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## Opinion Makers Section

### Affect, Reason, Risk and Rationality

by
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Our understanding of the psychology of human judgment, preference and choice is continually evolving. Behavioral researchers are coming to recognize that there is an aspect of information-processing that has been rather neglected. This is the, experiential, affect-based side of our mental life, which appears every bit as important as the analytic/deliberative side that has been the focus of much prior research and the foundation for multi criteria decision analysis. This essay will briefly describe new research demonstrating the powerful influence of affect on decision-making. Reliance on affect is essential to rational behavior yet it sometimes misleads us. In such circumstances we need to ensure that reason also is employed.

**Background and Theory: The Importance of Affect**

Although the visceral emotion of fear certainly plays a role in risk as feelings, we shall focus here on a "faint whisper of emotion" called affect. As used here, "affect" refers to specific feelings of "goodness" or "badness" experienced with or without conscious awareness. Affect plays a central role in what have come to be known as dud-process theories of thinking. As Epstein (1994) observed,

> There is no dearth of evidence … that people apprehend reality in two fundamentally different ways, one variously labeled intuitive, automatic, natural, non-verbal, narrative, and experiential, and the other analytical, deliberative, verbal, and rational. (p. 710)

Table 1 compares these two systems. One of the main characteristics of the experiential system is its affective basis. Although analysis is certainly important in some decision-making circumstances, reliance on affect is a quicker, easier, and more efficient way to navigate in a complex, uncertain, and sometimes dangerous world. Many theorists have given affect a direct and primary role in motivating behavior. Pleasant feelings motivate actions and thoughts anticipated to reproduce the feelings. Unpleasant feelings motivate actions and thought anticipated to avoid the feelings.

Table 1. Two modes of thinking: Comparison of experiential and analytic systems. Source: Adapted from Epstein (1994).

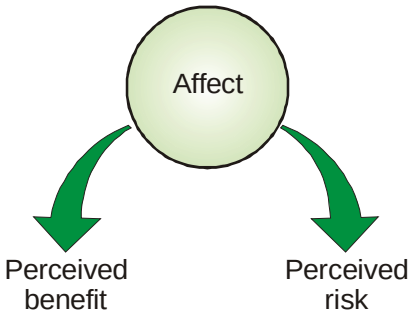
| **System 1**<br>**Experiential System** | **System 2**<br>**Analytic System** |
|---|---|
| Affective: pleasure-pain oriented | Logical: reason oriented (what is sensible) |
| Connections by association | Connections by logical assessment |
| Behavior mediated by feelings from past experiences | Behavior mediated by conscious appraisal of events |
| Encodes reality in concrete images, metaphors, and narratives | Encodes reality in abstract symbols, words, and numbers |
| More rapid processing: oriented toward immediate action | Slower processing: oriented toward delayed action |
| Self-evidently valid: "experiencing is believing" | Requires justification via logic and evidence |

There are strong elements of rationality in both systems. The experiential system enabled human beings to survive during their long period of evolution. Long before there was probability theory, risk assessment, and decision analysis, there were intuition, instinct, and gut feeling to tell us whether an animal was safe to approach or the water was safe to drink. As life became more complex and humans gained more control over their environment, analytic tools were invented to "boost" the rationality of experiential thinking.

Studies of risk perception have demonstrated that, whereas risk and benefit tend to be positively correlated in the world, they are negatively correlated in people's minds

and judgments (Fischhoff et al., 1978). The significance of this finding was not realized until a study by Alhakami and Slovic (1994) found that the inverse relationship between perceived risk and perceived benefit of an activity (e.g., using pesticides) was linked to the strength of positive or negative affect associated with that activity as measured by rating the activity on bipolar scales such as *good/bad, nice/awful,* etc. This implies that people judge a risk not only by what they *think* about it but also by how they *feel* about it. If their feelings towards an activity are favorable, they are moved toward judging the risks as low and the benefits as high; if their feelings toward it are unfavorable, they tend to judge the opposite—high risk and low benefit. Finucane, Alhakami, Slovic, & Johnson (2000) called this process “the affect heuristic” (see Figure 1).

