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## Opinion Makers Section

(This section is prepared by J. Clímaco)

### ROBUSTESSE DE QUOI ET VIS-À-VIS DE QUOI MAIS AUSSI ROBUSTESSE POURQUOI EN AIDE À LA DÉCISION ?

*par*

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Le terme robuste apparaît de plus en plus souvent en aide à la décision. Même si ce qualificatif a généralement le sens de «qui résiste à l'à peu près», il recouvre pourtant des significations différentes et parfois obscures. Le recours à cette notion pour

éclairer des décisions soulève, me semble-t-il, de multiples questions. Sans chercher à être exhaustif, je voudrais ici en aborder quelques-unes.

Tout d'abord, qu'est-ce qui doit être robuste ? Corrélativement, vis-à-vis de quoi, vis-à-vis de quel à peu près cette robustesse doit-elle être appréciée ? Enfin, pourquoi cette préoccupation de robustesse a-t-elle de l'importance en aide à la décision ?

#### 1. Robustesse de quoi ?

##### a) *De quoi ?*

Mais de la solution bien sûr ! La réponse est si évidente pour la plupart des auteurs qui se préoccupent de robustesse qu'ils ne l'évoquent même pas. De quelles solutions s'agit-il ? Bien évidemment de celles qui constituent le résultat d'une procédure ou d'un algorithme auquel l'auteur s'intéresse. Dans la mesure où cette solution est celle que l'aide à la décision a pour objet de préconiser, il importe qu'elle soit robuste dans un sens qui mérite pourtant d'être précisé (ce qui soulève diverses questions, cf. § 2). Voici deux brèves citations (choisies parmi beaucoup d'autres possibles) qui illustrent ce point de vue.

«Un des souhaits souvent formulés par les décideurs vis-à-vis de la méthode multicritère qu'ils utilisent est d'avoir une idée de la robustesse du résultat. C'est la raison pour laquelle l'étude de la sensibilité des méthodes multicritères fait partie des grands axes de recherche du domaine. Cette demande traduit la volonté de savoir dans quelle mesure une variation des données due par exemple à une erreur de mesure ou d'estimation risque d'affecter le résultat donné par la méthode» (Durand et Trentesaux, 2000).

«Nous utiliserons le terme de robustesse pour caractériser la performance d'un algorithme ou plutôt d'un processus complet de construction d'un ordonnancement en présence d'aléas» (Sanlaville, 2002).

Un décideur et, plus généralement, une quelconque partie prenante dans un processus de décision attend souvent, de l'aide à la décision, autre chose qu'une

ou quelques solutions résultant de l'application d'un algorithme ou d'une procédure. Dans la mesure où l'aide à la décision ne vise pas uniquement à préconiser des solutions, n'est-il pas nécessaire de reconnaître que la réponse à la question «robustesse de quoi?» ne doit pas être restreinte aux seules solutions. Il n'est donc pas surprenant que certains auteurs se soient déjà préoccupés de robustesse dans au moins deux autres directions : robustesse de méthodes, robustesse de conclusions.

*b) Mais qu'est-ce qu'une méthode ?*

Je voudrais tenter ici de faire brièvement comprendre ce que j'entends (en accord avec d'autres auteurs, notamment Philippe Vincke, 1999a,b) par méthode.

J'appelle **méthode**  $M$  une classe bien définie de procédures, une **procédure**  $P$  étant une séquence d'instructions qui, appliquées à une instanciation (jeu de données)  $E$  d'un problème (auquel la méthode est censée s'appliquer), fournit un **résultat**  $R(P,E)$ .

Le résultat dont il est question ici consiste le plus souvent en une (éventuellement quelques) solution  $S$  admissible et remarquable du problème pour l'instanciation  $E$ . Il peut aussi inclure, et parfois même se restreindre à, ce que j'appellerai des **constats**. Ces derniers peuvent revêtir diverses formulations telles que :

- la solution admissible  $S$  possède telles propriétés ;
- aucune solution ne jouit de telles propriétés ;
- $P$  appliquée à  $E$  n'a pas permis de trouver de solution ayant telle propriété (par exemple être admissible) ;
- ...

Dire que  $M$  est une classe bien définie de procédures implique que :

- toutes les procédures concernées ont des éléments communs (concepts, structures, ...) qui les font apparaître comme appartenant à une même classe ;
- une procédure de la classe n'est définie (c'est-à-dire applicable à une instanciation  $E$ ) que si des valeurs précises et convenables ont été attribuées aux divers paramètres (données d'entrée) et, s'il y a lieu, que si la place et le rôle de certaines règles de procédure ont été fixés (exemple : rôle

d'une fonction en tant que critère d'optimisation ou contrainte).

Quiconque envisage, pour éclairer une décision, de prendre appui sur une méthode ne va-t-il pas souhaiter qu'elle soit robuste ? Mais dans quel sens ? Il y a encore là matière à question (cf. § 2).

*c) Et qu'est-ce qu'une conclusion ?*

Ici encore je vais m'efforcer d'expliquer ce que j'entends sous ce terme (toujours dans une perspective d'aide à la décision).

Etant donné un ensemble  $\hat{E}$  d'instanciations d'un problème et un ensemble  $\hat{P}$  de procédures applicables à ce problème, j'appellerai conclusion toute assertion (de nature quelconque, vraie ou fausse) qui vise à tirer parti de certaines des informations contenues dans les résultats  $R(P,E)$  relatifs à tout ou partie des couples  $(P,E)$  envisagés, c'est-à-dire tels que  $P \in \hat{P}$ ,  $E \in \hat{E}$ .

Voici à titre d'illustration quelques formes typiques de telles assertions dignes d'intérêt pour l'aide à la décision.

- i)* Pour tous les couples  $(P,E)$  d'un sous-ensemble bien défini de l'ensemble des couples envisagés,  $S$  est une solution admissible dont l'écart à l'optimum n'excède jamais tel seuil.
- ii)* Les résultats  $R(P,E)$  obtenus sur un échantillon de couples  $(P,E)$  jugé représentatif de tous ceux envisagés font apparaître des invariants qui sont les suivants....
- iii)* Les solutions admissibles remarquables mises en évidence par les résultats  $R(P,E)$  relatifs à tels sous-ensembles de couples  $(P,E)$  étudiés font apparaître des différences (voire des contradictions) jugées importantes.
- iv)* A l'exception de quelques couples  $(P,E)$  (éventuellement définis avec quelque ambiguïté), telle solution  $S$  jouit, sur l'ensemble des couples  $(P,E)$  envisagés, des propriétés suivantes....
- v)* Les objectifs ci-après ... sont inconciliables dès l'instant où l'on considère l'ensemble des couples  $(P,E)$  définis comme suit...

Ce genre de conclusions ne conduit pas nécessairement à préconiser la mise à exécution de telle solution plutôt que telle autre, le choix de telle méthode plutôt que telle autre mais plus simplement à cadrer, à jalonner, voire à restreindre, le champ des options qui s'offrent à celles ou ceux pour le compte de qui ou au nom de qui l'aide à la décision s'exerce. Ici encore, il paraît pertinent de soulever la question : que faut-il entendre par conclusions robustes ?

Qu'il s'agisse de solutions, de méthodes ou, plus généralement, de conclusions, la signification du terme «robustesse» est à la fois (comme je vais m'efforcer de le montrer) fortement subjective et, dans les formalisations que l'on peut en donner, très contingente au contexte décisionnel considéré.

## 2. Robustesse vis-à-vis de quoi ?

Quel que soit l'objet en question (solution, méthode, conclusion, ...), donner un sens au qualificatif «robuste» ne peut se faire sans expliciter les raisons et les facteurs générateurs de contingence, d'arbitraire et d'ignorance vis-à-vis desquels la robustesse est recherchée. Outre leur caractère subjectif, ces raisons, ces facteurs revêtent des formes très variées dont la présence et/ou l'importance dépend beaucoup du contexte décisionnel considéré. Leur présence émane, je crois, essentiellement de trois sources :

α) Le caractère imprécis, incertain et, plus généralement, mal connu, voire mal défini, de certaines spécificités ou grandeurs factuelles du problème.

β) Les conditions de mise à exécution de la décision qui sera arrêtée, lesquelles peuvent être influencées par ce que sera l'état de l'environnement au moment où elle sera mise à exécution si elle est ponctuelle ou par les états successifs de cet environnement si elle est séquentielle.

γ) Le caractère flou, éventuellement lacunaire, et non nécessairement stable des systèmes de valeurs (et plus particulièrement de préférences) qui sont censés prévaloir pour apprécier la faisabilité et l'intérêt relatif des diverses actions potentielles en tenant compte des conditions envisagées pour leur mise à exécution.

Pour donner sens au terme «robustesse» dans un contexte décisionnel spécifié, il importe, me semble-t-il, d'analyser ce que recèle chacune des trois sources α), β), γ) ci-dessus comme raisons et facteurs

vis-à-vis desquels on recherche la robustesse. Cet effort d'analyse est nécessaire aussi bien pour définir un formalisme adapté à une modélisation convenable du problème que pour choisir une méthode appropriée à son étude. C'est vis-à-vis de la façon dont ces trois sources justifient que soient envisagées non pas une seule instanciation du modèle élaboré mais un ensemble  $\hat{E}$  et/ou non pas une unique procédure mais une méthode bâtie sur une classe  $\hat{P}$  que la notion de robustesse acquiert un sens.

Une attitude trop critique, une recherche trop systématique des générateurs de contingence, d'arbitraire et d'ignorance dans chacune des sources α), β), γ) risquent de conduire à un foisonnement excessif d'instanciations et de procédures à envisager. En prenant bien soin, à l'opposé, d'oublier l'adage qui veut que celui qui ne sait pas qu'il ne sait pas croit qu'il sait, on peut être tenté de réduire ce foisonnement en n'envisageant qu'un nombre par trop restreint d'instanciations et de procédures. Il convient, dans chaque situation, de trouver un compromis entre ces deux tendances opposées qui tiennent compte notamment des attentes de celles et ceux pour le compte de qui et au nom de qui l'aide à la décision s'exerce. Ceci me conduit à aborder (toujours de façon un peu rapide et superficielle) une dernière question...

## 3. Robustesse pourquoi ?

Ainsi formulée, la question est très vaste et peut appeler des réponses telles que : pour que les chercheurs fassent des publications... Je vais donc la restreindre à : pour répondre à quels besoins, à quel genre de préoccupations des demandeurs d'aide à la décision.

Celles et ceux qui sont responsables d'arrêter une décision ou, plus largement, d'influencer un processus de décision n'attendent pas, en général, de l'aide à la décision qu'elle leur dicte leur conduite mais, plus simplement, qu'elle leur apporte des informations utiles pour baliser leur champ de réflexions et d'actions. Que ces informations se présentent en termes de solutions, de méthodes ou de recommandations assises sur des conclusions, elles ne leur seront véritablement utiles que si la façon dont elles sont dépendantes ou encore conditionnées par la contingence, l'arbitraire et l'ignorance que recèlent les sources α), β), γ) est prise en compte dans un cadre suffisamment large et explicite. Pour qu'il en soit ainsi, il importe donc que ces

informations exploitent non pas un résultat privilégié  $R(P,E)$  mais tous ceux envisagés à partir des ensembles  $\hat{E}$  et  $\hat{P}$  découlant de l'analyse et du formalisme dont il vient d'être question. Pour être utile (répondre à des besoins effectifs), ce mode de prise en compte revêt inévitablement des formes très variées adaptées au contexte décisionnel considéré. Sans prétendre esquisser ici une typologie, je voudrais, pour terminer, illustrer quelques unes des préoccupations clés auxquelles l'analyse de robustesse peut vouloir chercher à répondre. Je considérerai pour cela quelques situations typiques.

a) *La décision a un caractère ponctuel et exceptionnel* (elle ne s'étale ni ne se répète dans le temps)

Avec ces restrictions, considérons par exemple le cas où il s'agit de sélectionner une variante parmi un ensemble fini de possibilités pour réaliser un projet ou encore d'attribuer des valeurs numériques à diverses variables afin d'arrêter les caractéristiques structurelles d'une grande réalisation. L'attente des demandeurs d'aide à la décision peut, schématiquement, revêtir deux formes :

i) La mise en évidence d'une solution accompagnée des arguments qui conduisent à la préconiser : le plus souvent, cette solution sera mise à exécution et finalement jugée dans des conditions, dans un environnement et selon des systèmes de valeurs qui ne peuvent, au moment de l'étude, être appréhendés avec exactitude. Attendre de cette solution qu'elle soit robuste, c'est la vouloir telle qu'elle puisse, le moment venu, apparaître, autant que faire se peut, comme étant l'une des meilleures et, quelles que soient les circonstances, comme jamais très mauvaise.

