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ANNOUNCEMENT

SPECIAL SESSION ON FUNDAMENTAL ISSUES

http://mcda63.inescporto.pt

63rd meeting of the European Working Group "Multiple Criteria Decision Aiding" that will be held in Porto, Portugal in 30-31 March 2006, at INESC Porto and FEUP (Faculdade de Engenharia da Universidade do Porto).

In the last Meeting, it was decided to schedule a time slot of the MCDA63 programme for a discussion of the fundamental issues of Decision Aid. This decision reflects the feelings that the group should agree on a common position over issues like scales, the notion of relative importance of criteria (weights, ….), imperfect knowledge (thresholds, …) and other relevant aspects for aggregation procedures. The session will be organized as an open forum with a moderator. Therefore no formal presentations will be asked, but the members of the group are strongly encouraged to prepare synthetic interventions for the debate (3-5 minutes maximum). A written, short summary of these interventions (conveying their main messages) would be appreciated as a way to support the preparation of the debate. We expect a fruitful discussion.

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Opinion Makers Section

MCDA and Environmental Problems

by

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Choosing or ranking environmental management strategies can be a complex and difficult problem, yet it is among the most important decisions an environmental manager will make. Natural and human-made ecosystems are complex: they may contain multitudes of species and a variety of landscapes, they may be simultaneously straining under the pressure of human development, and analyses of them can be highly uncertain. Amidst all this uncertainty, the manager must balance competing forces to find a resource-efficient, technically supportable, and effective management strategy.

These issues were discussed during a NATO Workshop at Thessalonica (Greece) last April on "Environmental Security in Harbors and Coastal Areas: Management Using Comparative Risk Assessment and Multi-Criteria Decision Analysis".

It should be pointed out before entering into the details of choosing environmental management strategies and MCDA that it was very difficult in many circumstances to adopt a common language among environmental managers, experts and operations researchers working on the field of MCDA.

Traditional environmental management approaches (such as management of contaminated sites, natural resource management, etc.) often do not provide a clear and systematic decision *rationale*. The uncertainties that exist in monitoring and simulating data, especially given the practical limitations of technical expertise, schedule, and finances, mean that some level of uncertainty is

unavoidable when managers commit to selection of a single management option (alternative). This uncertainty is difficult for managers to quantify and systematically incorporate into decisions. Modeling is often used to justify implementation of a single management option, but modeling inter-comparisons have revealed a large degree of uncertainty in model predictions even for simple ecosystems. For example, Linkov and Burmistrov (2003) report differences of up to seven orders of magnitude among model estimations of radionuclide concentrations in a strawberry plant sprayed with contaminants under well-controlled conditions.

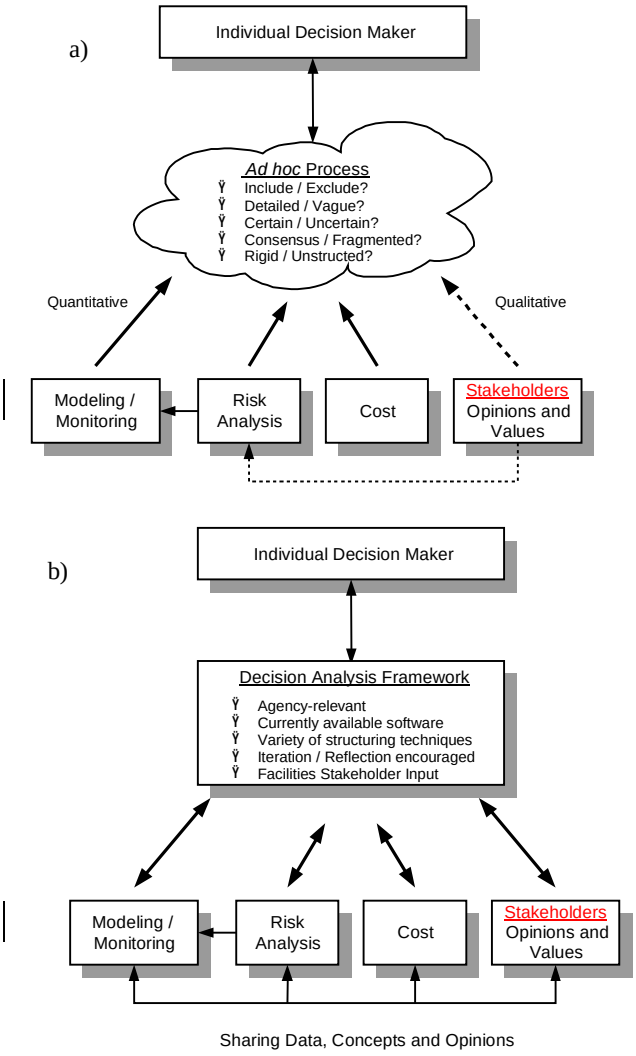

Figure 1: Current (a) and evolving (b) decision-making processes for contaminated sediment management.

In response to these decision-making challenges, some regulatory agencies and environmental managers have moved toward more integrative decision analytic processes, such as comparative risk assessment (CRA) or multiple criteria decision analysis (MCDA). These methods are designed to raise awareness of relationship that must be made among competing project objectives, help compare options that are dramatically different in their potential impacts or outcomes, and synthesize a wider variety of information (Figure 1b).

CRA has been most commonly applied within the realm of environmental policy analysis. Andrews et al. (2004), for example, distinguish between CRA use at macro and micro scales. At the macro scale, programmatic CRA has helped to characterize regional and national environmental priorities by comparing the multi-dimensional risks associated with policy options. U.S. government agencies at various levels have logged significant experience with policy-oriented, macro-level CRA. International CRA applications are reviewed in Tal and Linkov (2004) and in Linkov and Ramadan (2004). At smaller scales, so-called micro-CRA studies have compared interrelated risks involving specific policy choices, such as chemical *versus* microbial disease risks in drinking water. In these micro-scale applications, the CRAs often have specific objectives within the broader goal of evaluating and comparing possible options and their risks. Bridges et al. (2005) discuss micro-scale applications of CRA in more detail.

Central to CRA is the construction of a two-dimensional decision matrix that contains project options' scores on various objectives or criteria. However, CRA lacks a structured method for combining performance on criteria to identify an "optimal" project option. MCDA methods and tools, on the other hand, do provide a systematic approach for integrating risk levels, uncertainty and valuation. MCDA helps decision makers evaluate and choose among options based on multiple criteria using systematic analysis that overcomes some of the limitations of unstructured individual or group decision-making. Although almost all decision analysis methodologies share similar steps of organization in the construction of the decision matrix (often the end result of the CRA process), there are many MCDA methodologies which each synthesize the matrix information and rank the options by different means. Yet, taken by themselves, few MCDA approaches are specifically designed to incorporate multiple stakeholder perspectives or competing value systems.

Fortunately, MCDA tools can be naturally linked with an adaptive management paradigm for efficient applications to environmental problems. Adaptive management explicitly acknowledges the uncertainty in managers' knowledge of a system. As a consequence of this uncertainty, adaptive management holds that no single best policy can be selected, but rather a set of options should be dynamically tracked to gain information about the effects of different courses of action. Adaptive management concepts were introduced more than twenty years ago, but their implementation to date has been primarily limited to a few large-scale projects in long-term natural resource management, where uncertainty is so overwhelming that optimization is not possible. Even

though managers of smaller projects are confronted with the same problems and often have to go through the frustrating experience of changing their management strategy when it fails our review shows that the field of environmental management is far from accepting and using adaptive management approaches. Although adaptive management is recognized and even recommended by many state and government agencies, adaptive management applications vary widely in their implementation of the concept and there is no framework that robustly incorporates adaptive management in environmental practice.

Yet despite the promise of adaptive management, current environmental management practice has not widely accepted and utilized adaptive approaches. While adaptive management has been recommended by many state and government agencies, applications vary in their implementation of the concept, and there is no framework that robustly incorporates adaptive management in environmental practice.

Recent papers (Linkov *et al.*, 2004; Kiker *et al.*, 2005; Linkov *et al.*, 2005, Linkov et al., 2006) introduce a structured framework for selecting the best management strategy. This proposed framework (Figure 2) is intended to provide a road map to the environmental decision-making process. Having the right combination of people is the first essential element in the decision process. The activity and involvement levels of three basic groups of people (decision-makers, scientists and engineers, and stakeholders) are symbolized in Figure 2 by dark lines for direct involvement and dotted lines for less direct involvement. While the actual membership and the function of these three groups may overlap or vary, the roles of each are essential input into the decision process. Each group has its own way of viewing the world, its own method of envisioning solutions, and its own societal responsibility. Policy- and decision-makers spend most of their effort defining the problem's context and the overall constraints on the decision. In addition, they may be responsible for the final decision and subsequent policy implementation. Stakeholders may help define the problem, but they contribute the most in helping to formulate performance criteria and contributing value judgments for weighting the various criteria. Depending on the problem and regulatory context, stakeholders may have some responsibility in ranking and selecting the "final" option. Scientists and engineers have the most focused role in that they provide the measurements or estimations of the desired criteria that determine the success of various options. While they may take a secondary role as stakeholders or decision-makers, their primary role is, to the best of their abilities, to provide the technical input necessary for the decision process.

The decision-making process is in the center of the figure. While it is reasonable to expect that the process may vary in specific details among regulatory programs and project types, emphasis should be given to designing an adaptive management structure so that participants can modify aspects of the project to suit local concerns while still producing a structure that provides the required outputs. The process depicted in Figure 4 follows two basic activities: 1) generating management options, criteria, and value judgments and 2) ranking the options by applying value "weights". The first part of the process generates and defines choices, performance levels, and preferences. The latter section methodically prunes non-feasible alternatives by first applying screening mechanisms (for example, overall cost, technical feasibility, or general societal acceptance) followed by a more detailed ranking of the remaining options by decision analytical techniques (AHP, MAUT, decision rules approach, verbal analysis, multi-objective mathematical programming, outranking based methods, …) that apply the various criteria levels generated by environmental tools, monitoring, or stake-holder surveys.

