts on the basis of generally available scientific knowledge, and weights between categories by politicians based on policy priorities. Expert weights are set according to theoretical knowledge on the relative importance of impacts, such as the relative importance of different types of plants, or the relative importance of different pollutants in the soil. These weights reflect the opinion of one or more experts, and usually do not create much controversy. Weights between categories are political weights and reflect the trade-off between policy objectives and/or stakeholders. Examples are the trade-off between safety and nuisance, or between transport and environment. It could be argued that, if a category corresponds to an objective of a well-defined interest group, the weights within a category should reflect the subjective preferences of that group. This was not found in the examples.

The political decision-making follows publication of the EIA. The EIA report usually does not present one final ranking based on one set of political weights, but rankings based on several perspectives corresponding to the different weight sets of the various stakeholders. For example, political weights can be specified for economic, social or environmental perspectives, and rankings presented for each of these. Political weighting easily creates debate. The use of perspectives is used to demonstrate the relation between priorities and ranking. There is usually less discussion about the underlying scientific and technical weights, because most people have the idea that this is purely a question of fact. However, this distinction between scientific and political weights is gradual rather than absolute. An expert who balances the loss of one badger den (ecology) against the retention of one hectare of fen meadow (ecology again), is making the same type of subjective comparison as a politician who balances one road death (road safety) against the loss of one hectare of industrial land (economy). If political trade-offs are mixed with expert weights, as is often the case, debate on expert weights gets mixed with the debate on political weights (e.g. Hollandsch Diep (6), Betuwe Rail Link (14) and Biesbosch (8)).

2.3. MCA methods

Weighted summation is used ten times and is, therefore, clearly the most popular MCA method of the examples listed in Table I. This approach is relatively simple: a linear function is used to standardize the quantitative scores and the overall score is calculated as the weighted average of the standardized scores (Janssen, 1992). Criteria measured on a $---/+++$ scale are, most of the time, also standardized using a linear function. Because weighted summation is methodologically sound, easy to explain and transparent, this method is recommended in the MCA manual published by the Dutch Commission for EIA (Bonte *et al.*, 1997). The Evamix method, which was developed in the Netherlands, is also popular, because many projects include a mixture of quantitative and qualitative scores (Voogd, 1983). The popularity of the Evamix method is surprising, as the method is complex, and because it is very difficult to relate input to output. None of the electre methods (Vincke, 1992), the analytical hierarchy process (AHP) (Saaty, 1980), and the regime method (Nijkamp *et al.*, 1990) are used in the examples. According to Heidemij advies (1997), about half of the studies used the MCA software package DEFINITE (Janssen and Herwijnen, 1994; Janssen *et al.*, 2000). The choice of method is hardly an issue for the MCA users represented in this list, despite the intensive debate in the multi-criteria decision-making (MCDM) community on the best method. A clear explanation of the advantages and disadvantages of the different methods was found in one study only. Only six studies provided reasons for their choice of method, while two studies completely failed to mention which method was used. Sensitivity of the rankings to uncertainties in the effect scores, or to changes in MCA and standardization method used, is performed in only a limited number of cases. Results of sensitivity analysis may be found, at best, in a background report. Sometimes, as, for example, in the Betuwe freight line study (14), sensitivity analyses were deliberately not conducted to limit discussion on the reliability of the MCA results.

3. ROLE OF MCA

3.1. The decision process

An EIA is a formal procedure embedded in decision processes involving substantial environmental impacts. MCA can be part of the EIA, and so plays a role in the decision process. Mintzberg *et al.* (1976) developed a general model of decision processes. They found that decision processes can be divided into seven types, according to the path taken through the model. (1) *Simple impasse* decision processes are the simplest of these seven types. These decision processes involve no development activity. (2) *Political design* decision processes are more complicated, as they involve extensive design activities, and meet frequent and difficult interruptions. Design activities are mostly political, and initiated to change the power structure within the decision process. (3) In *basic search* decision processes, the best available ready-made solution is selected in one or more search cycles. (4) In *modified search* decision processes, search cycles are followed by limited design activity. (5) *Basic design* is the most common type of decision process in Dutch EIA. This type of decision process involves extensive design activity, which typically leads to complex, custom-made solutions. Interrupts are uncommon. (6) In *blocked design* decision processes, final authorization and implementation is blocked through external interrupts. (7) *Dynamic design* decision processes are the most complex of the decision processes. These processes involve complex search and design cycles and encounter multiple interruptions. All decision problems listed in Table I can be described as 'basic design decision process'.