Des propositions pour définir et élaborer des solutions robustes en ce sens ont été nombreuses. Je me bornerai ici à citer les travaux de Arbel et Vargas (1993), Escudero (1994), Kouvelis et Yu (1997), Malcolm et Zenios (1994), Mulvey *et al.* (1994), Rosenblatt et Lee (1987), Sengupta (1991), Yu et Yang (1998).

ii) L'élaboration de recommandations balisant le champ des décisions à considérer sur la base de conclusions robustes : ces conclusions ont pour objet (cf. § 1.c)) de mettre en évidence des décisions ou des

fragments de décision dont les avantages et inconvénients sont explicités aussi bien en fonction d'options pouvant conditionner la procédure (pondération des critères, mode de prise en compte de l'attitude face au risque, ...) que vis-à-vis d'hypothèses ou scénarios relatifs aux conditions de mise à exécution (par exemple la date) ou encore de certaines caractéristiques de l'environnement dans lequel la décision arrêtée prendra place et sera finalement jugée (nouvelles normes, nouveaux systèmes de prix, ...). Le lecteur pourra trouver des exemples précis de telles conclusions et recommandations dans Roy (1997), Roy et Bouyssou (1993).

b) *La décision a un caractère séquentiel* :  
Considérons par exemple ici le cas où la décision revêt la forme d'un plan qui s'étale dans le temps et qui, de ce fait, apparaît comme une suite de fragments de décisions. Dans ce cas, le plan peut, en général, être révisé à chaque étape afin de tenir compte de l'évolution des conditions de mise à exécution, des caractéristiques de l'environnement et, le cas échéant, des systèmes de préférences. Dans la mesure où les décisions prises au cours des premières étapes du plan sont susceptibles d'avoir un impact aussi bien sur les possibilités de décision dans les étapes ultérieures que sur les conséquences que ces futures décisions pourront avoir, la robustesse du plan (tel qu'il peut être revu à chaque étape) s'analyse en termes de flexibilité. Cet aspect de la robustesse a été étudié, de façon très approfondie, par Rosenhead et ses collaborateurs (voir notamment Gupta et Rosenhead, 1972, Rosenhead, 1989, Rosenhead *et al.*, 1972).

Ici, l'analyse de robustesse vise à mettre en évidence et à prendre en compte les possibilités d'adaptation et de réaction que la décision qui doit être arrêtée en chacune des étapes considérées préserve pour l'avenir. Quel que soit cet avenir, il s'agit d'arrêter à chaque étape des décisions qui ne rendent pas impossibles ou ne dégradent pas trop les meilleures possibilités de choix ultérieurs et minimisent le risque d'acculer le décideur à des résultats catastrophiques qui auraient pu être évités.

c) *La décision concerne l'adoption d'une méthode destinée à être utilisée de façon répétitive dans des conditions et environnements (lieux, moments, ...) susceptibles de varier :*

Considérons ici le cas fréquent où la méthode fait intervenir une classe de procédures définies chacune par un jeu de valeurs précises attribuées à divers paramètres (certains d'entre eux pouvant être des paramètres techniques sans signification concrète bien claire) ainsi que par la façon dont la place et/ou le rôle de certaines règles de procédures ont été fixés (notamment rôle des critères et des contraintes). Les méthodes auxquelles je songe ici ne se réduisent pas aux seules méthodes multicritères usuelles dont l'objet est d'opérer une sélection, un tri ou un rangement sur un ensemble d'actions. Elles concernent également celles qui visent à déterminer, de façon périodique, certaines conditions de fabrication ou de réapprovisionnement (voir par exemple Jeunet, 1997, Jeunet et Jonard, 2000, Vallin, 1999), celles dont l'objet est d'élaborer et de comparer des classifications (voir par exemple Barthélemy et Leclerc, 1995, Guénoche, 1993, Hansen et Jaumard, 1997) ou encore celles qui sont utilisées pour ajuster au mieux un modèle à visée descriptive sur la base d'observations multiples et répétées (voir par exemple Chang et Yeh, 2002, Grigoroudis et Siskos, 2001, Siskos et Grigoroudis, 2001).

Il importe ici que, dans la mesure où le choix des valeurs attribuées aux différents paramètres de même que la place et le rôle dévolu à certaines règles de procédures recèlent une place d'arbitraire, la variabilité des résultats auxquels la méthode conduit selon la procédure adoptée soit prise en compte. Pour que la méthode soit dite robuste, il convient donc que cette variabilité ne soit pas trop importante, autrement dit que les résultats ne soient pas trop différents comme ce peut être le cas avec des procédures d'optimisation qui autorisent la présence de solutions très contrastées dans un proche voisinage de l'optimum (voir notamment Beuthe et Scannella, 2001). Il importe surtout que ces résultats ne soient pas contradictoires (cf. Vincke, 1999a,b).

Pour conclure, j'aimerais attirer l'attention sur la grande diversité des préoccupations qui peuvent se cacher derrière le mot robustesse. Afin d'en mieux comprendre la polysémie, ne faudrait-il pas chercher à typer les principales situations contextuelles à partir notamment des distinctions suivantes :

- les données introduites font ou ne font pas intervenir l'état de l'environnement au-delà d'un très court terme ;
- la mise à exécution de la décision est appelée à être jugée dans un très court terme ou, au contraire, seulement à moyen ou long terme ;
- la décision implique une mise à exécution immédiate, différée ou progressive.

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## Forum

### Robustness Analysis

by

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Robustness Analysis is a way of supporting decision making when there is radical uncertainty about the future. It addresses the seeming paradox – how can we be rational in taking decisions today if the most important fact that we know about future conditions is that they are unknowable? It resolves the paradox by assessing initial decisions in terms of the attractive future options that they keep open.

While writing this article an academic colleague on another continent wrote proposing to purchase an air ticket to London for a project meeting scheduled for the summer of 2003 – ie 1 year ahead. The reason: that his local currency (in which the project funds are kept) is inflating fast, so that the ticket will cost much more if purchased later. This can stand in

as a simplified example of the dilemmas that life presents us with. Should he purchase an inflexible ticket now? Undoubtedly the cheapest option, but also the one with most exposure to uncertainty. Should he buy now, but choose a ticket with some form of flexibility for subsequent change of flight? Should he delay, and buy an inflexible ticket at a later time when our project uncertainties are less, but when the price will be higher.

This decision needs to be taken *now*. Not taking a decision is also a decision, the decision not to purchase. But consider the uncertainties. The project may move faster or slower than expected, rendering the planned August meeting untimely. An internal dispute may undermine the project, or the sponsors may pull the plug. Either of us may be subject to illness, or family demands, or to competing time priorities for those particular weeks from other equally valid commitments. And we do not know how fast or slow the future rate of inflation will be.

To resolve this particular problem will not, I am sure, require a massive analytical apparatus. But it does illustrate, in the small, the uncertainty-related issues that can bedevil a wide range of decisions – decisions confronted by individuals, businesses, public agencies, voluntary associations, governments. Many of *these* decisions are of an order of complexity that does merit serious analytic attention.

The example also points up the organising principle that most sensible people would use, intuitively, when confronted by such dilemmas: namely, to explore the future options for action that are left open by the alternative choices available to them now. What is curious is that OR/MS has almost entirely neglected this concept of flexibility, remaining largely fixated on optimisation or methods derived from it.

Flexibility is not the *only* criterion that is relevant, but it should be among those that are employed. Employing a number of criteria without a predefined rule for combining them may seem sloppy and incomplete to those who think that the task of analysis is to decide the issue. If, however, we adopt the more modest and practicable aim of providing those who have the problem with structured information relevant to their decision, this difficulty evaporates. And indeed it makes especial sense that this information should, as far as possible, make intuitive sense to those who must use it.

In this article I will first argue for the wide prevalence of uncertainty in strategic decision making situations (and hence the potential relevance

of robustness). I will then introduce the basic principles of robustness, how to specify a problem for robustness analysis, and the calculation of the robustness score. A commentary suggests how robustness can be appropriately applied, and there is an indication of the range of practical applications. Finally, robustness analysis is distinguished from a number of other nearby methods.

### Prevalence of uncertainty

How widespread are the decision situations for which uncertainty is crucial? I am tempted to wonder whether that question even needs asking in a world so evidently turbulent in its arrangements. I advance in evidence (just a sample, and all at the macro level) the collapse of the Soviet Union (who predicted it?), the dot.com bubble, the Twin Towers, the 2002 bear market. Clearly there are many decision situations in which uncertainty does *not* play a key role. This is particularly true of repetitive operational decisions. For these the rate of change of underlying conditions is usually small compared with the cycle-time of activities, and inherent variability can be accommodated by probabilistic analysis. However these saving graces are not usually available in the case of non-routine, more strategic decision situations.

Businesses are subject to turbulence in the market place, to variations in regulatory regimes, to new technologies threatening established markets, to the unpredictable results of R&D or of mineral resource exploration. Public service providers are vulnerable to the vagaries of governmental funding, to changing expectations of their clientele, to the organisational impacts of new technologies. Nation states may experience violent threats of novel kinds or sources, the impact of decisions by transnational corporations, the erosion of sovereignty to supranational organisations, forceful demands for regional autonomy. Grassroots organisations are hit by the backwash of the decisions of all these more powerful actors. And so on. This is not an attempt at an exhaustive categorisation of the ways in which uncertainty permeates our decision environment. Rather it is an attempt to convince you that uncertainty is significant in particular in the more formative decisions that social organisations confront.

### Principles of robustness analysis

Robustness analysis is applicable when

i) uncertainty is a factor that obstructs confident decision – which has been discussed above; and  
ii) decisions must be or can be staged. - that is, the commitments made at the first point of decision do not necessarily define completely the future state of the system. There will be one or more future opportunities to modify or further define it.

The first element ensures that uncertainty matters. The second ensures that there is something that we can do about it.

A simple statement of the robustness criterion is that, other things being equal, an initial commitment should be preferred if the proportion of desirable future situations that can still be reached once that decision has been implemented is high. Put still more simply, it is a good thing to keep your options open.

That is the intuitively sensible proposition that underlies robustness analysis. Further specification is needed however to transform it into a systematic methodology that can be applied with some consistency. What counts as a desirable future situation? How do we count them? How do we identify which of them are kept open?

### Specifying a problem situation for robustness analysis

The first set of elements which must be specified are

- a set of alternative initial commitments to be considered
- (normally) a set of 'futures' representative of possible environments of the system
- a set of relevant possible configurations of the system which the decisions will modify.

A *commitment* may be an allocation of resource in a particular decision domain, or it may comprise an integrated package of such allocations. Commitments may be those which appear logically possible, or those proposed by stakeholders with some influence over decision making. The *futures*, similarly, may be generated by systematic or more clearly subjective processes, or a mixture of the two. The *configurations* may be relevant in the sense that they are plausible extensions of the directions set by particular initial commitments; or that they can be expected to perform well in one or more of the identified futures; or that they have been proposed as a longer term goal by partisans within the management process.

It is evident that these three elements can be inter-dependent. Configurations may be generated by thinking about futures; the extrapolation of

commitments may lead to possible configurations; and so on. Specification is often best achieved in interactive mode with those who are faced with the need to decide. That is, the analysis is carried out by and under the control of the relevant management group, with the assistance of one or more consultants. This and other features place robustness analysis within the family of Problem Structuring Methods (see Rosenhead and Mingers, 2001).

The three elements above need to be complemented by information of the following types:

- q assessments of the compatibility of each commitment-configuration pair
- q evaluation of the performance of each configuration in each future.

The former, a zero-one assessment, is needed in order to examine the extent to which options are maintained by particular commitments. The latter is also carried out on a zero-one basis. Is the predicted performance acceptable or not?