Figure 1. A model of the affect heuristic explaining the risk/benefit confounding observed by Alhakami & Slovic (1994). Judgments of risk and benefit are assumed to derived by reference to an overall affective evaluation of the stimulus item. *Source:* Finucane *et al.* (2000).




If affect guides perceptions of risk and benefit, then providing information about benefit should change perception of risk and vice-versa (see Figure 2). For example, information stating that benefit is high for a technology such as nuclear power should lead to more positive overall affect which should, in turn, decrease perceived risk (Figure 2A).

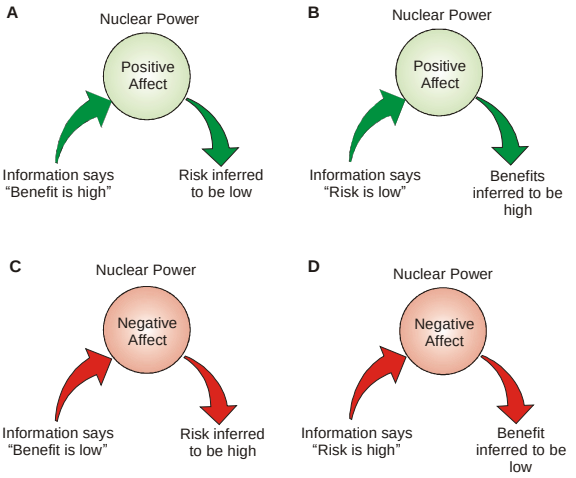



Figure 2. Model showing how information about benefit (A) or information about risk (B) could increase the positive affective evaluation of nuclear power and lead to inferences about risk and benefit that coincide affectively with the information given. Similarly, information could make the overall affective evaluation of nuclear power more negative as in C and D, resulting in inferences about risk and benefit that are consistent with this more negative feeling. Support for this model was found by Finucane *et al.* (2000).

Finucane *et al.* (2000) tested the predictions outlined in Figure 2, providing four different kinds of information designed to manipulate affect by increasing or decreasing perceived benefit or by increasing or decreasing perceived risk. This was done for each of three technologies. The predictions were confirmed. Further support for the affect heuristic came from a second experiment by Finucane *et al.* who found that the inverse relationship between perceived risks and benefits increased greatly under time pressure, when opportunity for analytic deliberation was reduced. These two experiments demonstrate that affect influences judgment directly and is not simply a response to a prior analytic evaluation.

## Failures of the Experiential System

The affect heuristic has been portrayed as the centerpiece of the experiential mode of thinking, the dominant mode of risk assessment and survival during the evolution of the human species. However, like other heuristics that provide efficient and generally adaptive responses but occasionally get us into trouble, reliance on affect can also mislead us, as will be shown below. Indeed, if it were always optimal to follow our affective and experiential instincts, there would have been no need for the rational/analytic system of thinking to have evolved and become so prominent in human affairs.

### *Judgments of Probability, Relative Frequency, and Risk*

The *experiential* system of thinking encodes reality in images, metaphors, and narratives to which affective feelings have become attached. To demonstrate this system, Denes-Raj and Epstein (1994) showed that, when offered a chance to win $1.00 by drawing a red jelly bean from an urn, individuals often elected to draw from a bowl containing a greater absolute number, but a smaller proportion, of red beans (e.g., 7 in 100) than from a bowl with fewer red beans but a better probability of winning (e.g., 1 in 10). These individuals reported that, although

they knew the probabilities were against them, they *felt* they had a better chance when there were more red beans.

We can characterize Epstein's subjects as following a mental strategy of "imaging the numerator" (i.e., the number of red beans) and neglecting the denominator (the number of beans in the bowl). Consistent with the affect heuristic, images of winning beans convey positive affect that motivates choice.