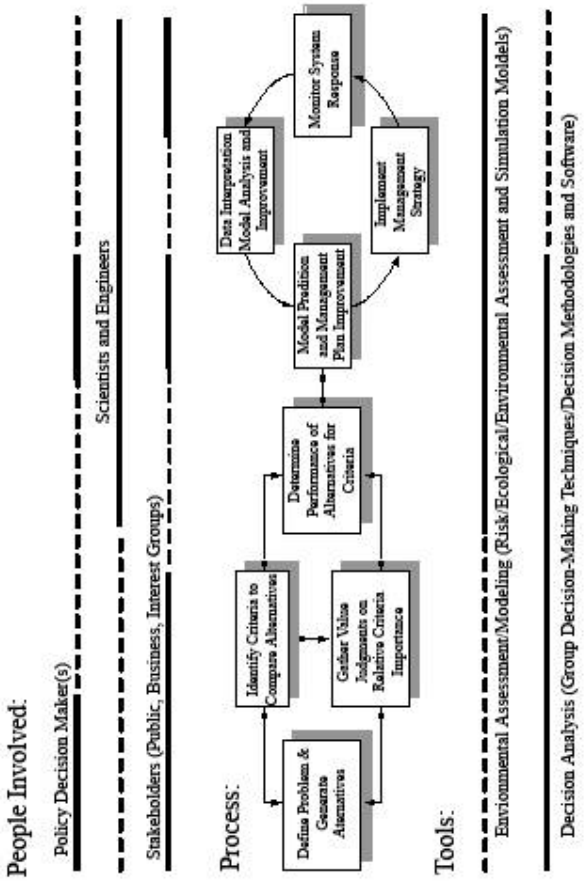

Figure 2: Adaptive decision framework. Solid lines represent direct involvement for people or utilization of tools; dashed lines represent less direct involvement or utilization.

As shown in Figure 2, the tools used within group decision-making and scientific research are essential elements of the overall decision process. As with the involvement of different groups of people, tool

applicability is symbolized by solid lines (direct or high "utility") and dotted lines (indirect or lower "utility"). Decision analysis tools help to generate and map preferences of stakeholder groups as well as individual value judgments into organized structures that can be linked with the other technical tools from risk analysis, modeling and monitoring, and cost estimations. Decision analysis software can also provide useful graphical techniques and visualization methods to express the gathered information in understandable formats. When changes occur in the requirements or the decision process, decision analysis tools can respond efficiently to reprocess and iterate with the new inputs. The framework depicted in Figure 2 provides a focused role for the detailed scientific and engineering efforts invested in experimentation, environmental monitoring, and modeling that provide the "rigorous" and defendable details for evaluating criteria performance under various options. This integration of decision tools and scientific and engineering tools allows each to have a unique and valuable role in the decision process without attempting to apply either type of tool beyond its intended scope.

As with most other decision processes, it is assumed that the framework in Figure 2 is iterative at each phase and can be cycled through many times in the course of complex decision-making. A first-pass effort may efficiently point out challenges that may occur, key stakeholders to be included, or modeling studies that should be initiated. As these challenges become more apparent one iterates again through the framework to explore and adapt the process to address the more subtle aspects of the decision, with each iteration giving an indication of additional details that would benefit the overall decision process.

In summary, using adaptive management and multiple criteria decision analysis gives structure to the decision-making process and allows the manager to learn about the system being managed and modify the management strategy based on new knowledge. Such a framework could be of great assistance to managers, saving them both time and resources as it helps them to understand the relationship involved between different management options and to make justified, intelligent selections.

This article is based on our recent publications cited below. We would like to thank our co-authors Drs. Seager, Gardner, Ferguson, Belluck, Benjamin and Mr. Satterstrom and Varghese for their help and support.

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Forum

Une nouvelle approche de robustesse : α - robustesse lexicographique

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Introduction

Évoquée dès la fin des années 1960 [5], l'idée de robustesse suscite un intérêt croissant à la fois de la part des praticiens et des théoriciens. Reflétant initialement une préoccupation de flexibilité dans un contexte d'incertitude vis-à-vis de l'avenir, ce concept paraît aujourd'hui s'adapter à un spectre beaucoup plus large de situations où l'on recherche "une aptitude à résister à des "à peu près" ou à des "zones d'ignorance" afin de se protéger d'impacts jugés regrettables" comme l'indique Roy [13].

De ce fait, il est important, lorsqu'on recourt à cette approche, de bien identifier le contexte dans lequel l'étude est faite. Dans cet article, nous nous intéressons à des problèmes de décision dans un contexte d'incertitude où les futurs possibles sont modélisés par un ensemble fini discret de scénarios et où l'on ne souhaite pas distinguer leur vraisemblance d'occurrence. Ceci peut résulter d'une situation d'incertitude pure où l'on ne disposerait d'aucune information sur ces vraisemblances, mais aussi de situations où l'on souhaite se prémunir contre toute éventualité même s'il est possible de distinguer des vraisemblances d'occurrence. Dans ce contexte, plusieurs approches de robustesse ont été proposées dans la littérature. Nous en présentons quelques-unes dans la section suivante et les classons en deux grandes familles. Nous nous intéressons, dans la section 3, à l'approche la plus utilisée, à savoir celle qui se base sur le pire cas. Nous mettons en évidence les limites du critère minmax et proposons une nouvelle approche de robustesse appelée *α -robustesse lexicographique.*

Les approches de robustesse en Aide à la Décision

La définition de la robustesse étant assez large, différentes approches ont été élaborées pour trouver des solutions robustes. On distingue, néanmoins, deux grandes familles d'approches: celles qui se basent sur l'optimisation d'un *critère de robustesse* et celles qui imposent des *conditions de robustesse* que la solution doit satisfaire pour être considérée comme robuste. Nous présentons, ci-après, une brève description de quelques travaux représentatifs de ces deux familles.

Approches basées sur l'optimisation d'un critère

- *Minimisation du coût ou du regret maximal* : Ce critère est le critère le plus utilisé dans la littérature concernant la recherche de solutions robustes. Certains auteurs identifient même la notion de robustesse à celle de regret maximal. La référence la plus importante sur ce critère est le livre de Kouvelis et Yu [8] où les auteurs traitent plusieurs problèmes d'optimisation discrète. Ils introduisent dans leur ouvrage trois critères de robustesse pour l'Aide à la Décision : la *robustesse absolue* (ou le critère du *coût maximal*), la *déviation robuste* (ou le critère du *regret maximal*) et la *robustesse relative* (ou le critère du *regret relatif*). Ces critères ont été beaucoup appliqués dans le cas où les scénarios sont représentés par des intervalles (voir notamment les travaux d'Averbakh *et al.*, par exemple [1,2,3,4]).

- *Maximisation d'un indicateur de flexibilité* : Dans le cas des problèmes de planification séquentielle et en présence d'incertitude, Rosenhead *et al.* proposent de mesurer la robustesse par la flexibilité qu'offre chaque décision prise à une étape donnée par rapport au reste du projet. La robustesse est donc perçue par ces auteurs comme le degré de flexibilité qu'offrent les décisions actuelles vis-à-vis de l'avenir [5,11].

- *Maximisation de la fréquence de quasi-optimalité* : Dans [10], Rosenblatt et Lee étudient un problème d'aménagement d'usine dans un contexte d'incertitude pure. Les auteurs utilisent un concept de robustesse lié à la stabilité du système vis-à-vis du traitement des demandes. Elle est mesurée par le nombre de fois où l'aménagement candidat conduit à un coût total de manutention inférieur à $(100+p)\%$ de l'aménagement optimal pour les différents scénarios, p étant fixé au préalable. Un

aménagement le plus souvent proche de l'optimum est considéré comme robuste.

Approches basées sur des conditions de robustesse

- *Proximité de l'optimum pour tous les scénarios* : Kouvelis *et al.* [7] se fondent sur le travail de Rosenblatt et Lee pour chercher des aménagements robustes. Par contre, ils restreignent l'ensemble des solutions robustes à celles dont le coût est à moins de (100+*p*)% (*p* un réel positif fixé) de celui de la solution optimale pour *tous* les scénarios, et non pas pour un nombre maximal de scénarios comme proposé par Rosenblatt et Lee. Dans [14], Snyder appelle cette mesure de robustesse la *p-robustesse.* Snyder et Daskin [15] présentent une variante de cette approche qui cherche la (ou les) solution(s) *p*-robuste(s) qui minimise(nt) l'espérance du coût.

- *Dominance de Lorenz* : Perny *et al.* étudient dans [9] les problèmes de plus courts chemins et d'arbres couvrants dans un contexte d'incertitude modélisée par un ensemble fini de scénarios. Les auteurs définissent le concept de robustesse en se basant sur la *dominance de Lorenz.* Ils considèrent qu'une solution est robuste si elle est non dominée au sens de Lorenz. Etant donné le grand nombre possible des optima de Lorenz, un raffinement axiomatique est ensuite exposé, conduisant à préconiser l'emploi de l'opérateur OWA (Ordered Weighted Average) pour discriminer entre ces optima.

Une nouvelle approche de robustesse

Limites de l'approche minmax

Pour déterminer les solutions robustes, la plupart des auteurs se sont appuyés sur les critères du coût maximal ou du regret maximal : une solution robuste est celle qui minimise le coût ou le regret maximal. Néanmoins, appréhender la notion de robustesse à travers une seule mesure paraît extrêmement difficile, car cette démarche conduit le plus souvent à privilégier un seul aspect qui est celui du pire cas. De plus, aucune tolérance n'est envisagée par rapport à la solution trouvée.

Considérons l'exemple suivant :

Coûts	s_1	s_2	max
Solution *x*	10	10	10
Solution *y*	0	11	11
Solution *z*	20	0	20

Il est fort probable que, dans ce cas, le critère du coût maximal ne donne pas la solution que le décideur aurait choisie. En effet, la solution *x*, optimale pour le critère minmax, présente un coût élevé dans les deux scénarios. En revanche, la solution *y* a un coût légèrement plus élevé que celui de *x* dans l'un des scénarios, et un coût beaucoup plus bas dans l'autre.

Dans ce qui suit, nous présentons une nouvelle approche de robustesse palliant les inconvénients de celle basée uniquement sur le pire cas.