In cases where configurations consist, in effect, of an aggregation of the available commitments, compatibility can be directly established. In other cases there will be a degree of subjectivity in the assessment. Likewise, for performance evaluation, it may sometimes be possible to agree a set of multi-dimensional performance measures each with their acceptance thresholds, and to build a model to predict the values of the measures for any combination of configuration and future. In such cases the performance evaluation can be automated. Otherwise it may require discussion among those with relevant experiential knowledge to establish which performances are 'good enough'.

If these two stages need to rely extensively on elicitation rather than on computation, there is a clear danger of combinatorial escalation rendering the process infeasible. Groups are not good at rapid and repeated but thoughtful evaluations of the kind that are required. There is therefore a strong argument for keeping the dimensions of the problem formulation as small as possible; and it may be necessary for the group to delegate the first attempt at one or both of these stages to one of its members, working with a consultant.

### Analysing for robustness

Once these processes of elicitation and evaluation have been carried out, it is possible to gain a picture of the pattern of flexibility which any commitment offers, interpreting flexibility to be the future opportunity to take decisions towards desired goals. The robustness of a commitment is the ratio of the



number of acceptably performing configurations with which that commitment is compatible, to the total number of acceptably performing configurations.

Clearly this limits robustness scores to the range (0, 1). A robustness score of zero indicates that no acceptable options are kept open, while a robustness of unity means that they all are.

Each commitment now has a robustness score for each future, since a configuration's performance will vary across future contexts. Commitments can thus be assessed for the spread of flexibility they offer both within and across futures. This process will rarely identify a dominant commitment, but it will usually eliminate non-contenders, and focus discussion on just a small number of relatively attractive alternatives. It may also concentrate attention on those futures which are most crucial to the choice between these alternatives – raising the question of whether the decision-making group can exert selective influence on what future does (or does not) materialise.

#### Some comments

It may be noted that this procedure depends on identifying alternative futures which the system under consideration may confront. It is a fair criticism that since the future is infinitely devious, we cannot know that any of our identified futures will capture the key aspects of the future that actually happens. Evidently the elicitation process should endeavour to reduce this risk, for example by selecting a broad range of contrasting possible future environments. However the approach does not, cannot, require that this eventual future is actually identified with certainty.

Consider an initial commitment which is the first step to an 'optimum' solution in a single predicted future. It will maintain flexibility at best only by accident. By contrast, a robust commitment will maintain flexibility over a wide range of conceivable futures. The value of this in a future which may be outside the range of those considered cannot be rigorously demonstrated. However it is at least highly plausible that this diversity of options is more likely to include routes to one or more future configurations that will perform acceptably in the eventual future context.

In any case the principle advantage of robustness analysis lies more in its process than in its product. It does not offer a simple decision rule – "calculate the highest robustness score, and select the commitment that provides it". Rather it provides a language in which the logic of option maintenance can be worked

through. Furthermore this language is accessible also to those without developed quantitative skills. It therefore opens up for systematic dialogue with and between those who must accept responsibility for any decision, an uncertainty-based discourse that optimisation-oriented methods do not provoke.

#### Applications of robustness

Practical uses of robustness analysis have included

- q brewery location
- q chemical plant expansion
- q hospital location
- q regional health planning
- q oil field development
- q personal educational and career planning

References to most of these will be found in Rosenhead (2001a, 2001b).

#### Relationship to other approaches

It may be helpful to compare and contrast this notion of robustness analysis with other related approaches.

#### *Statistical robustness*

The term 'robustness' is used in statistics to refer to a desirable characteristic of statistical procedures. One says that a procedure is robust against some departure from the assumptions of the model when the procedure continues to work well even when, to a greater or lesser extent, the assumptions do not hold. Such assumptions, often adopted for ease of computation, might be that an underlying distribution is Normal, or that the observations have constant variance. In the case of statistical hypothesis testing, which approaches most nearly the decision-focused approach adopted in this article, a robust test avoids the difficulty of a decision (here between two hypotheses) resting in too unstable a fashion on a particular assumption.

Bayesians give the term a rather more specific meaning. A Bayesian application is robust if the posterior distribution for an unknown parameter is not unduly affected by the choice either of the prior distribution or of the form of model taken to be generating the data.

In either approach uncertainty, though limited to knowledge about whether the specific assumptions do in fact hold, clearly lies behind the need for this concept. It does not of course purport to address other types of uncertainty, or sequentiality of decisions.

### *Sensitivity analysis*

Sensitivity analysis is a systematic procedure used to explore how an optimal solution responds to changes in inputs – which are typically either known values which might vary in the future, or parameters whose values are open to question. Thus the analysis is based round a prior assumption that optimisation is centre stage, with uncertainty viewed as a potentially disruptive factor. The analysis aims at discovering how sensitive the 'optimal' solution is to changes in crucial factors. An insensitive solution is an advantage and, to add to linguistic confusion, is sometimes termed 'robust'.

### *Robustness analysis (after Roy)*

This use of the term 'robustness analysis' entered the literature some 13 years after it was first introduced in the sense employed in this article. As with sensitivity analysis this approach seeks to incorporate the real world experience of uncertainty into the understanding of mathematically derived results. It differs from sensitivity analysis in two ways. The first difference is that it aims to handle not only optimisation but a range of other computational results – eg that a certain solution is feasible, or that it is near optimal. The second is that its perspective is virtually the mirror image of that of sensitivity analysis. This is to identify the domain of points in the solution space for which a particular result continues to hold. Uncertainty, however, remains attached to parameter values, rather than to the swathe of intangible uncertainties that may be resistant to credible quantification. And as with sensitivity analysis, the idea of exploiting sequentiality to achieve flexibility is absent.

The purpose of this comparison is not to criticise these formulations, but by distinguishing robustness analysis (in the sense of this article) from them to clarify its characteristics. Each of them performs functions which robustness analysis does not attempt, and vice versa.

### In conclusion

For a more extended introduction to robustness analysis, see Rosenhead (2001a, 2001b). Fuller references are available there.

This summary has been couched largely in terms of the practicalities of decision-making. A more polemical case, but no less legitimate, could be advanced in the language of sustainable development. To quote Russ Ackoff (1988)

"The freedom to decide, to make choices, is for me the most important freedom people of any age

can have. But this freedom is empty without alternatives from which to choose. To deprive future generations of options is a deprivation of their rights."

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## **MCDA Research Groups**

### **AMEVA Group (Valencia, Spain)**

The group AMEVA (Analysis of Methodology of Evaluation) was *constituted in 2001* with members of the Engineering Project Department of Polytechnic University of Valencia Spain.

#### Members of the group:

- Dr. Gómez-Senent Martínez, Eliseo
- Dr. Aragonés Beltrán, Pablo
- Dra. García Melón, Mónica
- Dra. González Cruz, M<sup>a</sup> Carmen
- Dr. Cloquell Ballester, Vicente

Dra. Santamarina, Cristina  
Ph.D, Amendola, Luis José  
Prof. Sánchez Romero, Miguel Ángel  
Prof. Peris Blanes, Jordi  
Prof. Monterde Díaz, Rafael  
Prof. Cloquell Ballester, Víctor  
Prof. Pastor Ferrando, Juan Pascual

The objective of the group is to investigate and contribute with knowledge on the theoretical and practice application of the Discrete Multicriteria Methods on the field of the Engineering Projects (Engineering of Design and Management of Projects).

From the study of the techniques of multicriteria decision and their application in projects, Dr. Gómez-Senent developed in 1991 the algorithm PRES to help on the multicriteria decision in the area of Engineering Projects of Polytechnic University of Valencia Spain.

This method was investigated depth by Dr. Aragonés, as consequence of his doctoral thesis, presenting the Metodology PRES II Multiexperto. Using the original method but enlarging the results allowing to integrate in a systematic way the process of decision, and the opinion of different experts in the area.

At the same time doctors Cloquell and Santamarina carry out an investigation of technical evaluation multicriteria based on linguistic focuses that culminates when Cloquell presents a doctoral thesis developing an evaluation of geographical localization of the economic activities, applying MCDM.

Dra. González incorporates to the group due to the parallelism of her thesis work in the analysis of factors for projects of industrial plants, that incorporates the application of the AHP in this study. In the same way, the studies on the process of resolution of problems in engineering carried out by Sánchez Romero contributes with a complementary vision of the decision and the evaluation, that are important elements of the proyectual process.

On the other hand, Dra. García Melón integrates the group to contribute with her previous investigating experience in evaluation of products design.

Also, previous experience of professors Pastor, Monterde and Peris open three specific investigation lines (construction projects, cooperation and space) in which they intend to apply the conceptual and theoretical focuses from the MCDM to their thesis in course.

Recently professor Amendola, Luis Ph.D in Industrial Engineering Management for the Pacific Western University, USA has incorporated to contribute his wide professional experience in this area and working with the tutorage of Dr. Aragonés in the application of MCDM in Project Management.

In this way is how a highly cohesive investigation team have arisen with common interests and shared objectives that is characterized by the great dynamism of its members.

### **Scientific production of the group (publications, patents, reports, etc.):**

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#### **Participation in investigation contracts.**

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## **Software**

### **A propos du logiciel « MACBETH for MCDA »**

C.A. Bana e Costa , J.M. De Corte , J.C. Vansnick

Le logiciel MACBETH for MCDA est destiné à faciliter une étude d'aide multicritère à la décision.

Il contient un module de représentation, sous la forme d'un arbre de points de vue, de l'ensemble des aspects dont il convient de tenir compte dans l'étude envisagée. Parmi ces points de vue, ceux avec lesquels on désire travailler au niveau de l'évaluation

( points de vue fondamentaux ) peuvent être librement déterminés.

Le logiciel est adapté à la saisie d'information préférentielle (relative à chaque point de vue fondamental ou à l' « importance » relative de ces points de vue) obtenue au départ d'un questionnaire de type MACBETH. Celui-ci demande une information verbale quant à la différence d'attractivité entre deux éléments sur base de sept catégories sémantiques : pas de différence d'attractivité, différence d'attractivité très faible, faible , modérée, forte, très forte ou extrême. Notons que ceci est à l'origine du nom MACBETH : Measuring Attractiveness by a Categorical Based Evaluation TecHnique. Dans la dernière version du logiciel, on admet que la réponse puisse être une catégorie particulière ou un ensemble de catégories consécutives (possibilité d'hésitation) ou même « je ne sais pas ».

Chaque fois que l'on obtient une information de type MACBETH à propos d'une nouvelle paire d'éléments, le logiciel teste, sur base de conditions de mesurage, la consistance (la compatibilité) de l'ensemble des réponses disponibles avec une information cardinale.

En cas d'inconsistance, le logiciel permet de déterminer l'origine de cette inconsistance (détermination des systèmes élémentaires incompatibles) et dès lors d'entamer une discussion avec le(s) décideurs (phase d'apprentissage). Des suggestions de modification des jugements initiaux permettant d'atteindre la consistance peuvent également être fournies par le logiciel.

Lorsque l'on dispose de réponses à la fois consistantes et permettant de ranger, par ordre d'attractivité, tous les éléments de l'ensemble considéré, le logiciel peut fournir une représentation numérique de l'information disponible ( échelle MACBETH ). Il est important de signaler que l'échelle MACBETH est obtenue, non pas à l'aide d'une règle mathématique arbitraire, mais bien sur base de conditions de mesurage qui garantissent le respect de l'information disponible. Ainsi par exemple, si la différence d'attractivité entre x et y est forte et que la différence d'attractivité entre z et w est faible, ces conditions imposent que  $(\text{note de } x) - (\text{note de } y) > (\text{note de } z) - (\text{note de } w)$ .

L'échelle MACBETH proposée par le logiciel n'est pas une échelle d'intervalle car l'information qu'elle vise à représenter numériquement, bien que plus riche qu'une information ordinale, est plus pauvre qu'une information cardinale. Elle ne constitue qu'une base de discussion en vue de

faciliter l'accès au cardinal, mais une base particulièrement intéressante puisque respectant parfaitement une information de type MACBETH ( information comprise entre l'ordinal et le cardinal ).

Le logiciel propose une représentation graphique de l'échelle MACBETH et toute une série d'informations complémentaires et d'outils particulièrement conviviaux permettant de faciliter la transformation progressive de l'échelle MACBETH en une échelle cardinale.