Although the jelly bean experiment may seem frivolous, imaging the numerator brings affect to bear on judgments in ways that can be both non-intuitive and consequential. Slovic, Monahan, and MacGregor (2000) demonstrated this by asking experienced forensic psychologists and psychiatrists to judge the likelihood that a hospitalized mental patient would commit an act of violence within 6 months after being discharged from the facility. An important finding was that clinicians who were given another expert's assessment of a patient's risk of violence framed in terms of relative frequency (e.g., "of every 100 patients similar to Mr. Jones, 10 are estimated to commit an act of violence to others") subsequently labeled Mr. Jones as more dangerous than did clinicians who were shown a statistically "equivalent" risk expressed as a probability (e.g., "Patients similar to Mr. Jones are estimated to have a 10% chance of committing an act of violence to others").

Not surprisingly, when clinicians were told that "20 out of every 100 patients similar to Mr. Jones are estimated to commit an act of violence," 41% refused to discharge the patient. But when another group of clinicians was given the risk as "patients similar to Mr. Jones are estimated to have a 20% chance of committing an act of violence," only 21% refused to discharge the patient. Follow-up studies showed that representations of risk in the form of individual probabilities of 10% or 20% led to relatively benign images of one person, unlikely to harm anyone, whereas the "equivalent" frequentistic representations created frightening images of violent patients (example: "Some guy going crazy and killing someone"). These affect-laden images likely induced greater perceptions of risk in response to the relative-frequency frames.

### *Insensitivity to Probability (Probability Neglect)*

When the consequences of an action or event carry strong affective meaning, as is the case with a lottery jackpot or a cancer, the probability of such consequences often carries too little weight. As Loewenstein, Weber, Hsee, & Welch (2001) observe, one's images and feelings toward winning the lottery are likely to be similar whether the probability of winning is one in ten million or one in ten thousand. They further note that responses to uncertain situations appear to have an all-or-none characteristic that is sensitive to the *possibility* rather than the *probability* of strong positive or negative consequences, causing very small probabilities to carry great weight. Empirical support for these arguments comes from Rottenstreich and Hsee (2001) who show that, if the potential outcome evokes strong positive or negative affect, its attractiveness or unattractiveness is relatively insensitive to changes in probability as great as from .99 to .01.

Legal scholar Cass Sunstein (2003; p. 122) labels this insensitivity probability neglect and argues that this phenomenon causes extreme overreaction to terrorist threats by both public officials and private citizens.

> [P]eople are prone to … *probability neglect*, especially when their emotions are intensely engaged. Probability neglect is highly likely in the aftermath of terrorism….When probability neglect is at work, people's attention is focused on the bad outcome itself, and they are inattentive to the fact that it is unlikely to occur.

### Managing Affect, Reason, and Risk

Affect misguides us in many important ways resulting from the natural limitations of the experiential system and the existence of stimuli in the environment that are simply not amenable to valid affective representation. We have seen above the way that perceptions of risk can be confused by positive feelings (e.g., benefits). Risk perceptions and decision making can also be inappropriate when the *presence of strong affect* leads us to be insensitive to probabilities. Moreover, the affective system seems designed to sensitize us to small changes in our environment (e.g., the difference between 0 and 1 deaths) at the cost of making us less able to appreciate and respond appropriately to larger changes further away from zero (e.g., the difference between 87 deaths and 88 deaths). Fetherstonhaugh et al. (1997) referred to this insensitivity as "psychophysical numbing." Nobel-prize winning biochemist Albert Szent-Gyorgi put it another way as he struggled to comprehend the enormity of the consequences of nuclear war: "I am deeply moved if I see one man suffering and would risk my life for him. Then I talk impersonally about the possible pulverization of our big cities, with a hundred million dead. I am unable to multiply one man's suffering by a hundred million."

Now that we are beginning to understand the complex interplay between emotion, affect, and reason that is wired into the human brain and essential to rational behavior, the challenge before us is to think creatively about what this means for managing risk and making good decisions. On the one hand, how do we apply reason to temper the strong emotions engendered by some risk events? On the other hand, how do we infuse needed "doses of feeling" into circumstances where lack of experience may otherwise leave us too "coldly rational?"