Définition d'une nouvelle approche de robustesse

Supposons que, pour un problème donné, l'un (ou plusieurs) des paramètres ne puisse être déterminé de façon certaine et qu'il existe un ensemble fini de réalisations (scénarios) possibles *S*. Notons *X* l'ensemble des actions ou solutions admissibles et *q* le nombre de scénarios. Pour un scénario *s* donné et un point *x* de *X*, on définit $C^s(x)$ le coût de la solution *x* pour le scénario *s.* Le raisonnement et les résultats étant valables pour les coûts ainsi que pour les regrets, on utilisera, dans ce qui suit, le terme "coût" et la notation *C* indifféremment pour le coût et pour le regret. La solution robuste au sens du critère du coût maximal est la solution x^* qui vérifie :

A toute solution *x*, on associe le $\min_{x\in X} \max_{s\in S} C^s(x)$ vecteur coût $C(x) = (C^{s^1}(x),...,C^{s^q}(x))$, où $C^{s^i}(x)$ est le coût de la solution *x* sous le scénario s^i, $1 \le i \le q$. En ordonnant les coordonnées de $C(x)$ par ordre décroissant, on obtient un vecteur $\hat{C}(x)$ appelé *vecteur de désutilité*. On a donc :

$$\hat{C}^1(x) \ge \hat{C}^2(x) \ge ... \ge \hat{C}^q(x).$$

Appelons $\hat{C}^j(x)$ *coût d'ordre j* de *x.*

Définition 1 : *Soient x et y deux solutions de X,* $\hat{C}(x)$ *et* $\hat{C}(y)$ *les vecteurs de désutilité associés. Soit a un réel positif. La relation* α-leximax *est définie comme suit :*

$$x \, \mathbf{f}^{a}_{lex} \, y \Leftrightarrow \begin{cases} \exists k \in \{1,...,q\} : \hat{C}^k(x) < \hat{C}^k(y) - a \\ \forall j \le k-1, \left|\hat{C}^j(y) - \hat{C}^j(x)\right| \le a \end{cases}.$$

On dit que x est préférée (strictement) à y au sens de la relation a-leximax.

$$x \sim^{a}_{lex} y \Leftrightarrow \forall k \in \{1,...,q\}, \left|\hat{C}^k(y) - \hat{C}^k(x)\right| \le a$$

x et y sont dits indifférents au sens de la relation a-leximax.

On veut définir un ensemble de solutions robustes en s'appuyant sur la relation de préférence *a-leximax.* Soit x^* une solution idéale, fictive la plupart du temps, telle que :

$$\hat{C}(x^*) = (\hat{C}^1(x_1^*), \hat{C}^1(x_2^*), ..., \hat{C}^1(x_q^*))$$

où $x_k^* = \arg\min_{x \in X} \hat{C}^k(x)$ pour tout $k \in \{1\ldots, q\}$. Considérons l'ensemble suivant:

$$A(a) = \left\{x \in X : x \sim^{a}_{lex} x^*\right\}$$

D'après la définition de la relation *a-leximax* ainsi que celle de x^*, l'ensemble $A(\alpha)$ peut aussi s'écrire sous la forme :

$$A(a) = \left\{x \in X : \forall k \le q, \hat{C}^k(x) - \hat{C}^k(x_k^*) \le a\right\}$$

L'ensemble $A(\alpha)$ est donc l'ensemble des solutions de X dont le $k^{ème}$ plus grand coût est proche du minimum pour tout $k \pounds q$. Cette propriété peut être considérée comme une condition de robustesse. On peut alors dire que $A(\alpha)$ est un ensemble de solutions robustes que l'on appellera ensemble des *solutions a-robustes lexicographiques.*

Considérons l'exemple suivant où $X=\{a,b,c,d\}$ et $S=\{s_1,s_2\}$:

Coûts	s_1	s_2	$\hat{C}^1$	$\hat{C}^2$
solution *a*	14	30	30	14
solution *b*	25	25	25	25
solution *c*	27	16	27	16
solution *d*	18	28	28	18

Il est évident que l'ensemble des solutions α-robustes lexicographiques dépend du seuil choisi. Pour α variant de 1 à 4, nous avons :

$\alpha=1 \Rightarrow A(1)=f.$
$\alpha=2 \Rightarrow A(2)=\{c\}$
$\alpha=3 \Rightarrow A(3)=\{c\}$
$\alpha=4 \Rightarrow A(4)=\{c,d\}$

Deux propriétés importantes ressortent de cet exemple :

1. $A(\alpha)$ peut être vide : si le seuil est trop faible, c'est-à-dire qu'une solution n'est considérée robuste que si tous ses coûts d'ordre *k*, $k \hat{I} \{1,...,q\}$, sont très proches du minimum, il est clair qu'on ne peut pas toujours trouver des solutions robustes.
2. $A(\alpha)$ est "monotone" :
   $\forall a \ge 0 \text{ et } a' \ge 0, a \le a' \Rightarrow A(a) \subseteq A(a').$

Conclusion

Dans cet article, une nouvelle approche de robustesse, appelée *a -robustesse lexicographique*, a été introduite. Elle concerne les cas où l'incertitude sur les paramètres est modélisée par un ensemble fini discret de scénarios. Comparée à l'approche basée sur le pire cas, cette nouvelle approche présente plusieurs avantages:

1. Elle prend en compte plusieurs mesures, en l'occurrence les coûts ou les regrets du pire cas jusqu'au meilleur, et ceci de façon lexicographique respectant ainsi l'idée d'aversion du décideur pour le risque.

2. Elle offre une certaine tolérance puisqu'elle introduit un seuil d'indifférence α traduisant la dimension subjective de la robustesse [16].

3. Elle peut conduire à un ensemble vide de solutions robustes selon la tolérance fixée. Il paraît, en effet, souhaitable de mettre en évidence le fait que certaines instances n'admettent pas de solutions jugées robustes.

4. La version simple de l'approche que nous avons présentée peut être étendue de multiples manières. Tout d'abord, le seuil *a* peut être variable et différencié pour chaque mesure. De plus, on peut envisager d'étudier la robustesse non pas vis-à-vis de toutes les mesures, mais seulement vis-à-vis des *k* premières, $k \pounds q$. De telles études visent à dépasser la préoccupation de la recherche de solutions robustes (qui n'est pas toujours possible) et à s'orienter vers la détermination de ce que Roy appelle des *conclusions robustes* [12].

Il est clair que l'a -robustesse lexicographique est plus complexe à mettre en oeuvre que les approches minmax et minmax regret. C'est pourquoi il paraît raisonnable de n'appliquer cette approche que pour les problèmes qui sont "faciles à résoudre" pour ces critères. Il en est ainsi lorsque l'ensemble des solutions est défini par une liste exhaustive. Néanmoins, elle peut être intéressante même dans le cas d'un ensemble infini de solutions. En effet, Kalaï *et al.* [6] ont développé un algorithme en $O(nq^4)$ pour résoudre le problème de localisation 1-median a-robuste lexicographique sur un arbre où n est le nombre de sommets de l'arbre et q le nombre de scénarios.

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MCDA Research Groups

Malaga Group of Multicriteria Analysis

Rafael Caballero

This research group was founded in 1991, within the Department of Applied Economics (Mathematics) of the School of Economics and Business of the University of Malaga (Spain). Nowadays, it is formed by doctors in Mathematics and in Economy, as well as by PhD students.

General Research Lines.

The group works in several lines within the frames of Multiobjective Programming, Goal Programming and Interactive Methods, specially with continuous problems.

We have carried out our research activity in static and dynamic problems, both linear and non linear. During these years we have been working in their theoretical and computational aspects, as well as their application to different topics within the frame of the Economy.

Since its birth, the group has been actively participating in both national and international societies and events related to MCDM. At the national level, we are members of the Spanish Society of Statistics and Operations Research (SEIO). We also are part of the Spanish Group of Multicriteria Analysis, which was born inside the SEIO society in 1997. Besides, our group was among the founders of the thematic network on Multicriteria Decision Making, which has nowadays members of 14 Spanish universities.

At the international level, we are members of the MCDM Society, and we have participated in many MCDM, MOPGP and IFORS conferences. Our group organized and hosted the second MOPGP Conference, held in Torremolinos in 1996.

Finally, we would like to point out that our group considers that the relations with researchers of other universities is highly desirable and profitable. Apart from the close relations with our Spanish colleagues, we are proud to have received in our Department the visits of many prestigious researchers. With most of them, we have produced joint works, or we are presently working together.

Main Interest Research Topics of the group.

- Multiobjective Programming and Goal Programming, especially for convex or fractional problems. We have analysed the main characteristics of their solutions, studying the relations among them, we have developed efficient algorithms to obtain such solutions, and we have carried out several applications in the field of the Economy.

- Multiobjective Stochastic Programming. We are interested in the relations among the several kinds of solutions and schemes, and in their characterization. We also intend to develop appropriate algorithms to solve these problems, and to carry out applications to environmental problems.

- Interactive Methods. We are interested in the categorization of the different existing methods, and in the determination of the relations existing among the information they require and in the solutions they provide. We are currently developing the theoretical tools in order to transfer information between methods, so as to make it easier to change the algorithm along the resolution process, keeping as much information as possible.

- Computational Implementations. Our aim is to develop software related to all the topics describe above. So far, several implementations have been carried out under Windows environment, and with a friendly interface, to apply multiobjective, goal programming and interactive methods to linear and fractional problems. Presently, we are working in the improvement of these

implementations, as well as in their extensions to wider classes of problems.

- Meta-Heuristic Methods in Multiobjective Programming. The complexity and high dimensionality of some multiobjective problems, together with the corresponding large resolution times needed, have led us to work during the last years in meta-heuristic procedures, especially in evolutive, tabu search and scatter search algorithms.

- Applications to the public sector, specially to the fields of Education Economy and Health Economy. Within this context, we have centred our attention in the development of models in order to assign monetary and human resources to different productive units that depend of a central decision unit. These models relate the budgeting with the achievement of certain objectives, so that an efficient use of the available public resources is encouraged.

- Applications to forest management. The multiple uses of the forest are incorporated through fractional goal programming models, in order to determine the equilibrium of the natural system, and taking into account economic and environmental aspects.