MACBETH for MCDA dispose également d'un module d'agrégation permettant de rassembler les échelles cardinales obtenues relativement à chaque point de vue fondamental et à l'« importance » de ces points de vue en une échelle d'attractivité globale. Cette échelle est obtenue en utilisant le modèle d'agrégation additif. Une représentation graphique, sous forme de thermomètre, de cette échelle globale est aussi proposée. Toute modification d'une quelconque des échelles cardinales est instantanément répercutée sur cette échelle globale ce qui permet de faire une première analyse de sensibilité des résultats obtenus.

Un module graphique ( offrant de multiples possibilités ) d'analyse de sensibilité relative aux « poids » est aussi disponible dans la dernière version du logiciel.

Enfin le logiciel dispose aussi, dans sa dernière version, d'un module d'analyse de robustesse particulièrement développé. Outre la possibilité de tester si une information ordinale ou de type MACBETH est suffisante pour tirer des conclusions au niveau des comparaisons globales, il permet maintenant d'observer l'effet, sur ces comparaisons, de l'introduction d'une marge de précision sur une ou plusieurs échelles cardinales. De plus, les valeurs des différences "minimales" et "maximales" que peuvent atteindre les cotes globales de deux actions, compte tenu de l'information sélectionnée, peuvent être affichées à tout instant. Cette analyse a pour support un tableau des comparaisons globales des actions qui se présente comme suit :

The screenshot shows a software window titled "Comparaisons globales". It contains a comparison matrix with rows labeled 'a' through 'e' and columns labeled '1' through '5'. The cells contain symbols representing comparisons: '+' for 'greater than', '-' for 'less than', '=' for 'equal to', and '?' for 'unknown'. Below the matrix are two control panels. The left panel has tabs for 'Macbeth', 'Sensibilité', and 'Robustesse', with 'Macbeth' selected. The right panel has tabs for 'Sensibilité' and 'Robustesse', with 'Sensibilité' selected. Both panels contain various input fields and checkboxes for adjusting parameters.

Vous pouvez télécharger une version complète (avec fonction d'enregistrement limitée) à partir du site suivant :

<http://www.umh.ac.be/~smq>

Tout renseignement complémentaire peut être obtenu à l'adresse suivante :

[Jean-Marie.DeCorte@umh.ac.be](mailto:Jean-Marie.DeCorte@umh.ac.be)

## Summer School on MCDM 2003 (MONTREAL, QUEBEC, CANADA)

The eight International Summer School on Multicriteria Decision Aid will be held at GERAD, Montreal, Québec, Canada, 22 May - 6 June 2003. Besides the introduction to theoretical subjects, a working group case study approach and special conferences will emphasize the issue of "Sustainable resources management and concertation: processes and tools".

GERAD (Group for Research in Decision Analysis) is A Joint Research Center in Operations Research, created in 1979, gathering members of École des Hautes Études Commerciales, École Polytechnique, McGill University and Université du Québec à Montréal. GERAD and its partners will welcome about 40 to 60 registered people in Montreal for this Summer School. The full program, registration information and other useful information will be available on the GERAD web site during December 2002 or earlier if possible ([www.gerad.ca](http://www.gerad.ca)).

The aim of the school is to give a state-of-the-art presentation of multiple criteria methods, applications and software. The course is addressed to new researchers and to staff members in Government and Industry involved in planning and decision making processes. The school is also an excellent opportunity for managers, consultants and other professionals with no previous experience in MCDA, to get acquainted with the potential of these methodologies.

The sixty hours course will be given in the new building of École des Hautes Études Commerciales, offering complete facilities for teachers and students. The courses will be given by about eight different teachers and various guest speakers having an



international reputation in their field. Four themes areas will be covered: general theory, methods and computer models, applications and new opportunities. In two weeks the program will cover 32 hours of taught courses devoted to fundamental aspects of MCDA, 16 hours of active participation in a working group (case study and questions/answers), and 12 hours of conference on specific subjects.

A grant program will be announced to increase outstanding student participation.

Contact: Jean-Philippe Waaub, GERAD  
(waaub.jp@uqam.ca).



## Persons and Facts

L'Université de Fribourg (Faculté des Sciences Economiques et Sociales), en Suisse, a décidé de proposer la nomination en qualité de Docteur Honoris Causa à notre collègue et ami Jean-Pierre Brans. La session solennelle aura lieu à Fribourg le 15 novembre 2002.

L'université de Technologie de Poznan (Pologne) a remis le diplôme de Docteur Honoris Causa à notre collègue et ami Edmundas Kazimieras Zavadskas. La cérémonie a eu lieu le Lundi 23 janvier 2002. Note collègue Edmundas Kazimieras Zavadskas est le recteur de l'Université de Technologie de Vilnius (Lituanie) (Vilnius Gediminas Technical University).

EURO is organizing a thesaurus of OR researchers. There exists a page on the topic "Multi-criteria decision analysis", where many members of our working group are listed. ([http://www.euro-online.org/thesaurus2000/topic\\_info.php?topicID=4000](http://www.euro-online.org/thesaurus2000/topic_info.php?topicID=4000))

Our web site (<http://www.inescc.pt/~ewgmcda>) has been renewed to improve its appearance and organization. It is one of the most popular sites on the subject, which appears in the top 10 results of search engines such as Altavista or Google, when the word "multicriteria" is used as a single search key.

The first electronic newsletter of the EURO Working Group PROMETHEUS on Ethics in Operational Research is ready. The Newsletter will be issued twice a year (January and August) and will be send by e-mail (see pdf-attachment) and/or post mail (on demand) to members and interested people and will be available at the EWG web site as well ([www.prometheus.vub.ac.be](http://www.prometheus.vub.ac.be)).



## About the 56<sup>th</sup> Meeting

by

**José Figueira, Carlos Henggeler Antunes  
and João Clímaco**

Les 56<sup>e</sup> Journées du Groupe de Travail Européen «Aide Multicritère à la Décision» se sont déroulées à Coimbra du 3 au 5 octobre 2002 dans une ambiance très fraternelle comme il est fréquent dans les réunions de ce groupe depuis déjà 28 années consécutives sans aucune interruption, ce qui montre bien l'esprit actif du groupe. Il s'agit donc du groupe le plus ancien d'Europe en recherche opérationnelle, fondé en 1975 par Bernard Roy lors du premier congrès de recherche opérationnelle, EURO I, qui a eu lieu à Bruxelles et qui a été organisé par Jean-Pierre Brans.

Lors de chaque réunion, on privilégie un thème particulier dans le domaine du multicritère ; «l'économie du bien-être» a été le thème choisi pour ces journées. Une séance plénière a été consacrée à ce sujet. Le nombre de communications et de papiers soumis à discussion a été de 43. Les journées ont accueilli 74 participants venant de 15 pays différents : Belgique – 9 ; Canada – 4 ; Estonie – 1 ; Finlande – 3 ; France – 4 ; Allemagne – 3 ; Grèce – 7 ; Ireland – 1 ; Italie – 4 ; Lituanie – 1 ; Portugal – 28 ; Russie – 2 ; Espagne – 4 ; Suisse – 2 ; Grande-Bretagne – 1.

Le programme social a été fort chargé : une réception à la Mairie de Coimbra par l'adjoint au Maire pour la culture le jeudi soir, le banquet au Palais de S. Marcos le vendredi soir et la visite au Palais de Buçaco et aux Caves de Porto le samedi toute la journée. Le vendredi soir, après le banquet, un groupe de Fado de Coimbra (chanson des étudiants de l'Université de Coimbra), a joué pendant plus de 40 minutes pour une audience de plus de 50 personnes. Pendant la journée du samedi et avant de visiter les Caves du vin de Porto, Real Companhia Velha, les plus anciennes du Portugal, nous sommes allés à Mealhada pour déguster le célèbre plat typique de cette région, « le cochon de lait ».



**Program/Programme**

**Thursday, October 3                      jeudi 3 octobre**

- 13.15-14.00    Welcome – Buffet / Accueil – Buffet  
14.00-14.30    **Opening Session / Session d'ouverture**  
14.30-15.30    MUNDA, G.: "Social multi-criteria evaluation"

**SESSION -1-  
Theory and Methodology I  
Chairman/Président: P. Salminen**

- 15.30-16.00    CARDOSO, D.; FREIRE DE SOUSA, J.: "A partial order on the set of solutions of a multiattribute ranking problem"  
16.00-16.30    PETROVSKY, A.: "Multisets as a model for multi-attribute objects"

**Papers submitted for discussion/Papiers soumis à discussion**

- ü CLÍMACO, J.: "A critical reflection on optimal decision"
- ü DE SMET, Y.; KUNSCH, P.; SPRINGAEL, J.: "Multicritère-Statistique: base théorique et application"
- ü DOUMPOS, M.; ZOPOUNIDIS, C.: "An outranking relation approach for classification problems based on pairwise comparisons"
- ü HABENICHT, W.: "Identifying the efficient set of an integer linear vector optimization problem using enumerative cuts"
- ü LOURENÇO, R.; COSTA, J. P.: "The LinearTri software: classifying solutions in multiple objective linear integer programming problem"
- ü PEREIRA, F.; FIGUEIRA, J.; MOUSSEAU, V.: "Single and multiple criteria combinatorial partition models and algorithms"

16.30-17.00    Coffee break / Pause café

**SESSION -2-**

**Theory and Methodology II  
Chairman/Président: D. Diakoulaki**

- 17.00-17.45    BRANS, J.-P.: "La gestion du futur: le respect, le multicritère, le bonheur"  
17.45-18.15    CHOO, E.; WEDLEY, W.: "Comparing additive and multiplicative aggregation rules in MCDM"  
18.15-18.45    FLORENTZOU, F.: "Le structuralisme constructivisme dans l'aide à la décision"

**Papers submitted for discussion/Papiers soumis à discussion**

- ü AKHARRAZ, A.; MONTMAIN, J.; MAURIS, G.: "Vers un système d'argumentation en aide multicritère à la décision basé sur un système de gestion de connaissances collectives"
- ü BOGGIA, A.: "Fuzzy MCDA (software presentation)"
- ü GOMES DA SILVA, C.; FIGUEIRA, J.; CLÍMACO, J.: "An interactive decision support tool dedicated to the bi-criteria {0,1}-knapsack problem"
- ü GOUVEIA, M. C.; FIGUEIRA J.: "A study on the number of non-dominated solutions for the bicriteria network flow model"
- ü MARTEL, J. M.; CHABCHOUB H.: "Une procédure d'exploitation de relations binaires valuées dans le cadre de la problématique du rangement"
- ü MOUSSET, C.: "Characterisation of non complete families of relations"
- ü PEREIRA, I.; FIGUEIRA, J.: "Bi-criteria spanning tree: algorithms and computational study"
- ü SCARELLI, A.: "ELECTRE III model and stochastic dominance"
- ü VAARMANN, O.: "Some iterative methods for decomposition-coordination problems"

20.00            Reception at the Town Hall /  
Reception à la Mairie de Coimbra

Friday October 4      Vendredi 4 octobre

**SESSION -3-**

**Economics and Management**

**Chairman/Président: M. C. Escribano Rodenas**

- 9.00-9.45      CHEVALIER, A.; KUNSCH, P.;  
GUPTA, J.: "Portfolio performance  
and ethical criteria"
- 9.45-10.15    FREIRE, F.; MALÇA, J.; ROSAKIS,  
S.: "Life cycle optimization within a  
partial equilibrium economic model  
for the estimation of welfare in the  
biofuel production system"
- 10.15-10.45   PAPADIMITRIOU,                    I.;  
HANTJIKONSTANTINO,            G.:  
"Grèce et Portugal: en voie de la  
convergence européenne"

**Papers submitted for discussion/Papiers soumis à discussion**

- ü      CHEVALIER, A.; KUNSCH, P.:  
"Desinvestment, law principles and  
manager behaviour"
- ü      GUPTA, J.; CHEVALIER, A.:  
"Investment decisions of venture  
capital firms in the emerging  
markets: a multicriteria approach"
- 10.45-11.15    Coffee break / Pause café

**SESSION -4-**

**Risk and Uncertainty**

**Chairman/Président: W. Habenicht**

- 11.15-11.45    LAHDELMA, R.; SALMINEN, P.:  
"Modelling dependent uncertainties  
in stochastic multicriteria  
acceptability analysis"
- 11.45-12.15    RASTEIRO, R.; ANJO, A.B.:  
"Multi-criteria theory to determine  
optimal paths in probabilistic  
networks"
- 12.15-12.45    MATOS, M.: "Eliciting and  
aggregating preferences with fuzzy  
inference systems"