### *Can Generation of Reasons Degrade Decision Quality?*

Daniel Kahneman (2003) in his Nobel Prize Address argues that highly accessible impressions produced by the experiential system (he calls it System 1) control judgments and decisions, unless modified or overridden by the deliberate operations of the analytic system (called System 2). This suggests that deliberative, reason-based analysis generally will improve decision quality. This view also implies that errors of intuitive judgment involve failures of both systems—System 1, which generates the error, and System 2, which fails to detect and correct it. The corrective operations of System 2 may be impaired by time pressure (Finucane et al., 2000), by cognitive load (Shiv & Federikhan, 1999; Gilbert, 2002), by stress, by age, or by individual cognitive limitations (Peters et al., 2005).

But what happens when System 2 is brought into play early, as when an individual is asked to generate reasons to support a judgment or decision? Research by Wilson and colleagues demonstrates that, when affect is important, an attempt by the decision maker to provide reasons might sometimes produce an inferior decision by interfering with the affective feelings (Epstein, 1994; see Table 1) that subsequently determine how we will experience the consequences of the decision (Wilson & Schooler, 1991; Wilson, Lisle, Schooler, Hodges, Klaaren, & LaFleur, 1993). For example, Wilson et al. found that people who gave numerous reasons for liking an art poster prior to choosing it were subsequently less satisfied with it than those who chose without explicitly considering reasons. Similar degrading of decision performance due to introspection is reported by Tordesillas and Chaiken (1999). Could this pose problems for decision analysis, which depends heavily on introspective judgments?

### *Can Analysis Benefit from Experiential Thinking?*

The answer to this question is almost certainly yes. Even such prototypical analytic exercises as proving a mathematical theorem or selecting a move in chess benefit from experiential guidance. The mathematician senses whether the proof "looks good" and the chessmaster gauges whether a contemplated move "feels right," based upon stored knowledge of a large number of winning patterns (de Groot, 1978). Analysts attempting to build a model to solve a client's decision-making problem are instructed to rely upon the client's sense of unease about the results of the current model as a signal that further modeling may be needed (Phillips, 1984). A striking example of failure because an analysis was devoid of feeling was perpetrated by Philip Morris. The company commissioned an analysis of the costs to the Czech government of treating diseased smokers. Employing a very narrow conception of costs, the analysis concluded that smokers benefited the government by dying young. The analysis created so much hostility that Philip Morris was forced to issue an apology ("Philip Morris," 2001). Another example of the need to respect "experiential wisdom" comes from the inquiry into the causes of the Columbia Space Shuttle disaster, which pointed to the failure of NASA's risk assessment protocols to give weight to the worries and hunches of personnel who had observed suspicious damage to heat-shielding tiles on previous flights. An article in *Aviation Week* asserted that lack of hard data prevented the input of common sense analysis into the risk-assessment process (Covault, 2003).

Elsewhere I have argued that risk analysis needs to be sensitive to the "softer" values underlying such qualities as dread, equity, controllability, etc. that underlie people's concerns, as well as to degrees of ignorance or scientific uncertainty (Slovic, 1987; 2000). A blueprint for doing this is sketched in the National Academy of Sciences report *Understanding Risk: Decision Making in a Democratic Society* (National Research Council, 1996).

### Conclusion

Reliance on affect is a sophisticated cognitive mechanism that helps us to respond quickly and effectively in many decision situations. In other circumstances, affect may lead us to judge probabilities and consequences and make decisions in ways that are not beneficial. We need to understand the circumstances in which affect improves our decision making and the circumstances in which it leads us astray. Additional research on affect and decision making will be essential to this understanding.

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## MCDA Research Groups

### Decision Modelling and Foresight Methodologies

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Directed by Prof. Ahti Salo, the research Group on Decision Modelling and Foresight Methodologies is based at the Systems Analysis Laboratory of the Helsinki University of Technology (www.sal.hut.fi). The research and teaching activities of our Laboratory – which is directed by Prof. Raimo P. Hämäläinen – cover a wide range of issues in systems sciences, decision analysis, optimization techniques, game theory, environmental decision making, among others. The Laboratory also coordinates the graduate school on systems analysis, decision making and risk management, run in collaboration with Helsinki School of Economics as of 1995. To-date, more than 40 doctoral degrees have been obtained within this school. The majority of these degrees have been awarded at the Helsinki University of Technology.