- Application to environmental problems. The main principles of Ecological Economy imply the simultaneous consideration of economical, social and environmental criteria. In this scenario, the use of multicriteria decision techniques seem the most natural tool for political decisions. We are presently working in an application to the Andalusian electricity supply system, and in the development of composite environmental indicators.

- Applications to the Andalusian tourist sector. The reality of the tourist sector is very complex, and it depends on many variables. Thus, strategic decisions in tourist policy have to be made taking into account many different criteria. Our aim in this field is to build an interdisciplinary research group, in order to aid the regional authorities to evaluate the present situation and the possibilities and threatens of the future, and to make decisions according to these data.

Members of the group.

Rafael Caballero, José Manuel Cabello, Teodoro Galache, Trinidad Gómez, Mercedes González, Mónica Hernández, Mariano Luque, Francisca Miguel, Julián Molina, María del Mar Muñoz, Lourdes Rey, Beatriz Rodríguez, Rafael Rodríguez, Francisco Ruiz, Ángel Torrico

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Consultancy Companies

Management Consulting & Multi-Criteria Decision Aid

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A.T. Kearney - www.atkearney.com

A.T. Kearney is a global management consulting firm with offices in more than 60 cities and 35 countries. It provides strategy, organization, operations and technology services to help clients navigate the challenges on the CEO's agenda. It offers a combination of customized management consulting and value-driven solutions that blend

industry expertise, integrated capabilities and global alliance partners.

Overview

Over the last years A.T. Kearney has been retained by numerous Federal, State and Local government organizations. Our support has been primarily strategic in nature, helping these organizations develop, evaluate and prioritize public policies.

Government projects have challenges that are very different from those consulting firms traditionally encounter when they support private and non-for-profit organizations. It is important to keep these issues in mind from the start to avoid future pitfalls that can result in project collapse or failure. The key challenges when working for government organizations are related to:

- The complex nature and dynamics of the socioeconomic and political environment in which the project will be developed and implemented, which requires that project leaders pay special attention to option risk analysis in the decision making process;
- The need to involve society through its key stakeholders, opinion leaders and experts, optimizing the effectiveness of decision making process and ensuring commitment and buy-in that are not only critical for successful implementation, but also a key for transparent processes that can withstand the test of successive audits.

Complex Challenges

The challenge is complex because both the supply and demand sides are in a constant state of transformation and flux, as new technologies evolve that significantly impact areas such as health, telecommunications and transportation, and because markets have become truly global. Globalization as a phenomenon was facilitated by the World Wide Web. It is brought home to us as a reality in the form of regional political and trading blocks and the proliferation of global and regional NGOs.

In any process of public policy development and deployment, policy makers must take into account a cost/risk *versus* benefit analysis of the options available. As the options become more extensive and more uncertain in time, due to the rapid pace of technological evolution, this task becomes much more difficult.

Complexity can be addressed by involving experts and stakeholders early in the decision making process. This means calling in recognized experts in different fields, involving academia, industry associations, citizen groups and other specific NGOs that can make relevant contributions to the policy-making process.

Structuring the Process - MCDA

An important issue is how to structure and manage large and complex decision making processes to ensure delivery of the desired end products, and that these are endorsed by all key stakeholders.

A.T. Kearney has helped clients use *Multi-Criteria Decision Aid* (MCDA) techniques together with *Decision Conferencing* methodology to successfully manage and **structure the decision making process** involving complex challenges and a multiplicity of stakeholders. This approach includes evaluating, selecting and prioritizing the options available.

This broad approach was developed together with Carlos Bana e Costa, Ph.D., a Professor at the London School of Economics & Political Science (LSE) and at the Instituto Superior Técnico (IST) in Lisbon. Dr. Bana e Costa strongly supported our consulting team in two projects that we touch on briefly in Cases I and II below.

A **structured decision making process** must be set in place early in the project. This is done by asking relevant questions, the answers to which will provide the framework and content for the project. An example of what constitutes relevant questions would include:

- What are the fundamental questions or issues facing policy makers?
- What are the key strategic objectives to be pursued by them? Are the strategic objectives aligned?
- What criteria should be used to evaluate the different options? How should the cost-benefit analysis be risk adjusted?
- How can these criteria be described so they are clear to all key stakeholders?

- Who are the key stakeholders? At which point of the Decision Conferencing process should they be involved? What form should this involvement take?
- How can one optimize the use of experts and opinion leaders to support the assessment process?

Recent Experience

For over three years we have used MCDA & Decision Conferencing in projects on behalf of government organizations throughout Latin America. We have selected two cases to highlight the key challenges faced by the consulting team.

Case I

The Brazilian Economic Development Bank (BNDES) developed a project to formulate a strategy to attract investment to manufacture integrated circuits in Brazil. A.T. Kearney was retained and used the MACBETH approach within a Decision Conferencing framework to pursue two sets of important challenges.

The first set of key challenges was to clearly define criteria for assessment and build a value tree that could be used by stakeholders to answer key questions formulated by the client: (i) what would be the impact of the electronics manufacturing complex on the country's trade balance? (ii) how would it impact the country's competitiveness? (iii) how would it contribute to technological innovation, and (iv) what would be the impact in terms of employment of qualified personnel?

The second set of challenges was how to involve key stakeholders under the umbrella of Expert Panels used to assess and validate the options developed by the project team. The success of these panels was key to the success of the final round of Decision Conferences with government authorities

Case II

The Government of Puerto Rico invited consulting firms to bid for a project to help develop a long term vision and strategic plan known as Puerto Rico 2025. A.T. Kearney won the bid by proposing a participative approach to long-range planning that included options for multi-stakeholder participation in strategy design and commitment to the implementation process.

The project was split into 4 phases as follows:

1. **Evaluation/assessment** – Where is Puerto Rico today? "The need for action"
2. **Vision** – Where does Puerto Rico want to be in 2025? "The fundamental objectives"
3. **Strategic priorities** – What are the strategies that will mostly contribute to reach the vision? "The strategies"
4. **Implementation launch** – Transfer responsibilities to the independent entity

MCDA was an important enabler of stakeholder participation, especially during the phase of strategy assessment and prioritization. This phase required a robust and structured decision making process. A.T. Kearney helped set up and conduct 10 MACBETH Decision Conferences and 2 EQUITY Decision Conferences, facilitated by Prof. Bana e Costa, mobilizing more than 100 stakeholders to prioritize over the 150 identified strategies.

Software

M-MACBETH version 1.1

Carlos A. Bana e Costa, Jean-Marie De Corte, Jean-Claude Vansnick

NEWS: The M-MACBETH team is pleased to announce the new version of the M-MACBETH software, released in July 2005. The new version is available in four different languages: English, French, Portuguese and Spanish.

M-MACBETH is a multi-criteria decision support software that permits the structuring of value trees, the construction of criteria descriptors, the scoring of options in relation to criteria, the development of value functions, the weighting of criteria, and extensive sensitivity and robustness analysis about the relative and intrinsic value of options.

The M-MACBETH software is based on the implementation of the MACBETH methodology (**M**easuring **A**ttractiveness through a **C**ategorical **B**ased **E**valuation **Tec**h**h**nique). An important

distinction between MACBETH and many other Multiple Criteria Decision Analysis methods is that MACBETH requires only qualitative judgements about the difference of attractiveness between two elements at a time, in order to help a decision maker, or a decision-adviser group, to generate numerical scores for the options in each criterion and to weight the criteria. The MACBETH approach is based on the additive value model and aims to support interactive learning about the evaluation problem and the elaboration of recommendations to prioritize and select options in individual or group decision making processes.

The **M-MACBETH** software allows model structuring through a representation module where the points of view are commonly organized in a tree structure, usually referred to as a “value tree”. The “value tree” (see figure 1) provides a useful visual interface of the structure of the points of view in several levels of increasing specificity.

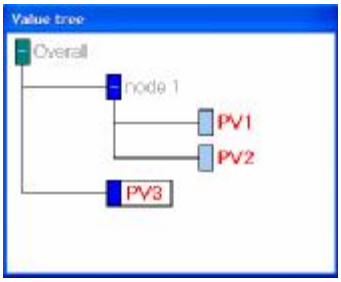

Figure 1 – Value tree.

The structuring component of the M-MACBETH software was designed with the purpose of being flexible enough to welcome all sorts of value trees, so that each time a point of view is inserted in the tree, the user can specify if it is a decision criterion or a simple node on the tree.

The name “**MACBETH** approach**”** comes from the mode of questioning. The process of building preferences requires that cardinal information concerning the attractiveness of the elements of a finite set be obtained from decision makers. The transition from ordinal to cardinal information reveals the origin of the notion of strength of preference, which in the MACBETH approach is designated as “difference of attractiveness”. The questioning procedure involves verbal information about the difference of attractiveness between two elements at a time, on the basis of the following seven semantic categories: "no", "very weak", "weak", "moderate", "strong", "very strong", and "extreme" difference of attractiveness. Judgemental hesitation or disagreement can be handled using several consecutive semantic categories.

For each of the answers about a new pair of elements, the software tests the compatibility of the information collected with regard to cardinal information. When incompatible judgments are detected, the software gives a warning message (“inconsistent judgements”) and the discussion with the decision maker can begin. To facilitate such a discussion, the software allows the source of the problem to be graphically displayed and provides suggestions to overcome inconsistencies. Once the incompatibility has been solved, the M-MACBETH software can propose a numerical scale, upon demand and at any moment (i.e. it is not necessary to make all pairwise comparisons). The software presents a graphic representation of the proposed scale and friendly tools that allow its progressive transformation into a cardinal scale (see figure 2).

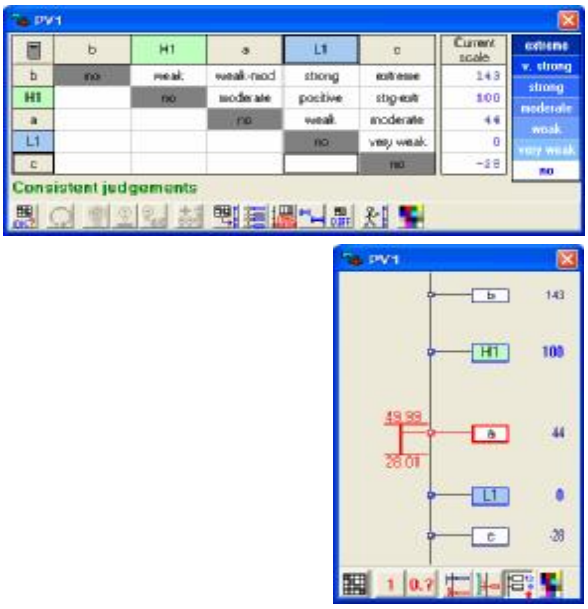

Figure 2 – Numerical and graphical display of a precardinal scale.