In the simplest case, the EIA process includes three design rounds and three feedback cycles (Figure 1). In practice, interruptions and many more loops are found. *Recognition* and *diagnosis* result in a small document from the initiator of the activity describing why the activity is considered necessary. This is the start of the EIA. The first *design* round is used for scoping. All possible alternatives are considered, and a few are selected for further design. Because the alternatives are often combinations of elements (for example, ten potential locations and five potential designs, or five alternatives for five sections of a highway), the number of alternatives in this first round can be very large. MCA plays a role in this scoping round, but not as often as might be expected. The

EIA procedure prescribes that the most environmentally friendly alternative must be included in the set of alternatives selected for further design. Because defining the alternative may include trade-offs among environmental impacts, MCA was used in the Flevoland (1) and Biesbosch (8) examples (see Table I) to design this alternative.

A second design round starts after the first feedback cycle. In this round, a small number of alternatives is designed in detail, and a detailed representation of the environmental impacts of these alternatives is provided. For analysis/evaluation, information is usually summarized in an evaluation table; aggregation may be supported by MCA. The EIA process is finished once the Commission on EIA approves the quality of the document. The decision process, however, is far from finished. The results of the evaluation enters *bargaining*, *evaluation choice* for the second time. The decision process is ended and implementation can begin when an alternative is selected and authorized by the competent authority. However, a new option interrupt often occurs at this point in the process. Examples are the introduction of an underground alternative for the Betuwe freight line, and the introduction of a tunnel for part of Highway 73. New option interruptions can send the process back to *design*, to elaborate the new option, or back to *evaluation/choice* to select or reject the new option immediately. It is also common, at this stage, that no agreement can be reached on the preferred alternative. This often results in a feedback to design and the construction of a compromise alternative using elements from existing alternatives. Design of this new alternative is usually not followed by an assessment of the impacts of this compromise alternative. A new MCA to evaluate the new alternative relative to the old alternatives is never conducted. At this stage, the political need to reach consensus dominates all other considerations.

3.2. Decision-makers

The objective of an EIA is to inform all stakeholders of the environmental impact of an activity. Stakeholders include the initiator of an activity, people involved in the public participation rounds, the authority that grants the environmental license (usually, the province) and, in some cases, the court, if the decision is challenged. The initiator is responsible for the production of the EIA. Public hearings are organized to inform all stakeholders, and to invite their suggestions. The quality of the EIA, and, therefore, of the MCA also, is controlled by the Commission on EIA. Stakeholders have different expertise and different interests. To play its role in the process, the MCA must be well-documented, easy to repeat, and as