At the moment, there are seven full-time doctoral students (Ville Brummer, Tommi Gustafsson, Janne Kettunen, Juuso Liesiö, Pekka Mild, Antti Punkka) and an M.Sc. student (Erkka Jalonen) in our Group on Decision Modelling and Foresight Methodologies. Practically all our activities are enabled through basic and applied research projects that are funded by organizations such as the National Technology Agency (Tekes), the

Academy of Finland, Ministries of the Finnish Government, industrial firms and the European Union.

Our focal research topics include (i) the modelling and exploitation of incomplete information in decision support processes; (ii) the development of methods and software tools for the selection and management of project portfolios; (iii) the design and implementation of innovative methodologically structured foresight processes.

For several years, we have been working on the question of how incomplete information can be dealt with in decision modelling. This question is motivated by the realisation that information on the performance of decision alternatives or the relative importance of the decision criteria can be difficult, impossible or prohibitively expensive to acquire; it is therefore pertinent to examine how useful and defensible recommendations can be provided on the basis of the information that can be obtained through reasonable efforts. Specifically, by building on the well-established frameworks for value tree analysis and AHP-like hierarchical weighting models, we have developed methods such as *PAIRS* (Salo and Hämäläinen, 1992) and *PRIME* (Salo and Hämäläinen, 2001) which accommodate incomplete information about the model parameters by way of set inclusion: this means, for instance, the lower and upper bounds may be placed on the alternatives' scores, and that criteria weights may be constrained through linear constraints.

With the help of relevant dominance concepts and decision rules, such information can be synthesised to convey (i) which alternatives can be surely recommended (in the sense that the recommendations are supported by all feasible combinations of model parameters) and (ii) what alternatives are supported by decision rules that transform incomplete information into corresponding decision recommendations (e.g., the max-min decision rule supports the alternative whose least possible overall value is the highest one among all alternatives).

The above methods synthesise incomplete information through interlinked phases of preference elicitation and presentation of intermediate results; we therefore refer to them by the term *Preference Programming* (Salo and Hämäläinen, 1995, 2003). From the viewpoint of decision support processes, preference programming methods are promising as they provide support for interactive learning processes, can reduce the costs of information elicitation, and may increase the DMs commitment to the decision support process (see, e.g., Mustajoki et al., 2004, 2005; Hämäläinen, 2003, 2004).

The recently developed *RICH* method (*Rank Inclusion in Criteria Hierarchies*; Salo and Punkka, 2005) extends preference programming methods to the analysis of incomplete ordinal information. In *RICH*, the DMs may provide incomplete information by associating subsets of attributes with corresponding subsets of rankings (e.g., 'cost and quality are among the top three most important attributes', 'the most important attribute is either cost or location'). We have also implemented a related decision support tool called *RICH Decisions*© which is available in the Internet (www.rich.tkk.fi). To-date, this tool has been employed in the selection of risk management methods at an energy utility (Ojanen et al., 2005) and the development of priorities for a Scandinavian research programme (Salo and Liesiö, forthcoming). Even more flexible preference elicitation modes are offered by the *RICHER* method (*RICH with Extended Rankings*; Punkka and Salo, 2005) which applies the preference elicitation modes of RICH to the comparison of alternatives. Thus, for any given subset of alternatives, the DM may specify a subset of rankings that these alternatives may assume in relation to a single evaluation criterion, several criteria, or even all criteria (whereby the last mode of preference elicitation corresponds to a holistic statement).

Much of our recent work has been at the juncture of preference programming and multicriteria project portfolio selection. This work has resulted in the *Robust Portfolio Modeling* (*RPM*) methodology (www.rpm.tkk.fi, Liesiö et al., forthcoming) which is well-suited to problems where a subset of available projects is to be selected subject to one of several resource constraints, and where there may be incomplete information about (i) the projects' performance with regard to the multiple evaluation criteria or (ii) the relative importance of these criteria.