The M-MACBETH software also has a module that aggregates the scoring and weighting scales in an overall scale of attractiveness. Criteria weights can be represented in a bar chart (see figure 3)

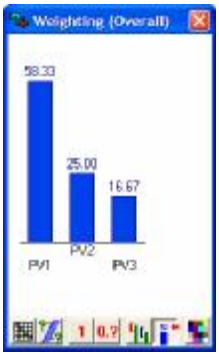

Figure 3 – Criteria weights.

The overall attractiveness of options is obtained through an additive aggregation model. The software presents the summarized information within a Table of scores (see figure 4), and proposes a graphic representation, the Overall thermometer, useful for discussion and analysis in group decision making settings.

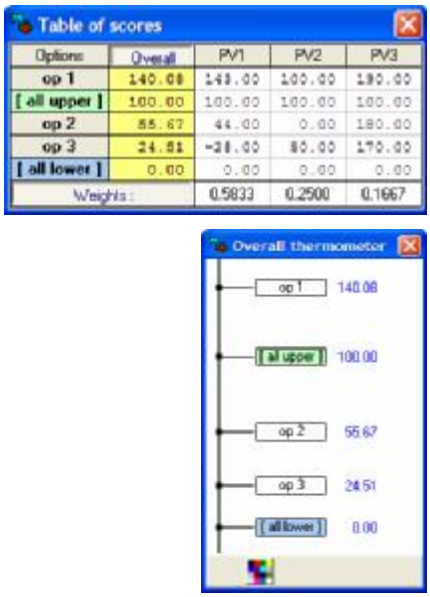

Figure 4 – Table of scores and overall thermometer.

The M-MACBETH software allows for sensitivity analyses to be performed. All changes on scores and weights are instantaneously reflected upon all other dependent values and graphics. A window in the software (see figure 5) is dedicated to the performance of sensitivity analysis on weight.

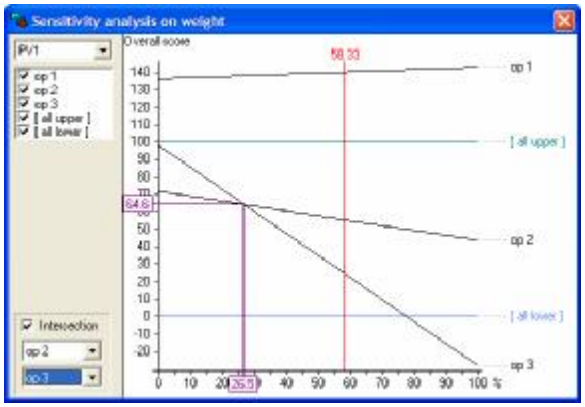

Figure 5 – Sensitivity analysis on the weight of "PV1".

The software also offers a module for robustness analysis that can be used to explore the extent to which conclusions can be drawn given varying amounts of information, and differing degrees of imprecision or uncertainty. M-MACBETH organises the information entered into the model into three types: ordinal, MACBETH and cardinal. Ordinal information refers only to ranking, thereby excluding any information pertaining to differences of attractiveness. MACBETH information includes the semantic judgements entered into the model; however, it does not distinguish between any of the possible numerical scales compatible with those judgements. In turn, cardinal information denotes the specific numerical scale validated by the decision maker. The robustness analysis module of M-MACBETH shows whether relations of dominance and global preference hold between options under varying amounts of information (see figure 6).

Moreover, when analysing the effect of cardinal information on the results, M-MACBETH allows a degree of imprecision to be associated with each criterion as a margin around each option's score. A similar analysis can be performed to explore the extent to which conclusions can be drawn given varying degrees of precision associated with the weights. Through robustness analysis, the decision maker is able to test whether hesitations on decision parameters are trivial to the model's results, or conversely, the cases that are worth investing resources to get into a deeper look.

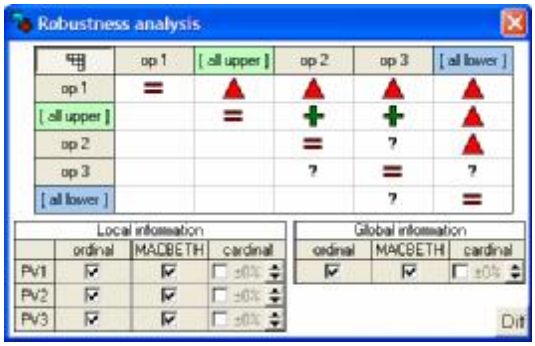

Figure 6 – Table of robustness analysis.

However, robustness analysis can also be seen in a different decision aid perspective. It may be that the decision-maker does not want to define numerical scores and weights, but rather opt for a pure qualitative analysis, just based on the (consistent) MACBETH judgements and using additive aggregation. In this perspective, after MACBETH judgments have been assessed and validated, one can skip the discussion of the numerical scales and go directly to the robustness analysis windows and select the MACBETH boxes in the local and global information tables, to display the overall comparison output for each pair of options (see figure 6).

The M-MACBETH software can be downloaded from the website:

http://www.m-macbeth.com

In the Demo version, saving is restricted to small models, but all other features are fully functional. To install either the professional or the academic edition, a license will be required. The User's Guide that comes with the software is available in four languages: English, Portuguese, French and Spanish.

Any additional information can be obtained at the following addresses:

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Overview of 'Kappalab', a toolbox for capacities and non-additive integral manipulation

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Abstract

Kappalab, which stands for "laboratory for capacities", is a package for the GNU R statistical system. It is a toolbox for capacity (or non-additive measure, fuzzy measure) and integral manipulation on a finite setting which can be used in the framework of decision making or cooperative game theory.

Introduction

The use of capacities (or fuzzy measures) and non-additive integrals in Multiple Criteria Decision Aiding (MCDA) is not anecdotal anymore. The use of the Choquet integral [CH53] for instance as an aggregation function is now commonly accepted among many MCDA researchers. It appears therefore more and more necessary to have tools which enable an easy manipulation of capacities and related integrals.

The Kappalab[1] package for the GNU R statistical system[2] is an answer to this shortage. It provides a set of high-level routines for the manipulation of capacities and associated non-additive integrals on a finite setting. In particular, it

[1] www.polytech.univ-nantes.fr/kappalab
[2] www.r-project.org

can be useful in MCDA when it comes to the development of new methods or simply to the use of existing capacities identification procedures.

The Kappalab package contains several routines for handling various types of set functions such as games or capacities. It can be used to compute non-additive integrals such as the Choquet integral or the Sugeno integral. The analysis of capacities in terms of decision behavior can be performed through the computation of various numerical indices such as the Shapley value [SH53], the interaction index, the orness degree, etc. The well-known Möbius transform [RO64], as well as other equivalent representations of set functions can also be computed. Furthermore, Kappalab contains four routines for the identification of capacities from (preferential) data : two least squares based approaches, a maximum entropy-like method based on variance minimization and an unsupervised approach grounded on parametric entropies. The three first methods are of particular interest for MCDA.

What is R?

GNU R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. It includes a suite of operators for calculations on matrices, a large, coherent, integrated collection of intermediate tools for data analysis and graphical display, and especially a well-developed, simple and effective high-level programming language.

Roughly speaking, one can think of GNU R as a free, Matlab-like software for statistical analysis grounded on an effective high-level language.

Using Kappalab

Kappalab being a package for GNU R, it follows that before being able to use it, a basic knowledge of the R language is necessary.

Let us consider a simple example showing how Kappalab can be used for capacity manipulation. Note that we hereafter assume that the reader is familiar with the basic concepts arising from the use of non-additive measures and integrals in the framework of multicriteria decision making and cooperative game theory. If not, a good starting point may be [GMS00]. One may also download the numerous articles available from the Kappalab web page.

Let us first define a capacity for a fictitious problem with 3 criteria :

```
mu<-capacity(c(0,0.07,0.15,0.23,0.28,0.48,0.56,1))
```

This capacity can then be visualized :

```
mu
```

{}	0.00	{12}	0.28
{1}	0.07	{13}	0.48
{2}	0.15	{23}	0.56
{3}	0.23	{123}	1.00

The Shapley value of the capacity can be computed :

```
Shapley.value(mu)
```

```
1 0.2333
2 0.3133
3 0.4533
```

The Möbius transform of the capacity can be easily obtained :

```
m <- Mobius(mu)
```

And then visualized :

```
m
```

{}	0.00	{12}	0.06
{1}	0.07	{13}	0.18
{2}	0.15	{23}	0.18
{3}	0.23	{123}	0.13

Finally, given a vector of partial evaluations, one can compute its Choquet integral with respect to the capacity:

```
x <- c(0.1,0.2,0.8)
Choquet.integral(mu,x)
0.294
```

Alternatively, the Möbius transform of the capacity can be used:

```
Choquet.integral(m,x)
0.294
```

There are more than 40 high-level functions in Kappalab. These can be mainly grouped into two categories : functions for capacity manipulation and functions for capacity identification from (preferential) data. For instance, in the framework of MCDA, a natural way of using Kappalab would be first to use a function from the latter group to identify a capacity and then, functions from the

former group to analyze the capacity and the related integral in terms of decision behavior.

A small MCDA example

We consider the simple example presented in [MR00] to illustrate how Kappalab can be used in the framework of Choquet integral based MCDA.

Four cooks *a*, *b*, *c*, and *d* are evaluated according to their ability to prepare three dishes : frogs' legs (FL), steak tartare (ST) and stuffed clams (SC). Their evaluations on a [0,20] scale are given in Table 1.