**Papers submitted for discussion/Papiers soumis à discussion**

- ü      HITES, R.: "The aggregation of  
preferences method for solving  
certain combinatorial problems with  
uncertainty"

- ü      ESCRIBANO RODENAS, M. C.;  
FERNANDEZ BARBERIS, G. M.;  
GARCIA CENTENO, M. C.: "The  
robustness concept applied to  
different models of evaluation and  
selection financial investment  
alternatives"

12.45-14.15    Lunch / Déjeuner

**SESSION -5-**

**Applications I**

**Chairman/Président: J.-M. Martel**

- 14.15-14.45    Working Group matters and next  
meetings/ La vie du groupe et  
prochaines réunions
- 14.45-15.30    LARICHEV, O.; KOCHIN, D.;  
USTINOVICIUS, L.: "Method for  
analysis of building reconstruction  
projects"
- 15.30-16.00    GRIGOURIDIS, E.; POLITIS, Y.;  
SPYRIDAKI, O.; SISKOS, Y.:  
"Modelling importance preferences  
in customer satisfaction surveys"
- 16.00-16.30    BANA E COSTA, C.; BARROSO,  
L.; SOARES, J.: "Qualitative  
modelling of credit scoring: a case  
study in banking"

**Papers submitted for discussion/Papiers soumis à discussion**

- ü      FERNANDEZ BARBERIS, G. M.;  
ESCRIBANO RODENAS, M. C.;  
GARCIA CENTENO, M. C.:  
"Comparative analysis between  
ELECTRE Is and PROMETHEE  
methods in the evaluation and the  
selection of financial investment  
alternatives"
- ü      MATSATSINIS, N. "CCAS: an  
intelligent decision support system  
for credit card assessment"
- 16.30-17.00    Coffee break / Pause café

**SESSION -6-**

**Applications II**

**Chairman/Président: D. Vanderpooten**

- 17.00-17.30    COLSON, G.; GOFFIN, B.:  
"Multiple criteria risk analysis: a case  
study of risk mapping."

- 17.30-18.00 VILELA, S.: "Decision support system (DSS) for the selection of sites for wind energy facilities"
- 18.00-18.30 DIAKOULAKI, D.; GLYKOGIANI, A.; MAVROTAS, G.: "Developing a multicriteria approach for classifying countries with respect to sustainability indicators"
- 18.30-19.00 CROSTON, J.: "Local community action for traffic calming: a retrospective analysis nine years after implementation"

#### Papers submitted for discussion/Papiers soumis à discussion

- Ü HONTOU, V.; DIAKOULAKI, D.: "Towards a multicriteria evaluation of environmental integration strategies for the industrial sector"
- Ü REICHELT, B.; PELDSCHUS, F.: "Multicriterial decision support in facility management"
- Ü URLI, B.; URLI, D.; OUELLET, F.: "Classification multicritère des sites routiers en terme de dangerosité infrastructurelle"
- 20.30 Dinner at S. Marcos Palace / Dîner au Palais de S. Marcos

## The Second Young MCDA Meeting

The YMCDA2 (the second MCDA meeting for young researchers) was once again a success. This meeting, held in Coimbra on October 3, 2002 just before the 56<sup>th</sup> MCDA meeting, gave each of the ten young researchers the opportunity to briefly present their research topics and to receive comments and suggestions from fellow colleagues. It was also the chance to make contacts with others from different countries (Belgium, Finland, Greece, Italy, Portugal) working in similar fields.

After the introductions, we proceeded with a workshop, where we discussed the following question: "What is a constructive approach in decision aid?" Alexis Tsoukias kindly started the workshop by introducing the four following approaches: normative, descriptive, prescriptive, and constructive approaches. We discussed which of these are better suited to our specific

research/applications and continued to look at which of the approaches are better adapted to the MCDA field in general. Through this discussion we were able to come to a better understanding of these different concepts.

It would be great if another YMCDA meeting could be organized in Viterbo, Italy before the 57<sup>th</sup> MCDA meeting.

Thank you to Luis Dias for organizing the meeting and to Alexis Tsoukias for leading the workshop.

Romina Hites

#### Participants:

Carla Oliveira (INESC Coimbra, Portugal)  
Céline Mousset (Univ. Mons-Hainaut, Belgique)  
Chiara D'Alpaos (Univ. Padova, Italia)  
Clara Pusceddu (Univ. Pisa, Italia)  
Irina Yevyseyeva (Univ. Jyväskylä, Finland)  
Jacobo Féas (Univ. Santiago de Compostela, Espana)  
Ramiro Sanchez Lopez (Univ. Ghent, Belgique)  
Romina Hites (Univ. Libre de Bruxelles, Belgique)  
Vasso Hontou (National Technical University of Athens, Greece)  
Yannis Politis (Technical University of Crete, Greece)



## Forthcoming Meetings

(This section is prepared by Luís Dias and Carlos Henggeler Antunes)

November 2002. The 3rd International Conference on Decision Making in Urban and Civil Engineering, London, <http://www.serenade.org.uk/>.

November 4-5, 2002, MOMH : WORKSHOP ON MULTIPLE-OBJECTIVE METAHEURISTICS (free of charge participation) Carre des Sciences, Paris – France, <http://tew.ruca.ua.ac.be/eume/momh.html>, <http://www.li.univ-tours.fr/pm2o> Marc.Sevaux@univ-valenciennes.fr

November 4-7, 2002, Pucón, Chile IV ALIO/EURO Workshop on Applied Combinatorial Optimization <http://www.inf.puc-rio.br/alioeuro2002/>

November 17-20, 2002, San Jose, California INFORMS Annual Meeting <http://www.informs.org/Conf/SanJose02/>

November 18-22, 2002, Orchid Country Club, Singapore International Conference on Fuzzy Systems and Knowledge Discovery (FSKD'02) 9th International Conference on Neural Information Processing (ICONIP'02) 4th Asia-Pacific Conference on Simulated Evolution And Learning (SEAL'02) <http://www.ntu.edu.sg/home/nef/>

November 28-30, 2002, University of Auckland, New Zealand 37th Annual Conference of the Operational Research Society of New Zealand <http://www.orsnz.org/conf/>

November 30-December 1, 2002, Beijing International Conference on Systems, Development and Self-organization (ICSDS'2002) <http://www.icsds.em.tsinghua.edu.cn/>

December 16-18, 2002, Shanghai Jiao Tong University, Shanghai, China Intelligent Systems and Applications ISA 2002 <http://www.icsc-naiso.org/conferences/isa2002/index.html>

December 27-30, 2002, Anna University, Chennai, India International Conference on Operations Research for Development (ICRD-2002) XXXV Annual Convention of ORSI <http://www.annauniv.edu/orsi-chennai/icord2002/index.html>

January 11, 2003, Hyatt Regency, Baltimore, MD, USA 5th Workshop on Algorithm Engineering and Experiments (ALENEX 03) <http://www.siam.org/meetings/alenex03/>

February 5-7, 2003, Gijon, SPAIN MAEB'03 - Second Spanish Int. Conf. on Metaheuristics, Evolutionary and Bio-Inspired Algorithms Email: [maeb03@maeb03.uniovi.es](mailto:maeb03@maeb03.uniovi.es)

**March 27-28, 2003, 57th Meeting of the EWG-MCDA, Viterbo, Italia. Theme: "MCDA and economical evaluation of environment". Organizer: A. Scarelli, University of Tuscia, Dpt Environmental Science, Via S. Camillo de Lellis, 01100 Viterbo, Italy [scarelli@unitis.it](mailto:scarelli@unitis.it) and Lorenzo Venzi [lvenzi@unitis.it](mailto:lvenzi@unitis.it) Site: [www.unitis.it/mcda57](http://www.unitis.it/mcda57). E-mail: [mcda57@unitis.it](mailto:mcda57@unitis.it).**

March 30- April 5, 2003, Aussois, France Sixth Workshop on: Models and Algorithms for Planning and Scheduling Problems <http://www.cs.put.poznan.pl/mapsp/>

April 8-11, 2003, Universidade do Algarve, Portugal Second International Conference on Evolutionary Multi-Criterion Optimization (EMO'03) <http://conferences.ptrede.com/emo03/>

April 14-16, 2003, Essex, UK 5th European Workshop on Scheduling and Timetabling (EvoSTIM2003) <http://evonet.dcs.napier.ac.uk/eurogp2003/evostim.html>

April 14-16, 2003, Essex, UK 3RD EUROPEAN WORKSHOP ON EVOLUTIONARY COMPUTATION IN COMBINATORIAL OPTIMIZATION (EvoCOP 2003)

<http://evonet.dcs.napier.ac.uk/eurogp2003/evocop.html>  
<http://www.ads.tuwien.ac.at/evocop2003/>

**May 5-7, 2003, Luxembourg 14th Mini-EURO Conference Human Centered Processes: Distributed Decision Making and Man-Machine Cooperation** <http://www.cu.lu/hcp2003/>

May 26-28, 2003, Porto, Portugal International Conference on Industrial Engineering and Production Management <http://staff.fucam.ac.be/~cregi/default.htm>

June 1-4, 2003, Vancouver, Canada CORS 2003 National Conference (Congrès SCRO 2003) <http://www.cors.ca/meetings/confer.htm>

June 23-27, 2003, Toronto, Ontario Canada SIAM Conference on Mathematics for Industry: Challenges and Frontiers <http://www.siam.org/meetings/mi03/index.htm>

**July 6-10, 2003, Istanbul, Turkey EURO XIX Conference** <http://www.istanbul2003.org/>

July 7-11, 2003, Sydney, Australia 5th International Congress on Industrial and Applied Mathematics (ICIAM 2003) [http://www.iciam.org/iciamHome/iciamHome\\_tf.html](http://www.iciam.org/iciamHome/iciamHome_tf.html)

July 9-11, 2003, Lille, France The IMACS/IEEE Multiconference CESA' 2003 : Symposium on: Applied Mathematics, Operational Research and Optimization <http://cesa2003.ec-lille.fr/>

July 7-11, 2003. 5th Int. Congress on Industrial and Applied Mathematics (ICIAM 2003). Sydney, Australia.URL: [http://www.iciam.org/iciamHome/iciamHome\\_tf.html](http://www.iciam.org/iciamHome/iciamHome_tf.html)

August 18-22, 2003, Copenhagen, Denmark ISMP 2003 18th International Symposium on Mathematical Programming <http://www.ismp2003.dk/>

August 25-28, 2003, Kyoto International Conference Hall, Kyoto, Japan The Fifth Metaheuristics International Conference (MIC2003) <http://www-or.amp.i.kyoto-u.ac.jp/mic2003/>

**October 2003, 58th Meeting of the EWG-MCDA, Moskow, Russia. Organizers: Alexey Petrovski and Oleg Larichev.**

December 8-10, 2003, New Delhi, India The Sixth Conference of the Association of Asian-Pacific Operational Research Societies (APORS) within IFORS [www.apors2003.com](http://www.apors2003.com)

## 14th Mini-EURO Conference

\*\*\*\* HCP'2003 \*\*\*\*

### Human Centered Processes Distributed decision making and man-machine cooperation 5-7 May 2003 Luxembourg

#### Objectives

The Commission of the European Union, in its forthcoming sixth framework Programme, specifically recognizes the necessity to place human beings at the centre of future development of the knowledge-based society and more specifically the emerging e-government. In addition, a EURO working group on Human Centered Processes has recently been created in order to tackle the study of operational strategies and processes used by people in professional contexts (<http://www-hcp.enst-bretagne.fr/>).

Such problems represent important challenges for both public administrations and commercial firms. More generally, the analysis and study of distributed decision making and man-machine cooperation requires a multi-disciplinary approach involving cognitive psychology, operational research, cognitive science and domain expertise. Indeed, cognitive design and implementation approaches can complement more traditional frameworks. They may allow design and analysis of more complete, complex, robust and secure systems involving experienced users with specific domain expertise as well as common users.

#### Purpose

The purpose of this conference is to bring together:

- Practitioners from industry and administration who are confronted with issues related to cognition and domain expertise and computer assisted collaborative work,
- Researchers who have expertise in Cognitive Psychology or more generally Cognitive Science, Artificial Intelligence and Computer Science,
- Operational Researchers interested in discussing human centred approaches applied to complex industrial and administrative problems.