In *RPM*, the conceptual and computational breakthrough is the determination of all non-dominated portfolios (i.e., portfolios that cannot be improved upon with regard to *all* criteria at the same time). This makes it possible to determine (i) which *core* projects are included in all non-dominated portfolios, (ii) which *exterior* projects are not included in any non-dominated portfolios, (iii) which *intermediate* projects are included in some but not all non-dominated portfolios. Based on this analysis, the DM can be advised to choose core projects and to reject exterior ones. Moreover, subsequent information elicitation efforts can be focused on intermediate projects, which helps reduce the costs of information elicitation.

In comparison with the earlier literature on robustness, *RPM* is unique in that it offers decision recommendations about individual projects instead of offering a 'single' optimal portfolio on some selected robustness measure (e.g., max-min). This makes it suitable for interactive group decision support processes where considerations that are less amenable to formal modelling efforts can be addressed through judgemental considerations (e.g., project interactions). To-date, we have carried out a wide range of applied RPM projects in the contexts of road asset management (Liesiö et al., forthcoming), formulation of a product strategy in a high-technology firm (Lindstedt et al., forthcoming), screening of innovation ideas (Könnölä et al., 2006a), development of a strategic research agenda (Könnölä et al., 2006b), and *ex post* evaluation of an innovation programme (Salo et al., 2005). Our current RPM-related projects are concerned with the selection voluntarily offered forest reserves in a conservation programme, the analysis of patent portfolios in high-technology company, the establishment of a research agenda for an industrial federation, and the development of guiding budgetary

principles for road asset management. We are actively working on the development of decision support tools for the computation (*RPM-Solver©*) and Internet-based dissemination of *RPM* results (*RPM-Explorer©)*.

*Contingent Portfolio Programming* (*CPP*; Gustafsson and Salo, 2005) is another recent methodology that we have developed for the management of project portfolio. An important rationale for this methodology is that although decision trees are widely employed in the development of project management strategies, they are not suitable for portfolio problems, because the number of decisions becomes prohibitive if there are many projects. For instance, if there are 10 projects at the initial decision node, there would be as many as $2^{10}$ = 1024 alternative decisions. This is far too many for the purpose of building a decision tree, even if many of these decisions may be infeasible due to budget constraints.

In essence, *CPP* is a novel framework for the selection and management of project portfolios in settings where exogenous uncertainties can be captured through scenario trees, and where the DM is interested in maximising her terminal resource position, as captured by an objective function that consists of the expected value of her resources and a modifying risk factor (e.g., lower semi-absolute deviation or expected downside risk). In such settings, *CPP* permits the determination of optimal project management strategies; it also permits the valuation of projects and real options in contexts where marketable securities are available to the investor (Gustafsson et al., 2005). We believe that the *CPP* methodology is a very promising one: for example, on November 14, 2005, the Decision Analysis Society of the Institute of Operations Research and the Management Sciences (INFORMS) recognized the significance of *CPP* by granting the best student paper award to Dr. Janne Gustafsson for our seminal paper (Gustafsson and Salo, 2005). At the moment, we are working on various extension and applications of the *CPP* methodology.

In our applied research projects, have worked extensively on the development of methodologies and approaches for Internet-based consultation processes, particularly in connection with technology foresight which, as an activity, can be defined as "an instrument of strategic policy intelligence which seeks to generate an enhanced understanding of possible scientific and technological developments and their impacts on economy and society, in order to support the shaping of sustainable S&T policies, the alignment of research and development (R&D) efforts with societal needs, the intensification of collaborative R&D activities and the systemic long-term development of innovation systems" (Salo and Cuhls, 2003). In this area, our past projects include, among others, foresight processes for the Finnish Food and Drink Industries Federation (Salo et al., 2004b), Foresight Forum of the Ministry of Trade and Industry (Könnölä et al., 2006), future-oriented evaluation of RTD programmes in electronics and telecommunication (Salo and Gustafsson, 2004), prospective evaluation of the cluster programmes for the forestry and forest-based industries (Salo et al., 2003, 2004a). We have also sought to make conceptual advances concerning the role of systematically structured foresight processes in relation to strategic policy making processes (see, e.g., Salo, 2001; Salo and Kuusi, 2001; Salo and Salmenkaita, 2002; Salmenkaita and Salo, 2002, 2004).