Table 1: Partial evaluations of the four cooks

cooks	FL	ST	SC
a	18	15	19
b	15	18	19
c	15	18	11
d	18	15	11

The decision maker adopts the following reasoning: when a cook is renowned for his stuffed clams, it is preferable that he/she is also better in cooking frogs' legs than steak tartare, which implies that *a* is preferred to *b*. However, when a cook badly prepares stuffed clams, it is more important that he/she is better in preparing steak tartare than frogs' legs, which leads to *c* is preferred to *d*. Of course, we also immediately have that *a* is preferred to *d* and *b* is preferred to *c*. Nevertheless these preferences do not contribute to anything since they naturally follow from the monotonicity of the Choquet integral [MA00].

Marichal and Roubens showed that there are no additive model that can lead to this partial ranking [MR00].

Using Kappalab and the above preferential information, it is for instance possible to obtain the "least specific" capacity [KO05] such that the Choquet integral with respect to this capacity preserves the decision maker's preferences.

Define four vectors representing the profiles of the cooks :

```
a <- c(18,15,19)
b<-c(15,18,19)
c <- c(15,18,11)
d <- c(18,15,11)
```

Indicate that if an alternative is preferred to another, then their difference in terms of global evaluation should be at least equal to one :

```
delta.C <- 1
```

Encode the preferential information "*a* is preferred to *b*" and "*c* is preferred to *d*" in an R matrix :

```
Acp <- rbind(c(a,b,delta.C),c(c,d,delta.C))
```

Use a maximum entropy like method [KO05] to determine the "least specific" capacity compatible with the provided preferential information :

```
s <-mini.var.capa.ident (3,3,A.Choquet.preorder = Acp)
```

Display the solution :

```
mu <- zeta(s$solution)
```

{}	0.00	{12}	0.67
{1}	0.17	{13}	0.84
{2}	0.50	{23}	0.50
{3}	0.34	{123}	1.00

And compute the global evaluations of the cooks :

```
Choquet.integral(mu,a)
17.83334
Choquet.integral(mu,b)
16.83334
Choquet.integral(mu,c)
15.16666
Choquet.integral(mu,d)
14.16666
```

They are in accordance with the decision maker's preferences.

This short example illustrates how Kappalab can be used in the framework of Choquet integral based MCDA.

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[RO64] G-C. Rota, On the foundations of combinatorial theory: Theory of Möbius functions, Z. Wahrscheinlichkeitstheorie und Verw. Gebiete 2, 340—368, 1964.

[GMS00] M. Grabisch and T. Murofushi and M. Sugeno Editors, Fuzzy Measures and Integrals: Theory and Applications, Physica-Verlag, 2000.

[KO05] I. Kojadinovic, Identification of Choquet integral models by means of a minimum variance principle, 3rd International Summer School on Aggregation Operators (AGOP 2005), Lugano, Switzerland, 61-65, 2005.

THESES AND SOFTWARE REPOSITORY

Tommi Tervonen and José Figueira

Decision aiding usually involves software that implements the used methods. In many cases the algorithms are simple and easy to implement. Yet there hasn't yet existed an MCDA software repository for centralised distribution of programs for decision makers. For this reason, we have put up an MCDA repository that can be found in http://monet.fe.uc.pt/thesessoftware. The repository is supported by the MONET research project.

The MCDA repository serves for three purposes: for software distribution, for thesis distribution, and as forum for discussion. All kinds of software is welcome to be uploaded there: open source and freeware as well as demos of commercial software. For theses PhD and master's thesis are welcome. The website comprises a forum for discussing the software, but also discussing MCDA in general.

The repository has been open for public for six months, and there are open source codes available for SMAA, ELECTRE, and ClusDM methods. Also one PhD thesis is available for download. The source code packages have already been downloaded over 250 times. All uploads are checked before publishing and uploading requires registration. We welcome contributions, why not upload your work and see more researchers and MCDA practicioners using your software and reading your thesis!

Persons and Facts

*** *** ***

Dear Colleagues,

We are sorry to let you know that our colleague, Professor Charles (Chuck) ReVelle, passed away on 10 August 2005. Chuck has been for nearly 20 years a member of our Editorial Board of EJOR. As many of you know, Chuck was a pioneer in location theory, and in applications of mathematical programming to environmental and social issues. An article from the **The New York Times** on Chuck can be found at:

http://www.nytimes.com/2005/08/25/national/25revelle.html?ex=1125633600&en=e40c23808fd235d1&ei=5070&emc=eta1

With kind regards, Editors of EJOR.

*** *** ***

Our colleague Roman Slowinski has been just awarded FNP annual prize which is the most prestigious independent scientific award in Poland.

*** *** ***

The current Editor of this Newsletter, José Rui Figueira has recently moved from the University of Coimbra to Instituto Superior Técnco at the Technical University of Lisbon. His new email: figueira@ist.utl.pt. The complete address can be found in the back cover of this issue.

About the 62nd Meeting

The MCDA European Working Group has held it's northernmost meeting so far: in Borlänge, Sweden, September 22 – 24 2005. The meeting gathered 45 participants from the group, consultants and sponsors. 12 participants (including 4 from Sweden) were doctoral students. 13 countries were represented.

The meeting was hosted by the Swedish National Road and Transport Research Institute (VTI). Financial support was given by the Swedish Railway Administration, the Swedish Road Administration and the Swedish Institute. For Transport and Communications Analysis The main theme of this reunion was: Infrastructure, Transport and Multicriteria Decision Aiding.

The key note speaker, Roger Vickerman , Jean Monnet Professor of European Economics at University of Kent, gave the group a challenge under the heading: " Evaluating infrastructure projects. In defence of (good) Cost-Benefit Analysis." A decision support is a way to structure advantages and disadvantages of proposed decisions. Distributional and welfare issuse are always at the centre of politics. CBA has well known properties and limits.

During five sessions, 14 presentations gave examples on what MCDA could contribute to the theme. Several cases where MCDA works as a support were given. An evidence coming out of the examples is that MCDA methods are part of a development of decision support, where more traditional planning and evaluation methods are regarded as inadequate or at least insufficient. A role for MCDA as an established form as a decision support is still bit away in public infrastructure planning.

The cases were from different fields:
- Maintenance of road pavements.
- Bus driver scheduling.
- Planning of electricity transmission.
- Choice among motorway alternatives.
- Planning of railway transport in Europe.

A number of presentations addressed the use of decision support in different situations:
- A decision group planning a transport route.
- Support to improve participation for formulation of an action plan for the transport sector
- Introduction of MCDA in the transport sector planning in general.

Methodological questions of different kinds were addressed. Applications of Electre III, Macbeth, AHP and Promethee were demonstrated. Development of aggregation methods built on individual preferences, the problem of structuring of problems, the use of interactive methods and development of verbal decision analysis were addressed. A new type of decision software under uncertainty was introduced, and finally the wider question of goal rationality in Swedish transport policy was asked.

Sofia Grahn-Voorneveld explained why MCDA so far has not played any role in Swedish transport planning. A main reason is the well established routines and practices of using CBA.

The invited speaker, Carlos Bana e Costa, gave his view upon the question: "Multicriteria in infrastructure planning, what kind of support?" His answer was to support the decision process as such in the form of decision conferencing. Then the formal decision support could give the best result.

The Saturday excursion took the participants to the World heritage site of the old copper mine in Falun. This mine gave material to copper coins and to copper roofs on churches, palaces and houses around Europe during many centuries. Waste from the mining gave material to the red colours of so many Swedish houses.

Sven-Olov Larsson

PROGRAMME

JEUDI 22 septembre
THURSDAY, September 22

11h00-12h00 Accueil et enregistrement / ***Welcome and Registration***

12h00-12h15 Message de bienvenue / ***Welcome Message*** (S-O Larsson, J-E Nilsson)

12h 15- 13.15 Intervenant principal/***Key note speaker***

Roger Vickerman Evaluating infrastructure projects. In defence of (good) Cost-Benefit Analysis

13.15 – 14.15 Déjeuner (buffet) / ***Lunch (buffet)***

14.15-15.45 Session 1 MCDA applications in the transport sector I.
Chairman: Maria Franca Norese

- O. Pilate, A. Fiordaliso et M. Pirlot Decision aiding for the selection of road pavements and surfacings (30 min)

- Sophie Labbouz, Elaboration d'une méthodologie d'aide à la décision lors de l'implantation d'une ligne de transport en comun en site propre (30 min)

- Carlos A. Bana e Costa, João C. C. Lourenço From weights to their corresponding anchor points on performance scales: The REN case-study (30 min)

Papers submitted for discussions I:

- *Gheorghe Condurache, Romeo-Mihai Ciobanu . The applications of the multicriteria problem of transport in electric power and machine building industries*

- Benjamin Rousval Vers une aide multicritère à l'évaluation de l'impact des transports sur l'environnement

15.45-16.15 Pause café / *Coffee break*

16.15 – 17.45 Session 2 MCDA applications in the transport sector II.
Chairman: Roman Slowinski

- Jens Borken Evaluation of environmental indicators for transport with ELECTRE III (30 min)

- Federico Menichini An application of multicriteria analysis for choosing among motorway projects (30 min)

- Ralf Hedel and Colin Vance On the application ELECTRE III to the analysis of rail freight options: Advances in assessing the sensitivity of rankings. (30 min)

Papers submitted for discussion II:

- Jaroslava Halova, Martin Aust, Lucia Austova Criteria for the multicriteria choice of optimum variant of transport of radioactive wastes from nuclear power plants.

- Paolo Delle Site and Francesco Filippi Analytic hierarchy process for the assessment of metro line layout alternatives

- Birgit Friedl, Ines Omann Addressing Trade-offs in Implementing Road Pricing: Economic Effects as Decisive Criteria in an MCDA?

18.00 – 19.00 Reception / reception at the "Pylon", National Road Authority,

20.00 - Conference dinner en/at Haganäs Transport: Bus

VENDREDI 23 septembre
FRIDAY, September 23

09.00-10.00 Session 3 Decision support I
Chairman: Manuel Matos

- Danae Diakoulaki, George Mavrotas, Ioannis Ziomas A participatory multicriteria approach to formulate an action plan for the transport sector under the limits of the air quality directives. (30 min)

- Jorge Pinho de Sousa, Teresa G. Dias, João F. Cunha. Interactive Multi-Objective Genetic Algorithms for Bus Driver Scheduling. (30 min)

Papers submitted for discussion III:

- Manuel Matos A discussion on independence requirements for value functions

- Nikolaos F. Matsatsinis, Vassilios Chr. Fortsas A Multicriteria Methodology for the Assessment of the Performance of Distance Education Trainees

- Yevseyeva Iryna, Kaisa Miettinen, Pekka Räsänen Decision support system for Attention Deficit Hyperactivity Disorder Diagnostics

- Romeo-Mihai Ciobanu, Gheorghe Condurache Decision making: the most important.