In view of this, the Conference focuses on practical application oriented themes where human centered approaches have already shown their usefulness

including planning, scheduling, decision making, quality control, project and risk management, intelligent management of multimedia documents, e-commerce and e-government.

Three plenary sessions with invited guest speakers such as Ola Svenson (S) and Paul Slovic (USA) are planned.

Four half-day symposiums dedicated to special sessions on multi-criteria decision aid, decision support systems and ethics in OR are foreseen.

#### Local Organizer

Raymond Bisdorff (chair), [hcp2003@cu.lu](mailto:hcp2003@cu.lu), Cunlux (L)

#### Call for papers

Three kinds of submissions are welcome:

- Proposal for a session of three short papers (maximum five pages) dedicated to a given topic. After acceptance, the promoter will be responsible for his/her session and will chair it.
- Proposal for a panel discussion on a given topic (one hour). After acceptance, the promoter will be responsible for his/her session and will serve as session chair.
- Free submission of short papers (maximum five pages). The accepted papers will be published as Conference Proceedings by the Centre Universitaire.

Two types of sessions, panel discussions or papers are solicited:

- Those discussing cognitive theories and practices from a practical application perspective and those presenting administrative, business or industrial applications. Suitable sessions, panel discussions and papers include: distributed decision making, human expertise centred decision aids, man-machine cooperation, intelligent assistance for decision, knowledge extraction, representation and modelling, intelligent management of multimedia documents, perception, recognition and interpretation and intelligent operator guidance and assistance systems.
- Application reports may cover the following: practice and integration, quality control, management of industrial and administrative processes, scheduling and planning, industrial production, supervision and control, public administration, transportation, health care, banking, insurance,

telecommunications, management of the environment, new technologies for information and communication.

Authors' instructions may be found on the conference web site: <http://www.cu.lu/hcp2003>.

### Publication

Selected papers will be proposed for publication (and refereed separately) in a feature issue of the European Journal of Operational Research: <http://www.elsevier.nl/homepage/sae/orms/eor/menu.htm>.

A specific publication for French, Italian, Spanish or Portuguese versions of the accepted papers is also foreseen in a special issue of the In Cognito journal: <http://www.univ-ubs.fr/valoria/cognito/>.

### Venue

The conference will be located at the Kirchberg Conference Centre, the hemicycle of the European Parliament in Luxembourg (<http://www.luxcongress.lu>).

### Registration fee

The conference fee is 220EUR before February 28, 2003 and 280EUR for late registrations. It includes the proceedings book, coffee and tea during breaks, three lunches, and a social event. For accompanying persons a social program will be organized.

The conference fee for students is 150EUR if a copy of a student card accompanies the registration formular.

Registering can be made by using the formular you may download from the following url: <http://www.cu.lu/hcp2003/Registration.pdf> (PDF format).

Young researchers and PhD students may apply for financial support directly at EURO (contact: [Secretary@euro-online.org](mailto:Secretary@euro-online.org)). The Luxembourg FNR offers special grants for young Luxemburgish researcher (contact: [fnr@fnr.lu](mailto:fnr@fnr.lu)).

Some participants from Eastern European and African countries may get special financial support directly from the organizer (contact the conference secretary: [hcp2003@cu.lu](mailto:hcp2003@cu.lu)).



## Books

(This section is prepared by Luís Dias)

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### Utility Maximization, Choice and Preference

**Aleskerov, F.**

*Institute of Control Sciences, Moscow, Russia*

**Monjardet, B.**

*Universite de Paris I,*

A classically rational subject is a maximiser: he chooses the best alternative(s) according to some utility function, a paradigm going back to the eighteenth century. One of the ways to overcome its well-known deficiencies is to extend it to take into account insensitivity threshold as well as the context of choice. This book gives a systematic overview on the extended utility maximisation theory covering the classic theory, the theory of utility maximisation within a context-free or context-dependent threshold, and the related preference and choice models. The presented models will be helpful to specialists in economics, decision making theory, social choice theory, behavioral and cognitive sciences, and related fields.

Keywords: Choice, Maximisation, Preference, Threshold, Utility.

Contents: Introduction.- Preference, Utility, and Choice: Classic Models.- Threshold Depending on One Alternative.- Threshold Depending on Both Compared Alternatives.- Context Dependent Threshold Function.- Conclusion.

Springer Verlag. Series: Studies in Economic Theory. VOL. 16, 2002.

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### Fuzzy Reasoning in Decision Making and Optimization

**Carlsson, Christer,**

*Abo Akademi University, Abo, Finland*

**Fuller, Robert**

*Eötvös Lorand University, Budapest, Hungary*

This book starts with the basic concepts of fuzzy arithmetics and progresses through the analysis of sup-t-norm-extended arithmetic operations, possibilistic linear systems and fuzzy reasoning approaches to fuzzy optimization. Four applications of (interdependent) fuzzy optimization and fuzzy reasoning to strategic planning, project management with real options, strategic management and supply chain management are presented and carefully discussed. The book ends with a detailed description of some intelligent software agents, where fuzzy reasoning schemes are used to enhance their functionality. It can be useful for researchers and students working in soft computing, applied mathematics, operations research, management science, information systems, intelligent agents and artificial intelligence.

Keywords: Fuzzy Intelligent Systems, Fuzzy Optimization, Fuzzy Reasoning, Soft Computing

Physica-Verlag, Series: Studies in Fuzziness and Soft Computing. Volume. 82

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### **Managing Project Risk and Uncertainty: A Constructively Simple Approach to Decision Making**

**Chris B. Chapman and Stephen Ward**

*School of Management of the University of Southampton*

Rigorously grounded conceptually but developed to meet practical concerns, this book underpins and extends the scope and power of current approaches to the management of risk and uncertainty in projects and related operational and strategic management decision making.

Ten tales, based on real cases, explore a range of project related problems, including: cost estimation, pricing competitive bids, risk allocation and incentive contract design, evaluation of threats and opportunities, buffer management in a supply chain, investment appraisal, portfolio management, and strategy formulation. Each tale provides practical guidance on achieving effective and efficient uncertainty management through simple analysis and discussion of emergent issues.

Using a 'constructively simple' approach to model building and the associated decision support processes, the authors show the reader how to take the guesswork out of managing risk and uncertainty.

Keeping formal analysis simple, without being simplistic, and adding complexity only when it facilitates additional insights, they provide a framework for 'constructive simplicity' which can be used to enhance risk and uncertainty management in any area of managerial decision making, whether in a project, operational, or strategic context.

Contents. Preface. Acknowledgements. 1. Introduction. 2. Nicola's tale: sizing inventories and other buffers. 3. Martha's tale: setting bids and other pricing decisions. 4. Eddy's tale: estimating measures of uncertain performance. 5. Ian's tale: aligning buyer and supplier motivation. 6. Roger's tale: assigning ownership of project uncertainty. 7. Sarah's tale: facilitating the precautionary principle. 8. Norman's tale: discounting future performance measures. 9. Tess's tale: making decision analysis practical. 10. Sam's tale: concepts and issues in portfolio management. 11. Conrad's tale: formulating strategy. 12. From concepts to culture. Bibliography. Index.

John Wiley and Sons, Ltd. ISBN: 0-470-84790-5. August 2002

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### **PROMETHEE-GAIA. Une méthodologie d'aide à la décision en présence de critères multiples**

**Jean-Pierre Brans**

*Free University of Brussels*

**Bertrand Mareschal**

*Université Libre de Bruxelles*

De tout temps, les responsables de la prise de décision se sont concentrés sur la recherche de solutions optimales. Un problème complexe, on le sait depuis 1960, dès lors que les décideurs socio-économiques souhaitent souvent optimiser plusieurs critères simultanément.

De nombreuses méthodes multicritères ont alors été proposées pour tenir compte de cette diversité. Toutes traitent le même problème, mais elles se différencient par l'information supplémentaire plus ou moins sophistiquée que doit fournir le décideur. L'approche PROMETHEE-GAIA nécessite de ce dernier une information supplémentaire simple et claire. Cette méthodologie a permis de traiter avec succès nombre d'applications économiques, sociales et industrielles.

Alliant qualités pédagogiques et caractère pragmatique destinés à faciliter sa lecture, cet



ouvrage constitue un document de travail fondamental pour les preneurs de décision.

Editions Ellipses, Collection "Statistique et mathématiques appliquées".

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### Optimisation multiobjectif

**Yann Collete**

*EDF, France*

**Patrick Siarry**

*Université Paris XII Val-de-Marne*

L'optimisation multiobjectif et ses applications. Les ingénieurs se heurtent quotidiennement, quel que soit leur secteur d'activité, à des problèmes d'optimisation. Il peut s'agir de minimiser un coût de production, d'optimiser le parcours d'un véhicule, d'améliorer les performances d'un circuit électronique, d'affiner un modèle de calcul, de fournir une aide à la décision à des managers, etc. On parle d'optimisation multiobjectif dans les cas complexes où l'on doit optimiser simultanément plusieurs objectifs contradictoires, ce qui amène à choisir une solution de compromis parmi une multitude de solutions possibles.

Un ouvrage de référence illustré d'études de cas. Destiné à tous les ingénieurs confrontés à des problèmes d'optimisation, ainsi qu'aux spécialistes en recherche opérationnelle et en aide à la décision, cet ouvrage présente dans une première partie les principes de l'optimisation multiobjectif en décrivant toutes les méthodes permettant de résoudre ce type de problème. La deuxième partie explique comment évaluer les performances de ces méthodes et choisir la méthode la mieux adaptée à un problème donné. La dernière partie propose trois études de cas réels : optimisation de la simulation numérique d'un processus industriel (CEA), dimensionnement d'un réseau de télécommunication (France Télécom R&D), outil d'aide à la décision pour le traitement d'appels d'offres (EADS).

A qui s'adresse le livre ? (1) Aux élèves ingénieurs et étudiants en mathématiques appliquées, algorithmique, sciences de l'ingénieur (électronique, automatique, mécanique), économie (recherche opérationnelle), etc. (2) Aux ingénieurs, enseignants-chercheurs, informaticiens, industriels, économistes et décideurs ayant à résoudre des problèmes complexes d'optimisation ou d'aide à la décision.

Au sommaire

Méthodes d'optimisation multiobjectif (Principes de l'optimisation multiobjectif, Méthodes scalaires, Méthodes interactives, Méthodes floues, Méthodes exploitant une métaheuristique, Méthodes d'aide à la décision). Évaluation des méthodes et critères de choix (Mesure des performances, Fonctions de test, Classification des méthodes et critères de choix). Études de cas (Étude de cas n° 1 : qualification d'un modèle numérique pour l'optimisation d'un processus industriel (CEA); Étude de cas n° 2 : dimensionnement d'un réseau télécoms (France Télécom R&D) ; Étude de cas n° 3 : aide à la décision pour le traitement d'appels d'offres (EADS Launch Vehicules))

Eyrolles, 2002. ISBN : 2-212-11168-1.

www.eyrolles.com

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### Multicriteria Decision Aid Classification Methods

**Michael Doumpos**

*Technical University of Crete, Dept. of Production Engineering and Management, Financial Engineering Laboratory, Chania, Greece*

**Constantin Zopounidis**

*Technical University of Crete, Dept. of Production Engineering and Management, Financial Engineering Laboratory, Chania, Greece*

The book discusses a new approach to the classification problem following the decision support orientation of multicriteria decision aid. The book reviews the existing research on the development of classification methods, investigating the corresponding model development procedures, and providing a thorough analysis of their performance both in experimental situations and real-world problems from the field of finance.

Audience: Researchers and professionals working in management science, decision analysis, operations research, financial/banking analysis, economics, statistics, computer science, as well as graduate students in management science and operations research.

Contents. Prologue. **1.** Introduction to the Classification Problem. **2.** Review of Classification Techniques. **3.** Multicriteria Decision and Classification Techniques. **4.** Preference Disaggregation Classification Methods. **5.** Experimental Comparison of Classification



Techniques. 6. Classification Problems in Finance. 7. Conclusions and Future Perspective. References. Subject Index.