At the moment, we are responsible for the methodological and IT support for FinnSight 2015 (www.finnsight2015.fi) which is the largest foresight process in Finland to-date, run by and on behalf of the Academy of Finland and the National Technology Agency (Tekes). Taken together, these two funding organizations allocate some 600 million Euros for basic research and applied technological research per year. One of the main objectives of FinnSight 2015 – which is a collaborative process involving 120 leading experts from industry and academia – is to address future challenges that the Finnish society and its industries are faced with, and to identify focal competence areas that should be strengthened in view of these challenges. The results of this project will be widely communicated to the highest level of policy making including, for instance, the Prime Minister and other members of the Science and Technology Policy Council.

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# Forum
## (Robustness Analysis)

## Robustness Analysis: A Powerful Tool in the Multiple Criteria Decision Making Field.

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### 1. Introduction

Robustness analysis has achieved a remarkable importance in recent years. However, there is some confusion about the different meanings that the term robustness has received. For that reason it is necessary to delimit the significance of the word ***robustness*** and to pay special attention to studying robustness in Bayesian Methods and also in Multiple Criteria Decision Aid.

We know, perfectly well, that uncertainty is present and has an influence on every decision-making context. But it appears in different ways, which is:

- We can not omit nor relegate it;
- We need to realize its importance;
- We must consider it in an appropriate manner.

As Robustness allows us to experiment with uncertainty, it is necessary to define its concept, its significance and to emphasize its importance in the Multiple Criteria Decision Aid field.

### 2. Robustness: concept, meaning and importance

The word ***robustness*** is used very frequently in the Multiple Criteria Decision Making (MCDC) field. Recently, it has been introduced into the Multiple Criteria Decision Aid (MCDA) with a stable character.

It isn't always clear what is the real meaning of robustness. It can refer to: robust solutions, robust methods, robust processes and robust conclusions.

***Robust Solutions*** are those solutions that represent a process result or the one's which appear after some algorithmic application. Both, process and algorithm have to lead and to help the decision maker in the difficult task of choosing the best compromise solutions of the decision problem he faces.

The term robustness is used to characterize the process working or the algorithmic behaviour whose objective is to reach the alternative set ranking but in the presence of uncertainty.

Bernard Roy (1996) considers that a ***method*** is a well-defined process kind and a ***process*** is a sequence of instructions that, being applied to the set data problem produces a result. The obtained result, generally, consists of an acceptable solution to the problem. Every data set is considered as an instance of the decision problem.

A ***solution*** is every assertion that tries to use the information contained in the results referring to the same or every pair of elements [process; a data set] examined in the decision-making problem.

However, ***robust conclusions*** do not necessarily lead to the preference of one decision over another, to choose one method or another, but they simply limit the option scale offered to the decision maker.

### 3. The subjective aspect of Robustness

The robust ***adjective*** referred to methods, solutions or conclusions, it itself is strongly subjective. It is essential to make the reasons explicit and the factors, which produce arbitrariness, contingency and ignorance with respect to the questions which robustness is being studied.

In Phillipe Vincke's (1999) opinion the uncertainty sources that have been considered as the most important are the following:

1. The problem decision specifications are, usually, very imprecise, unpredictable, not much known and not well defined.
2. The environment in which the decision has to be taken could affect the conditions, under which the decision could operate.
3. The unstable and imprecise character of the value systems and the decision-maker preferences has priority in deciding the feasibility and the relative interest of the potential alternatives.

### 4. The search for Robustness

Why are we doing research into robustness? The question seems to be unlimited, imprecise and subject to innumerable different answers, so it is necessary to define it precisely. We look for robustness so that we can pay attention to the needs, and the different types of concerns, which the decision-makers are worried about.

Robustness must be studied in order to answer every wish or concern that the decision-maker or the analyst has declared during the steps of the decision making process.