10.00-10.30 Pause café / *Coffee break*

10.30 - 12.00 Session 4 Decision support II
Chairman: Jens Borken

- J Figueira, S. Greco, R. Slowinski. Building a set of additive value functions representing a reference preorder and intensities of preference (30 min).
- Céline Mousset, Jean-Claude Vansnick Structuration aid : case study / Un cas pratique d'aide `a la structuration en MCDA (30 min)
- Sofia Grahn-Voorneveld, Why isn´t MCDA used more in the Swedish transport sector? (30 min)

12.00-13.00 Intervenant invité / Invited speaker
Carlos A. Bana e Costa Multicriteria in infrastructure planning, what kind of support?

13.00-14.00 Déjeuner (buffet) / *Lunch (buffet)*

14.00-14.30 Bernard Roy. Vie du groupe et prochaines réunions / *Working group matters and next meetings*

14.30-16.30 Session 5 Methodology I
Chairman: Tommi Tervonen

- Alexey Petrovsky Verbal Decision Analysis with Inconsistencies and Contradictions (30 min)
- Aron Larsson, Mats Danielson, Love Ekenberg, Jim Johansson Decision Software for Multi-Criteria Decisions under Uncertainty (30 min)
- Holger Rosencrantz, Collective rationality and political goals (30 min)

Papers submitted for discussion IV

- Vaarmann, Otu Damped Gauss-Neston type methods for strongly non-linear least squares problems.
- Tommi Tervonen , José Figueira , Juscelino Almeida-Dias SMAA-TRI: A Stochastic Method for Robustness Analysis in Sorting Problems
- Georgios Samaras, Nikolaos Matsatsinis, Pandelis Ipsilandis A Multicriteria DSS for Stock Selection

16.30-16.45 Final

Forthcoming Meetings

(This section is prepared by Carlos Henggeler Antunes)

Forthcoming EWG Meettings/Prochaines réunions du Groupe

Note:

- It should be remarked again that this is a bilingual group; all the papers should be presented in both official languages of the group (i.e. French with English slides, and *vice-versa*).
- Ceci en un groupe bilingue ; tous les papiers doivent être présentés dans les deux langues officielles du groupe (i.e. en français avec les transparents en anglais et *vice-versa*).

March 30-31, 2006. 63rd Meeting of the European Working Group on MCDA. Organisers: Manuel Matos and Jorge Pinho de Sousa. Topic: Performance Evaluations (Individuals, Institutions, Services, etc). Place: Faculty of Enginnering, The University of Oporto or INESC-Porto.
E-mail: mmatos@inescporto.pt.
Web page: http://mcda63.inescporto.pt

September 28-30 or October 5-7, 2006. 64th Meeting of the European Working Group on MCDA. Organisers: Georgios Samaras, Pandelis Ipsilandis and Nikolaos Matsatsinis. Main Topic: Multicriteria Decision Support Systems. Place: Larissa – Greece. Contacts emails:
G. Samaras (samaras@teilar.gr)
P. Ipsilandis (ipsil@teilar.gr)
N. Matsatsinis (nikos@ergasya.tuc.gr)

Other Meetings

December 19-21, 2005, The 5th International Conference on Operational Research for Development (ICORD-V) Jamshedpur, India tripathy@iimahd.ernet.in
[http://www.iitk.ac.in/ime/ICORD05/]

December 27-29, 2005, ICORAID-2005-ORSI: International Conference on Operations Research Applications in Infrastructure Development Bangalore, Índia
[http://www.mgmt.iisc.ernet.in/~orsibc]

January, 16-18, 2006, 7th APORS (Association of Asia-Pacific Operational Societies) Conference Manila, Philippines
[http://www.managementsciences.org.my]

6, 7 et 8 février 2006. Le 7ème congrès de la société française de Recherche Opérationnelle et d'Aide à la Décision (ROADEF) aura lieu à Lille.
[http://www.lifl.fr/ROADEF2006]

April, 3-5, 2006, 3rd International Conference on modeling decisions for artificial intelligence" (MDAI 2006). University Rovira i virgili, Tarragona, Spain.
[http://www.mdai.info/mdai2006]

April 2, 2006, The 8th INFORMS Telecommunications Conference Dallas, Texas March 30.
[http://telecom.section.informs.org/conference/]

April 27-28, 2006, European Conference on e-Government Philipps-Universität Marburg, Germany
[http://www.academic-conferences.org/]

May 11-13, 2006, ECCO XIX - CO 2006 Joint meeting of the European Chapter on Combinatorial Optimization working group and the Combinatorial Optimization Conference. Portuguese Association of Operations Research and University of Porto, Portugal.
jfo@fe.up.pt
[http://www.apdio.pt/ECCOXIX-CO2006/]

May 15-17, 2006, The International Conference on Information Systems, Logistics and Supply Chain (ILS'06) Lyon, France
valerie.botta@insa-lyon.fr
[http://www.ic-ils.org]

May 17-19, 2006, 12th IFAC Symposium on Information Control Problems in Manufacturing INCOM'2006 Saint Etienne, France
[http://www.emse.fr/incom06/index.html]

May 23- 26, 2006, Third International Workshop on Freight Transportation and Logistics (ODYSSEUS 2006) Altea, Spain
[http://www.ifors.org/panorama/conferences/ODYSSEUS2006.pdf]

June 12-14, 2006, MOPGP 2006 : 7th Int. Conf. devoted to Multi-Objective Programming and Goal Programming Loire Valley, City of Tours - France
[http://www.mopgp06.org]

June 14-16, 2006, Joint International Conference on Computing and Decision Making in Civil and Building Engineering Montreal (Delta Centre-Ville Hotel), Canada
[http://www.icccbexi.ca]

June 19-26, 2006. The 18th International Conference on Multiple Criteria Decision Making, Chania, Greece.
[http://www.dpem.tuc.gr/fel/mcdm2006/]

June 22-23, 2006, The International Conference on e-Learning University of Quebec in Montreal, Canada,
[http://academic-conferences.org/index.htm]

June 25-28, 2006, INFORMS Hong Kong International 2006 Hong Kong, China,
[http://www.informs.org/Conf/Hongkong06/]

June 25 - 28, 2006. Group Decision and Negotiation 2006 (GDN 2006). The Castle of Karlsruhe, Karlsruhe, Germany.
[http://www.gdn2006.org]

June – July 1, 2006, EUROPT Workshop on "Advances in Continuous Optimization" Reykjavik, Iceland
gweber@metu.edu.tr
[http://wwwhome.math.utwente.nl/~stillgj/COPT06/]

June 28 - July 1, 2006. CIDMDS 2006 - International Conference on Creativity and Innovation in Decision Making and Decision Support (IFIP TC8/WG 8.3 Open Conference), London School of Economics, London, UK.
[http://www.psych.lse.ac.uk/cidmds2006/index.php]

July 2- 5, 2006, EURO XXI, 21st European Conference on Operational Research 2006 Reykjavik, Iceland
info@euro2006.org
[http://www.euro2006.org]

July 6-8, 2006, 5th Global Conference on Business & Economics Cambridge University, Cambridge, UK,
[http://www.Facultyforum.com/gcbe]

November 5- 8, 2006, INFORMS Annual Meeting 2006, Pittsburgh Pittsburgh, PA, USA
[http://www.informs.org]

Call for Paper

Web site for Call for Papers:
www.inescc.fe.uc.pt/~ewgmcda/CallforPapers.html

FIRST ANNOUNCEMENT and CALL FOR PAPERS
19th Mini EURO Conference on
OPERATIONAL RESEARCH MODELS AND METHODS IN THE ENERGY SECTOR
(ORMMES'06)

6-7-8 September 2006; University of Coimbra, Portugal

Scope and objectives

Since the early days of Operational Research, the application of the models and methods of OR has revealed a very effective contribution to the successful resolution of several problems in the energy sector. Moreover, a cross-fertilization has occurred in the sense that the challenging diversity and complexity of the problems arising in the energy sector have fostered new methodological developments to tackle them in innovative ways that sometimes could be replicated in or adapted to other fields of application.

The energy sector is currently undergoing important changes. Namely, the shift towards the liberalization of the energy markets, although in each case assuming distinctive features, brings up new challenges which can be tackled in a creative manner by models and algorithms existing in the toolbag of OR. Moreover, decisions of distinct nature (policy, planning and management) to be made by different entities (utilities, regulatory bodies and governments) must take into account several conflicting objectives such as technical, socio-economic, environmental, etc. at various levels of decision making (ranging from the operational to the strategic). This diversity of problems arising in the energy sector and the corresponding diversity of perspectives to tackle them result in a vast and rich set of approaches and developments, which constitute a relevant value-added for researchers and practitioners confronted with those problems.

This Mini EURO Conference is aimed at providing an open forum in which researchers and practitioners can discuss and share their experience regarding the application of OR models and methods to tackle in a creative and effective manner the challenging problems arising in the energy sector.

As far as areas of application are concerned, original contributions in the following topics (but not limited to) are welcome: Power systems planning (power generation expansion planning, network planning, equipment location, spatial planning, reliability); Power systems operation (unit commitment, generation dispatch, network reconfiguration management, remote load control, reliability); Environmental issues (interactions between energy and the environment, dispersed and large-scale generation, integration of renewables, global warming abatement); Deregulation and liberalization (energy and power pricing, network services pricing, coordination with energy efficiency and environmental policies, network congestion prevention and management, energy and power purchase strategies, competition); Energy policies (security of supply, market transformation and energy efficiency, interactions between the energy sector and the whole economy, demand-side management); Local and regional planning (urban energy planning, load forecasting, interactions with land use planning); Technical issues (protection, voltage stability, reactive power, transmission losses).