Kluwer Academic Publishers, Dordrecht. Hardbound, ISBN 1-4020-0805-8. September 2002

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## **Decision Making in Multicriteria Environment: a Quantitative Approach**

**Vladimir D. Noghin**

*Department of Mathematics*

*St. Petersburg State Polytechnic University*

This book was supported by the Russian Fund for Basic Research and is a pioneer work where for the first time the well-known Pareto Principle has logically justified. The main part of the book is devoted to the so-called quantitative theory of the relative importance of criteria which is developed by the author.

Contents: Notation. Preface. Introduction. 1. Basic concepts of multicriteria choice ( 1.1. Multicriteria choice problem, 1.2. Binary relations, 1.3. Set of nondominated, decisions, 1.4. Pareto set). 2. The relative importance for two criteria (2.1. Definition and some properties of the relative importance of criteria, 2.2. Invariance of the preference relation, 2.3. Use of information on the relative importance of criteria to reduce the Pareto set, 2.4. Scales of criteria and invariance of measuring). 3. The relative importance for two groups of criteria (3.1. Definition and properties of the relative importance of criteria, 3.2. Use of information on the relative importance, 3.3. Geometric illustrations for a problem with three criteria). 4. Pareto set reducing based on a collection of information on the relative importance of criteria (4.1. Case of two messages on the relative importance, 4.2. Collection of information on the relative importance: consistency, 4.3. Use of collection of information, 4.4. Algorithmic approach in case of arbitrary finite collection of information on the relative importance). 5. Completeness of information on the relative importance (5.1. Preliminary consideration, 5.2. First completeness theorem, 5.3. Second completeness theorem), 6. Decision making methodology based on the relative importance of criteria (6.1. How a person make his/her choice?, 6.2. Consequential Pareto set

reducing, 6.3. Combined methods). F. Edgeworth and V. Pareto (short information). Index. References.

Published by FIZMATLIT (Moscow), 176 pages, in Russian.

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## **Evolutionary Algorithms for Single and Multicriteria Optimization**

**Andrej Osyczka**

*Cracow University of Technology, Poland*

Many design optimization problems are of a very complex nature and quite hard to solve by conventional optimization techniques. Genetic algorithms, or their more advanced forms called evolutionary algorithms, have recently received considerable attention because of their potential of being a very effective design optimization technique. Both genetic and evolutionary algorithms simulate natural genetic processes of living organisms and they can often outperform conventional optimization methods.

In this book after the introduction to design optimization, genetic and evolutionary algorithms as a design optimization tool are described. Then the advanced evolutionary algorithm techniques are provided. These techniques are used in single and multicriteria optimization methods described in detail in this book. Finally three real-life design optimization problems are formulated and solved by means of the methods presented in the book. The book is designed as a self-study guide for researchers and students in all engineering departments, especially in mechanical, civil and industrial engineering. The book may also be useful as a comprehensive text for operations researchers, artificial intelligence researchers, management scientists, system analysts and others who face challenging and difficult to solve optimization problems in their fields of study.

Contents. 1. Introduction to Design optimization. 1.1 Formulation of a design optimization problem. 1.2 Mathematical preliminaries. 1.3 Conventional optimization methods. 2. Genetic and Evolutionary Algorithms as a Design Optimization Tool. 2.1 A brief introduction on genetic algorithms. 2.2 Simple example. 2.3 More advanced example. 2.4 Parameters of genetic algorithms. 2.5 Three

advanced problems. 3. Advanced Evolutionary Algorithm Techniques. 3.1 Chromosome representation. 3.2 Selection mechanisms. 3.3 Evolutionary operators. 4. Evolutionary Algorithms for Single Criterion Optimization. 4.1 Objective function and fitness function. 4.2 Handling constraints. 4.3 Penalty function strategy. 4.4 Tournament selection in constrained optimization. 4.5 Constraint tournament selection method for single criterion optimization. 5. Evolutionary Algorithms for Multicriteria Optimization. 5.1 A brief overview of some methods. 5.2 Methods of selecting a set of Pareto optimal solutions. 5.3 Distance method. 5.4 Pareto set distribution method. 5.5 Constraint tournament selection method or multicriteria optimization. 6. Some other Evolutionary Algorithm Based Methods. 6.1 A Bicriterion approach to constrained single criterion optimization problems. 6.2 Design automation with evolutionary algorithms. 6.3 Multicriteria optimization with selecting a representative subset of Pareto optimal solutions. 7. Design optimization Examples and their Solution by Evolutionary algorithms. 7.1 Optimal design of multiple clutch brakes. 7.2 Optimum design of concentric springs. 7.3 Optimization of robot grippers. Appendix A Evolutionary optimization system. Appendix B. C codes for two design optimization problems. Bibliography. List of symbols. Index.

Physica-Verlag, 2001. (Studies in Fuzziness and Soft Computing, Vol. 79). ISBN 3-7908-1418-0

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**Matrix games in building technology and management  
(in Lithuanian)**

**Friedel Peldschus**

**Edmundas K.Zavadskas**

*Vilnius Gediminas Technical Universit  
Lithuanian Academy of Science*

Publisher: Lithuanian, Vilnius: Technika. Pages: 134.  
ISBN 9986-05-332-3.

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**Rational Analysis for a Problematic World  
Revisited: Problem Structuring Methods for  
Complexity, Uncertainty and Conflict.  
(2<sup>nd</sup> Edition)**

**Jonathan Rosenhead (Editor)**

**John Mingers (Editor)**

Planning and management is increasingly problematic in the real-world environment of spiralling change and uncertainty. Knowledge is incomplete, values are in dispute and the decisions of others are often unpredictable.

Problem structuring methods (PSMs) are now widely accepted within Operational Research and the systems movement, and have generated an impressive record of high-profile applications. This new edition provides easier access to PSMs. Each of five methods is presented from both a theoretical and a practical perspective. The justification for each approach is explained, and an illustration of applying each method is given in a practical case study. New topics in line with the many advances in the field of problem structuring methods are explored and multimethodology is introduced for the first time.

This book does not peddle methods for optimum solutions, but instead shows you how to facilitate an enriched and fluid decision-making process. Participatory methods are explained to assist the formulation and re-formulation of problem solving in an uncertain world.

Offering contributions from leading thinkers in the field and building on the success of the first edition, this theoretical guide and practical source will prove invaluable to students of management, systems and OR and to practitioners negotiating real-life problems in today's complex, conflicting and uncertain business climate.

Contents. Contributors. Preface. Acknowledgements. A New Paradigm of Analysis (Jonathan Rosenhead and John Mingers). SODA — The Principles (Colin Eden and Fran Ackermann). SODA — Journey Making and Mapping in Practice (Fran Ackermann and Colin Eden). Soft Systems Methodology (Peter Checkland). Soft Systems Methodology in Action: Participative Creation of an Information Strategy for an Acute Hospital (Peter Checkland). The Strategic Choice Approach (John Friend). Gambling with Frozen Fire? (Allen Hickling). Robustness Analysis: Keeping Your Options Open (Jonathan Rosenhead). Robustness to the First Degree (Jonathan Rosenhead). Drama Theory and Confrontation Analysis (Peter Bennett,

Jim Bryant and Nigel Howard). The M&A Play: Using Drama Theory for Mergers and Acquisitions (Nigel Howard). An Overview of Related Methods: VSM, System Dynamics and Decision Analysis (John Mingers and Jonathan Rosenhead). Multimethodology — Mixing and Matching Methods (John Mingers). Mixing Methods in Practice (Richard Ormerod). Diverse Unity: Looking Inward and Outward (John Mingers and Jonathan Rosenhead).Index.

John Wiley and Sons, Ltd. ISBN: 0-471-49523-9. 2nd Edition. September 2001

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### **Multicriteria Scheduling Theory, Models and Algorithms**

**T'kindt, V.**

*Universite Francois-Rabelais Tours, France*

**Billaut, J.-C.**

*Universite Francois-Rabelais Tours, France*

Scheduling and multicriteria optimisation theory have been subject, separately, to numerous studies. Since the last fifteen years, multicriteria scheduling problems have been subject to a growing interest. However, a gap between multicriteria scheduling approaches and multicriteria optimisation field exists. This book is a first attempt to collect the elementary of multicriteria optimisation theory and the basic models and algorithms of multicriteria scheduling. It is composed of numerous illustrations, algorithms and examples which may help the reader in understanding the presented concepts.

Keywords: Scheduling, Multicriteria Scheduling, Multicriteria Optimization  
Springer Verlg. 2002.

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### **Multiple Criteria Analysis of a Buildings Life Cycle (in Lithuanian)**

**E.K.Zavadskas**

*Vilnius Gediminas Technical University, Lithuanian Academy of Sciences*

**A.Kaklauskas, N.Banaitiene**

*Vilnius Gediminas Technical University*

Contents: Introductions, 1.A Model for a Complex Analysis of Building's Life Cycle. 2. Development if Criteria System Describing a Building's Life Cycle.

3. Theoretical Fundamentals of Multiple Criteria Decision Making Methodology. 4. Methods for the Determination of the Weight of Criteria. 5. Methods of Multiple Criteria Decision Making in Construction. 6. Methods for Multiple Criteria Analysis Developed by Authors. 7. Decision Support Systems Author Index. English Summary (pp. 361-379).

Publisher: Lithuania, Vilnius: Technika, 2001. Pages: 380 (Hard Cover), 62 figures, 72 tables. ISBN 9986-05-441-9.

\*\*\* \*\*

### **Decision Support Systems in Construction (in Lithuanian)**

**Edmundas K. Zavadskas**

*Vilnius Gediminas Technical University, Lithuanian Academy of Sciences*

**Leonas Simanauskas**

*Vilnius University*

**Arturas Kaklauskas**

*Vilnius Gediminas Technical University*

Contents: Introduction, 1. A Survey of Decision Support Systems. 2. A Survey of Decision Support Systems in Construction. 3. A Model for a Complex Analysis of a Building Life Cycle. 4. Methods of Multiple Criteria Analysis. 5. Multiple Criteria Decision Support Systems. Author Index, Summary (English) pp. 228-236.

Publisher: Lithuania, Vilnius: Technika. Pages: 236 (Hard Cover), 37 figures, 22 tables ISBN 9986-05-382-X.

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### **Expert Systems in Construction Industry. Trends, Potential and Applications**

**Edmundas K.Zavadskas**

**Vilnius Gediminas**

*Technical University, Lithuanian Academy of Science*

**Oleg Kaplinski**

*Poznan University of Technology, Poland*

**Arturas Kaklauskas**

*Vilnius Gediminas Technical University, Lithuania*

**Jacek Brezinski**

*Poznan University of Technology, Poland*

Contents: Preface. Part 1. Introduction to expert system technology. Part 2. Expert system applications in construction planning. Part 3. Expert system applications in construction activities. Part 4. Efficiency increase of expert systems by applying the methods of alternative designing and multi criteria analysis. Part 5. Perspectives and trends. Conclusion. References.

Publisher: Lithuania, Vilnius: Technika. Pages: 179. ISBN 9986-05-252-1.

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### **Multiple Criteria Evaluation of Projects in Construction**

**Edmundas K. Zavadskas**

*Vilnius Gediminas Technical University, Lithuanian Academy of Science*

**Friedel Peldscus**

*Leipzig University of Applied Science, Germany*

**Arturas Kaklauskas**

Contents: Preface, 1. General considerations about the selection of the best suitable projects. 2. Theoretical fundamentals of the multiple decision making methodology. 3. Optimality criteria. 4. Methods and models of multiple criteria decision making. 5. Alternative design of the lifetime of a building. 6. Examples illustrating the efficiency boost of construction. References.

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**Proceedings of the 8-th international workshop "Rational decisions in the activities of construction companies"** (May 14-15, 2001) from Germany, Poland and Lithuania in Civil Engineering, 2001, Vol. VIII, No 4 ISSN 1392-1525.1. E. K. Zavadskas, A. Kaklauskas History and trends of development of colloquy. 2. R. Ginevicius, V. Podviezko Complex evaluation of economical-social development of Lithuanian regions. 3. L. Ustinovicus Determining integrated weights of attributes. 4. E. K. Zavadskas, A. Kaklauskas, S. Raslanas, V. Maliene. 5. Die Anwendung der mehrkriteriellen Methode bei der Bewertung von Erholungsgrundstücken. 6. S. Mitkus Public procurement of construction work: a bimatrix game model.

Publisher: Lithuania, Vilnius: Technika. Pages: 226 (Hard Cover). ISBN 9986-05-046-4.