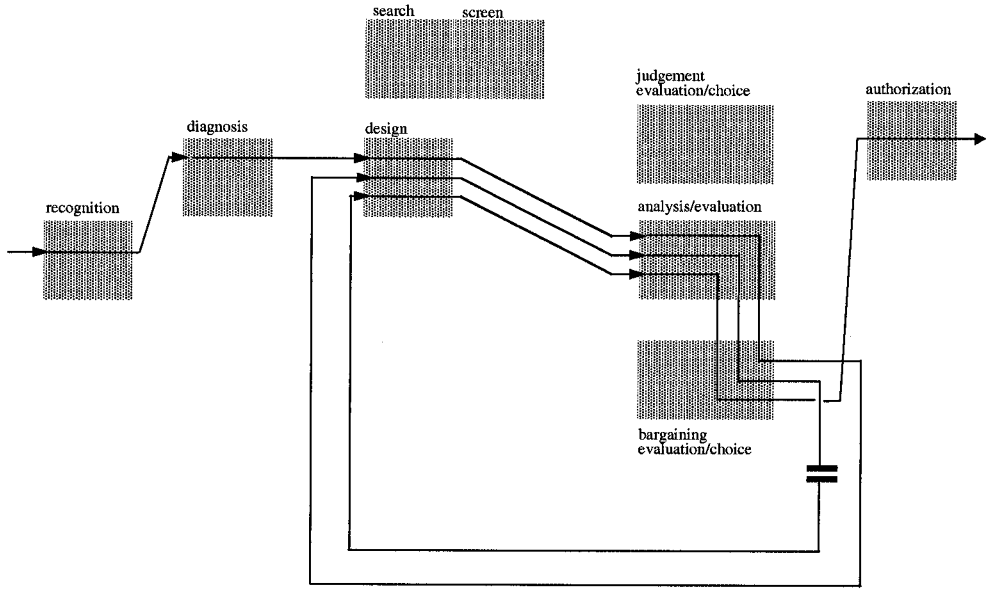

Figure 1. A basic design decision process.

objective and transparent as possible. Well-conducted and presented MCAs play an important role in the debate around the activity, and are usually appreciated by all participants. A well-structured evaluation table is a central factor for success. According to Mooren (1996), a certain mistrust towards MCA can be observed at the start of an EIA procedure. Decision-makers fear a technocratic instrument that can be manipulated easily, yet are sometimes afraid of results that are too precise and leave too little space for political manoeuvring. This attitude changes during the process, because the decision-maker comes to appreciate that MCA provides a structured approach, and provides an efficient means of communication. By the end of the process, the confidence in the results is often too high. For example, in the Highway 73 case (10) (see Table I), decision-makers used small differences in the weighted sum scores of the alternatives to argue their case in the political debate (Mooren, 1996).

4. MCA IN COURT: THE HOLLANDSCH DIEP CASE

The EIA process usually ends with a decision to implement one of the alternatives. An environmental license granted by the competent authority usually formalizes this decision. The granting of the license may be challenged in court. The EIA usually plays an important role in these court cases. It is rare that the judge goes into the details of the MCA and that the use of MCA itself is the subject of the court case. However, this happened in the case of the storage facility for polluted sediments in Hollandsch Diep. The need for storage in Hollandsch Diep stems from the presence of contaminated sediments in the area. According to national policy, these sediments must be dredged and stored. The proposed storage facility is a 50 m deep pit within a ring-dike, with a capacity of 30 million m^3 and a dike height of 3.5 m. The ring-dike can be removed once the pit is filled and consolidated.

An EIA procedure was initiated to find a location for this facility. Combining locations, storage capacities and management measures resulted in a total of 26 alternatives linked to three locations. The alternatives were compared using 35 criteria grouped into 13 evaluation categories. Expert weights were determined to aggregate criteria within each category. Weight sets linked to different perspectives were used to generate overall rankings linked to these perspectives. The Evamix method was used to generate the rankings, because parts of the criterion scores were measured on a qualitative scale (Nijkamp *et al*., 1990). The results of the MCA were used by the Province of South Holland and the Ministry of Transport and Waterways (the decision-makers) to select a location and grant an environmental license. This decision was challenged in the Council of State, the highest administrative court in the Netherlands, by the town of Willemstad and others. The view on this historical town, with a protected heritage status, would have been obstructed by the large ring-dike for a number of years. The town of Willemstad challenged various aspects of the MCA. After consulting with an external advisor with expertise on MCA, the court overruled the decision about the location and environmental license (Raad van State, 1996).

In summary, the court made the following points:

- The category 'landscape and use' included storage surplus material and additional capacity. The court decided on formal grounds that these criteria should not have been included, and that, therefore, the criterion 'visual disturbance' within this category was weighed too low;
- Within the same category, 'visual disturbance' was weighed lower than 'use functions'. The court decided that, given the large impact on 'visual disturbance', this weight was too low;
- The court made a field visit to the site, and decided that the extent of the visual disturbance and the impact on safety of recreational shipping was underestimated;
- Within the category 'dispersion', the criterion 'isolation' had a weight of 70%. Three of the alternatives had a score of 2.6 mm on this criterion, and the fourth alternative a score of 3.6 mm Using interval standardization, 2.6 mm is translated to 0, and 3.6 mm to 1. The court decided that this implied that a difference of 1 mm weighed more than the other two criteria in this category together and, therefore, was weighed too high.
- The use of the Evamix method was not challenged.