From a methodological perspective approaches are expected from a broad spectrum of OR models and methods, such as single and multiple objective mathematical programming, decision and risk analysis, meta-heuristics and evolutionary programming, game theory, simulation, data envelopment analysis, etc.

Organizing Committee
Álvaro Gomes (Chair), Carlos Henggeler Antunes, Humberto Jorge, Luís Neves, Dulce Coelho, Carla Oliveira

Programme Committee
Carlos Henggeler Antunes (Chair, Portugal), A. Traça de Almeida (Portugal), A. Gomes Martins (Portugal), Derek Bunn (UK), Laureano F. Escudero (Spain), Andrew Philpott (New Zealand), Reinhard Madlener (Switzerland), Antonio Conejo (Spain), Yves Smeers (Belgium), Vladimiro Miranda (Portugal), Gurkan Kumbaroglu (Turkey), Thomas Bruckner (Germany), Manuel Matos (Portugal), Gerald B. Sheblé (USA), Dag Henning (Sweden), Danae Diakoulaki (Greece), Elena Georgopoulou (Greece), Pedro Linares (Spain), Luis Augusto Barroso (Brazil), Benjamin Hobbs (USA), Tom Weyman-Jones (UK), Corinne Chaton (France), Wietze Lise (The Netherlands), Roberto Aringhieri (Italy), Claudia Sagastizabal (Brazil), … Other member of the PC will be announced soon.

Submissions
Three kinds of contributions are welcome:

• Proposal for a session of 3 papers devoted to a given topic. After acceptance the promoter will be responsible for the session and will chair it.

• Proposal for a panel discussion on a relevant topic. After acceptance the promoter will be responsible for the session and will chair it.

• Free submission of contributed papers (6-8 pages A4). The accepted papers will be published in a CD-ROM Conference Proceedings.

The official language of the Conference is English.

Publication
The organizers envisage to prepare a special issue of the European Journal of Operational Research based on a thoroughly review process of papers presented at the Conference and submitted by the authors. If the number and diversity of papers justifies it, a special issue of other scientific journals, namely those more devoted to the energy area, will be also envisaged.

Venue
The conference will be hosted by the Department of Mathematics, University of Coimbra. Dating from 1290, the University of Coimbra is one of the oldest in Europe and the oldest in Portugal. Coimbra is located in the central region of Portugal, easily accessible by car (A1 highway), bus or train from Lisbon (200 Km) or Porto (130 Km) international airports.

Registration fees
Type of registration: Until June 25, 2006; After June 25, 2006: Normal (1) 275€; 325 € | Student (2) 150€; 200€.

(1) Includes the CD-ROM Proceedings and conference documentation, lunches, coffee breaks, social program, and taxes (VAT).

(2) Includes all of the above, except the banquet comprised in the social program. To qualify as a student, the delegate must present a student card.

Support from EURO may be granted to eight delegates from Eastern European countries (up to 700€ each).

Important dates
25 March 2006 - Proposals for sessions, panel discussions and contributed papers (6-8 pages)
20 May 2006 - Notification of acceptance
25 June 2006 – Revised short papers for CD-ROM Proceedings due and end of early registration

15 July 2006 – Registration deadline for guaranteeing the inclusion in the final program and proceedings volume
6-7-8 September 2006 – Conference
30 November 2006 - Full papers for special issue(s) of scientific journal(s) due

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Books

*** *** ***

Multicriteria Optimization - Second Edition

Matthias Ehrgott

About the book:
Decision makers in many areas, from industry to engineering and the social sector, face an increasing need to consider multiple, conflicting objectives in their decision processes. In many cases these real world decision problems can be formulated as multicriteria mathematical optimization models. The solution of such models requires appropriate techniques to compute so called efficient, or Pareto optimal, or compromise solutions that - unlike traditional mathematical programming methods - take the contradictory nature of the criteria into account. This book provides the necessary mathematical foundation of multicriteria optimization to solve nonlinear, linear and combinatorial problems with multiple criteria. Motivational examples illustrate the use of multicriteria optimization in practice. Numerous illustrations and exercises as well as an extensive bibliography are provided.

In the new edition a section on optimality conditions has been added. Additional scalarization techniques have been introduced and the chapters on multiobjective linear programming and multiobjective combinatorial optimization have been extended and spread over several chapters. A "Notes" section has been added to each chapter for further links to relevant literature and recent developments. The bibliography has more than doubled.

Contents

Springer
ISBN 3-540-21398-8
XIII + 323 pages
http://www.springeronline.com/sgw/cda/frontpage/0,11855,5-40109-22-29184360-0,00.html

*** *** ***

Rational Choice and Judgment
Decision Analysis for the Decider

Rex Brown

This book takes an innovative new approach to decision analysis that moves away from cumbersome, quantitative methods to give students and professionals decision-making tools that can be applied immediately. The author, who has forty years of experience in top-level decision consulting, explains how deciders actually think about their choices from the beginning and provides methods to solve problems by addressing a given choice several different ways. Simple decision-making models are integrated into the thinking process to add logical rigor. Careful account is taken of the use, the user and the organization, as well as all available data and subjective knowledge. Next, readers are given the chance to apply their new skills to resolve actual real-life problems. Beginning with basics, the text advances progressively, enabling readers to develop and then use more sophisticated decision-making skills that can be applied in both public and private enterprise, including:

- Modelling decision making under conditions of uncertainty or multiple objectives
- Risk analysis and risk assessment
- Facilitating group decision making
- Making personal life choices and political judgments
- Economic analysis of competitive and strategic decisions

The cornerstone of *Rational Choice and Judgment* is a term project presented in the final chapter where readers can pick an actual decisionmaking problem and apply their newfound tools to prepare a recommendation. A sample student report is provided in the appendix. Replete with exercises, cases studies and observations from the author's own extensive consulting experience, the book quickly

engages readers and enables them to master decision analysis by doing rather than simply reading. In familiar situations, readers learn how to handle knowledge as it unfolds in the real world. Because of its broad applicability, this is an excellent resource for any professional in any organization. It also serves as a textbook for decision-making courses in a variety of fields, including public policy, business management, and systems engineering.

Wiley Series in Systems Engineering and Management. ISBN: 0-471-20237-1 Cloth 278 pages April 2005

*** *** ***

Dear colleagues,

It was announced about publication of my book DECISION MAKING IN MULTI-CRITERIA ENVIRONMENT: A QUANTITATIVE APPROACH, Fizmatlit, Moscow, 2002 (in Russian). The second edition has appeared. Since translation by myself of this book is performing too slowly, at this moment I can offer FREE download [in PDF format] only the first two chapters of this book on my web-page

http://www.apmath.spbu.ru/en/staff/nogin/abstracts.html#p6

The presented material can give a perception on ideas, concepts, and methods of the whole book, where a theory of the relative importance of criteria has systematically developed. First of all this book is intended for operational researchers. Senior and post-graduate students, majoring in Mathematics, Economics, or Engineering may also use it.

All the best

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THE JOURNAL OF FINANCIAL DECISION MAKING

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CONTENTS

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Soft Computing for Complex Multiple Criteria Decision Making

Ignacy Kaliszewski

About this book:

There are numerous books on Multiple Criteria Decision Making. **Soft Computing for Complex Multiple Criteria Decision Making** concentrates on providing technical (meaning formal, mathematical, algorithmical) tools to make the user of Multiple Criteria Decision Making methodologies independent of bulky optimization computations. These bulky computations up to now have been a necessary, but limiting, characteristic of interactive MCDM methodologies and algorithms. This book

removes these limitations of MCDM problems by reducing a problem's computational complexity. The book systematically applies the approximate — soft — treatments to major MCDM solving methodologies. As a result, it provides a wider and more functional general framework for presenting, teaching, implementing and applying a wide range of MCDM methodologies. The book seeks to provide a stimulus for a broader development and application of MCDM methods.

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Articles Harvest

(This section is prepared by Maria João Alves and Carlos Henggeler Antunes)

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Research Reports of

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Dissertations

JOAO THOMAZ : Title : DECISION MAKING SUPPORT IN PERSONNEL'S PERFORMANCE APPRAISAL: CONTRIBUTES TO THE MILITARY DECISION-MAKING PROCESS IN PEACE TIME. PhD Thesis, Instituto Superior Técnico. Superviror: Porfessor Bana e Costa. September 2005.

ABSTRACT: The purpose of this thesis is to build up a new *management* (peace time) *military decision-making process* (M-MDMP), based on the methodologies of decision conferencing, group process consultation and multiple criteria decision analysis in a multimethodological framework by developing a real case study to conceive a new performance appraisal model for the Portuguese Army Officers. The processes used provide an answer to the multidimensional (social, technical e technological) complexity of the M-MDMP, particularly, when you have to integrate different aspects quantitative, qualitative and, also, intangible ones in the model. All the processes were developed with a multidisciplinary work group and a representative high-level group of the Portuguese Army Personnel Command and were supported by the M-MACBETH decision support system.

JENS BORKEN. Title: Environmental Indicators as an Instrument of Technology Impact Assessment – Selection, Aggregation and Multi-Criteria Assessment for Transport as Example) Full text online:
http://www.freidok.uni-freiburg.de/volltexte/1938/

Announcement:

The "Useful links" section of the group's homepage

(http://www.inescc.pt/~ewgmcda)

is being enlarged. Contributions of URL links to societies, research groups and other links of interest are welcome.

A membership directory of the European Working Group on "Multiple Criteria Decision Aiding" is available at the same site. If you would like to be listed in this directory please send us your data (see examples already in the directory).

Contact: José Figueira (figueira@fe.uc.pt) and Luís Dias (ldias@inescc.pt)

Web site for the EURO Working Group "Multicriteria Aid for Decisions"

A World Wide Web site for the EURO Working Group on "Multicriteria Aid for Decisions" is already available at the URL:

http://www.inescc.pt/~ewgmcda

This WWW site is aimed not just at making available the most relevant information contained in the Newsletter sections, but it also intends to become an online discussion forum, where other information and opinion articles could appear in order to create a more lively atmosphere within the group.

Groupe de Travail Européen "Aide Multicritère à la Décision" /
European Working Group "Multiple Criteria Decision Aiding"

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