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### **INFORMATIKA**

ISSN 0868-4952

2001, Vol. 12, N 1, 190 p.

This issue contains selected papers of the 52nd Meeting of the European Working Group on Multicriteria Aid for Decisions (MCAD, <http://www.inescc.pt/~ewgmcd/>), held on October 5-6, 2000, at the Academy of Sciences of Lithuania, in Vilnius. Editor-in-Chief J. Mockus, [mockus@ktl.mii.lt](mailto:mockus@ktl.mii.lt). Guest Editors of the issue are prof. Gintautas Dzemyda, assoc. prof. Leonidas Sakalauskas, prof. Edmundas-Kazimieras Zavadskas. Institute of Mathematics and Informatics Lithuanian Academy of Sciences. Vilnius.

Contents: S. AZAR, J.-M. HAUGLUSTAINE. Multicriteria and multiple actors tool aiding to optimise building envelope at the architectural sketch design. A. CAVALLO, M.F. NORESE. GIS and multicriteria analysis to evaluate and map erosion and landslide hazards. G. DZEMYDA, T. PETKUS. Application of computer network to solve the complex applied multiple criteria optimization problems. A. JANIAK, Y. SHAFRANSKY, A. TUZIKOV. Sequencing with ordered criteria, precedence and group technology constraints. O. LARICHEV. Method ZAPROS for multicriteria alternatives ranking and the problem of incomparability. I. MAGDISYUK. Using the cascade-correlation algorithm to evaluate investment projects. A. PETROVSKY. Method for approximation of diverse individual sorting rules. F. RAUSCHMAYER. Philosophical aspects of incommensurability and incomparability. T. THIEL, T. MROZ. Application of multi-criterion decision aid method in designing heating systems for museum buildings. F.C. TROYANO, A. BAT. The competitiveness of industrial sectors in CEECs countries as the base for their successful economic integration to the EU. E.K. ZAVADSKAS, A. KAKLAUSKAS, N. KVEDERYTĖ. Multivariant design and multiple criteria analysis of a building life cycle.

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**Special issue "Operational Research Models in  
Banking Management"  
International Transactions in Operational  
Research (Volume 9, Issue 5)**

Contents. 1. Editorial, Constantin Zopounidis. 2. Assessing Profitability Factors in the Greek Banking System: A Multicriteria Methodology, Ch. Spathis, K. Kosmidou, M. Doumpos. 3. Branch Network and Modular Service Optimization for Community Banking, G. Iannou, A. Karakereziz, M. Mavri. 4. A Hierarchical Location Model for Locating Bank Branches in a Competitive Environment, P. Miliatis, D. Dimopoulou, I. Giannikos. 5. Multi-criteria Classification Methods in Financial and Banking Decisions, M. Doumpos, C. Zopounidis. 6. Multi-objective Evolutionary Algorithms for the Risk-return Trade-off in Bank Loan Management, A. Mukerjee, R. Biswas, K. Deb, A. Mathus. 7. Satisfaction Benchmarking and Customer Classification: An Application to the Branches of a Banking Organization, E. Grigoroudis, Y. Politis, Y. Siskos. 8. Time-series Behavior of Intra-daily Data from the Athens Stock Exchange, R. Markellos, C. Siriopoulos. 9. Portfolio Value at Risk Bounds, E. Luciano, M. Marena. 10. On the Evolution of Global Style Factors in the Morgan Stanley Capital International Universe of Assets, G. Christodoulakis, S. Satchell. 11. Dual Stochastic Dominance and Quantile Risk Measures, W. Ogryczak, A. Ruszczycki. 12. A Comparison of the Rough Sets and Recursive Partitioning Induction Approaches: An Application to Commercial Loans, M. Daubie, P. Levecq, N. Meskens. 13. Determination of Loan Interest Rate Considering Bankruptcy and Mortgage Collection Costs, S. Nakamura, C. Qian, H. Samdoh, T. Nakagawa.

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**CALL FOR PAPERS**

**Feature Issue of  
European Journal of Operational Research  
on  
SCHEDULING WITH MULTIPLE  
OBJECTIVES**

**Guest editors : Vincent T'kindt and Jean-Charles  
Billaut**

Scheduling models have evolved in the last decades to take account of several conflicting criteria. Moreover, the use of multicriteria analysis has led to more powerful scheduling algorithms. The European Journal of Operational Research will publish a feature issue on Multicriteria Scheduling which will aim at collecting relevant contributions at the cross roads of Multicriteria Optimisation and Scheduling.

**AREAS OF INTEREST**

Original, high quality papers about Multicriteria Scheduling in project management, production, computer systems or any other area are welcome. Papers are sought which may belong, but are not restricted, to the following categories :

- Just-in-Time scheduling with multiple criteria,
- Scheduling with controllable processing times,
- Scheduling with set-up/removal costs,
- Time/Cost trade-off scheduling problems,
- Scheduling with any regular criteria.

The contributions should present a priori, interactive or enumeration algorithms for computing Pareto optima, or theoretical elements of Multicriteria Scheduling.

**DEADLINE FOR SUBMISSIONS**

December 31, 2002.

**SUBMISSION DETAILS**

The submitted papers must be original, not have been previously published or being currently under consideration for publication elsewhere. The format of manuscript for the European Journal of Operational Research can be found on the web page of Elsevier Science, the publishing of the journal, under « Instructions to Authors » ([www.elsevier.com/homepage/sae/orms/eor/menu.htm](http://www.elsevier.com/homepage/sae/orms/eor/menu.htm)). In order to speed up the refereeing process, we encourage authors to send submissions via email by december 31, 2002. Alternatively four hard copies must be sent by mail to one of the two guest editors :

Vincent T'kindt (tkindt@univ-tours.fr)

Jean-Charles Billaut (billaut@univ-tours.fr)

Laboratoire d'Informatique

EPUTours Département Informatique

64 avenue Jean Portalis

37200 Tours. France.



## Articles Harvest

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

Allahverdi, A. and T. Aldowaisan. No-wait flowshops with bicriteria of makespan and total completion time. *Journal of the Operational Research Society*, vol. 53, no 9, 1004-1015, 2002.

Annetts, J.E. and E. Audsley E. Multiple objective linear programming for environmental farm planning. *Journal of the Operational Research Society*, vol. 53, no 9, 933-943, 2002.

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## Séminaires du LAMSADE

### “MODÉLISATION DES PRÉFÉRENCES ET AIDE MULTICRITÈRE À LA DÉCISION”

Responsables: Bernard ROY et  
Daniel VANDERPOOTEN  
(le mardi, de 14:00 à 17:00, en salle P510)

- |                     |   |
|---------------------|---|
| 22 octobre<br>2002  | Discussion des travaux de <b>Lambert Rousseau</b> (Université Paris IX, LAMSADE):<br>Prise en compte de l'activité de formulation de problème dans les processus d'aide à la décision et application de l'analyse de l'accompagnement et à la construction d'outils pour la gestion des territoire. |
| 12 novembre<br>2002 | Conférence de <b>Céline Mousset</b> (Université de Mons-Hainaut) :<br>Etude de familles de relations emboîtées dont la réunion n'est pas complète.  |
| 10 décembre<br>2002 | Conférence de <b>Xavier Juret</b> (LIP 6) :<br>Conditions axiomatiques de monotonie des procédures de rangement itératives.   |
| 14 janvier<br>2003  | Conférence de <b>Xavier Gandibleux</b> (LAMIH, Université de Valenciennes) :<br>Peut-on envisager une alternative à Dijkstra pour effectuer un routage "optimisé" dans un réseau IP ?   |

## Other Works

(Communicated by the authors)

## Collections du LAMSADE

(Université Paris-Dauphine)

S. DAMART, A. DAVID, B. ROY : Comment organiser et structurer le processus de décision pour favoriser la concertation entre parties prenantes et accroître la légitimité de la décision (juin 2002), Document N° 125, 73 p.

L. DIAS, G. GOMES Da SILVA, V. MOUSSEAU : IRIS-Interactive Robustness analysis and parameters Inference for multicriteria Sorting problems (juin 2002), Document N° 127, 55 p.

B. ROY, R. SLOWINSKI : Multicriteria assignment of tasks to heterogeneous processing units with incompatibility and capacity constraints (mai 2002), Cahier N° 194, 51 p.

D. BOUYSSOU : Questionner le passé de la recherche opérationnelle pour préparer son avenir . Cahier N° 195

A. AÏT YOUNES, B. ROY : Prise en compte d'une connaissance imparfaite à l'aide d'un pseudo-critère : procédure interactive de construction, Cahier N° 197.

L. C. DIAS, V. MOUSSEAU: Inferring Electre's veto-related parameters from outranking examples, Cahier N° 198.

## Research Reports of INESC Coimbra

L. C. DIAS, V. MOUSSEAU: Inferring Electre's veto-related parameters from outranking examples, Research Reports of INESC COIMBRA, No. 5/2002.

A. GOMES, C. HENGGELER ANTUNES, A. G. MARTINS: Adaptive mutation probability as a tool to incorporate knowledge in an evolutionary algorithm for multiobjective electricity planning, Research Reports of INESC COIMBRA, No. 7/2002.

## Dissertations

**An NGO THE** : Structures de préférence non-conventionnelles en aide à la décision. Jury : A. TSOUKIAS (Université Paris-IX-Dauphine, Directeur de thèse), P. VINCKE (Université libre de Bruxelles), M. PIRLOT (Faculté polytechnique de Mons) D. BOUYSSOU, V. PASCHOS, (Université Paris IX-Dauphine), F. ROBERTS (Université Rogers, USA), P. PERNY (Université Paris VI).

**Isabelle SOMMERLATT** : Incitation et contrôle en univers multi-institutionnel : nature et rôle des outils d'aide à la décision. Application à l'amélioration de la qualité de service dans les transports urbains. Jury : A. DAVID (Université d'Evry Val d'Essonne), G. GAREL (Université de Marne la Vallée), M. NAKHLA (Institut National agronomique Paris-Grignon), B. ROY (Université Paris-Dauphine), D. BOUYSSOU (CNRS-LAMSADE), B. AVEROUS (Pôle), M. O. MOUNIER ((Mission Institutions et Economie des Transports)).

**Sigitas LUNKEVICIUS**, Ranking of efficiency of investment's to rural property using multicriteria decision methods (in Lithuanian) Vilnius Gediminas Technical University (VGTU) PhD dissertation, February 2002, December 2001, Scientific Board: E.K. ZAVADSKAS (Dep. Construction Technical and Management VGTU, Supervision), F. PELDSCHUS (University of Applied Science in Leipzig, Technological Sciences), A. KAKLAUSKAS (Dep. Construction Technical and Management, VGTU), A.V. RUTKAUSKAS (VGTU, Dep. Of Economics), G. SATKAUSKAS (Dep. Construction Technical and Management, VGTU). Opponents: R. GINEVICIUS (Dep. Management and Administration, VGTU), V. JONAITIS (Ministry of Environment).

**Paulius GAUCAS**, Search Decision for Multi-criteria Construction Problem Solving by Applying Fuzzy Sets Theory ( in Lithuanian) Vilnius Gediminas Technical University (VGTU) Ph.D dissertation, February 2002, Scientific Board: E.K. ZAVADSKAS (Dep. Construction Technical and Management VGTU Supervision), J.BIVAINIS (Dep. Management and Administration VGTU), J. PARASONIS (Dep. Engineering and Architecture VGTU), A. ASTRAUKA (ISC Geotechnical Engineering) . Opponents: A. RUTKAUSKAS (Dep. Economics and Finance VGTU), R. JANUSAITIS (Dep. Construction Eng. And Management, Kaunas University of Technology).

**Isabel RAMOS**, Multicriteria Strategic Environmental Assessment, (in portuguese). Lisbon Technical Institute, Ph.D dissertation, February 2002, Scientific Board: Carlos Bana e Costa (supervisor, IST-Lisbon), João Paulo Fernandes (co-supervisor, Univ. Évora), Maria do Rosário Partidário (Univ. Nova de Lisboa), Francisco Nunes Correia (IST, Lisbon), Fernando Nunes da Silva (IST, Lisbon), Paulo Dias Correia (IST, Lisbon).

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

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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).

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

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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.

All information as well as links to other Web sites of interest can be sent to Luís Dias by the e-mail:

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