It is interesting to note that the court accepted the use of the MCA method to translate the evaluation table and weights to a ranking of alternatives. This is remarkable, because the Evamix method is far from transparent. The fact that the results can be reproduced and the method is accepted in scientific circles is apparently sufficient. By linking differences in emission scores to the weights, the court showed a clear understanding of the concept of swing weight. Because Evamix is a compensatory method, this is an important issue. The town of Willemstad commissioned a small MCA study to show that, as a result of these changes in scores and weights, the alternative near Willemstad was no longer the preferred alternative. The Minister of Transport and Waterways was forced to report to parliament that her decision was overruled, and that she would start an open plan process to invite stakeholders to find new alternatives (Tweede Kamer 25015, no. 2). This interrupt caused substantial delay, and started a feedback loop from authorization to design. A third design loop was started and MCA was used again to select a limited number of alternatives for detailed design. It is unclear, at present, how the selection of the preferred alternative will be performed. What is interesting, in this case, is that the court used MCA as a means to discuss assessments of impacts, and as a means to differ in opinion about the importance of impacts. Although it is unfortunate for the decision-maker that the project is delayed, MCA proved its worth as a communication tool.

5. CONCLUSIONS

A few lessons can be learned from experience with MCA in the Netherlands. The role of MCA is to make the decision process more transparent and the information manageable for all stakeholders. The fear that stakeholders will perceive the MCA as a 'black box' and, therefore, reject its results, leads to the use of simple straightforward methods, such as weighted summation, and limited interest in sensitivity analysis. Computational effort is not the issue here, as software packages are available and widely used. A shift in emphasis from analysis/evaluation to communication can be observed in many EIA processes. This shift leads to glossy, well-designed evaluation reports, information bulletins and public presentations. In some of these reports, for example, the Zandmaas (19) and the Hanze line (20) (see Table I), the analysis is only represented in background reports.

The importance of the MCA results for the final decision is not always clear. In many cases, the political decision process following the submission of the EIA report results in compromise alternatives, usually based on a mixture of elements from the original alternatives. These alternatives are usually not compared with the original alternatives. In several cases, for example, the Betuwe line, stakeholders have tried to make their own calculations. Usually, this results in enormous effort and wrong results, which then enter the public participation discussions. For these groups, the availability of a CD-ROM that includes the evaluation table and the methods applied would have been useful and would have helped the public debate.

The main methodological challenge is not in the development of more sophisticated MCA methods. Simple methods, such as weighted summation, perform well in most cases. More important is the support of problem definition and design. Building on the work of Keeney (1992), methods should be developed to provide more systematic support for building a consistent evaluation framework. Methods to support design are rare in the MCA circuit. Development of methods that could use the results of evaluation to support the design of new alternatives could make a major contribution to the EIA decision process.

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NOTES

1. The EIA reports included in table I were produced by the following environmental consultants and governmental organizations: 1. Witteveen en Bos, 2. Grontmij, 3. Micon Milieuconsultants, 4. Nederlandse Spoorwegen/Rijkswaterstaat, 5. Buro voor Milieumanagement, 6. Rijkswaterstaat Flevoland, 7. Province of North Holland, 8. Witteveen en Bos, 9.

Rijkswaterstaat Zuid-Holland, 10. Arcadis Heidemij Advies, 11. DHV Milieu en Infrastructuur, 12. Witteveen en Bos, 13. Haskoning, 14. Grontmij, 15. DHV Milieu en Infrastructuur, 16. Arcadis Heidemij Advies, 17. NS Railinfrabeheer, 18. NS Railinfrabeheer, 19. Witteveen en Bos, 20. Iwaco/DHV, 21. Arcadis Heidemij Advies.

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