The information received by the decision-maker or the analyst must be sufficiently useful for them to be able to delimit the performance field in which, every one of them has to operate and to think about. That information must be given in terms of solutions, methods and recommendations based on conclusions, which must be taken into account contingence, arbitrariness, imprecision, that is, ambiguity in a large and explicit sense.

## 5. Other Analyses in relation to Robustness Analysis

### Robustness in Statistics

The term robustness is very often used in Statistics in order to make reference to certain desirable characteristics of statistical processes. A *process* is considered *robust* with respect to the deviations of the model hypothesis when the process continues working in a suitable way, even though, some of the initial assumptions are not maintained.

The Bayesian researchers give a more specific meaning to the word *robustness*. The selection of the a priori distribution or the shape of the model that has been chosen for generating the data does not meaningfully affect a Bayesian application is robust if the unknown parameter distribution that follows.

In Hampel's (2001) opinion: *"Robust Statistics is the statistics process stability theory. It studies, systematically, the deviation effects from the initial model hypothesis to the known processes and, if necessary, it develops new and better processes".*

### Sensibility Analysis

It is a systematic process used by exploring how an optimal solution, in the paretian sense, is able to react under the changes that have been introduced in the initial conditions. Such changes are, usually, known values that could be different in the future or some parameters whose subjective values could be questionable.

The analysis is based on the initial assumption that optimisation is the most important and desirable instance by taking uncertainty as a potentially detrimental factor.
The objective of sensibility analysis is to analyse and to discover the sensibility strength of the optimal solution under the changes introduced in the essential factors. An insensitivity solution is considered a good opportunity and by introducing more linguistic confusion, it is, very often, named as a robust solution.

## 6. Robustness Analysis from the point of view of the Bayesian Decision Theory

### The first studies and research

The Bayesian Decision Theory and the Inference basis have been severely criticised form various sources from their beginnings. Perhaps, the main reason has been the extreme precision, which the input data might have under the Bayesian analysis. The starting point of various critics is very often the incomplete and imprecise nature of the decision-maker's opinions and preferences.

The need to know and to manage the uncertainty emerging from the imprecision and the lack of completeness in such a decision making context, in an appropriate way, has led the researchers to work and to investigate in certain scientific areas such as: stochastic domination, robust Bayesian statistics, sensibility analysis and alternative decision making inference models (Ríos-Insúa, Martín, 1993).

The authors referred to have studied axiomatic bases by modelling the lack of completeness and the lack of precision in the decision-maker opinions and preferences, using a utility function class and a probability distribution class.

In that way it is possible to unify and to support several recent research sources, especially, in the robustness and sensibility areas of Bayesian Decision Theory and Statistics.

The robustness study loses part of its strength in the Expected Utility Theory. A lot of experiments have proved that the Utility Theory isn't suitable enough and it loses its validity from a descriptive point of view (Ríos-Insúa; González-Pachón, 1993).

It is necessary to continue doing research in other directions in order to provide the Expected Utility theory with the appropriate robustness.

### Recent Approaches and New Study Directions

A lot of different studies and approaches have emerged from the European Working Group in Multiple Criteria Decision Aid in relation to robustness analysis.

There are two different approaches in the Multiple Criteria Discrete Decision Making Methods context, which have a high priority and importance in relation to other proposals:

- Outranking Relations Methods;
- Multiattribute Utility Theory.

There are as many conceptual as operative problems, with the point of view based on the Multiattribute Utility functions. Those difficulties have led to the development of other Multicriteria Discrete Decision Making Methods, perhaps, theoretically stronger but easier to apply in real situations.

The main advantage of working with Outranking Binary Relations is that the preferences are not necessarily transitive and it is possible that some alternative pairs are incomparable.

On the other hand, the transitivity and completeness must be present in every approach based on utility functions.

*What is the significance of Robustness Analysis in the field of the Bayesian Decision Theory?*

The Bayesian approach, with respect to both, the Inference and the Decision Analysis, essentially suggests the following actions (French; Ríos-Insúa, 2000):

1. To model opinions about a certain parameter which has interest in the initial instance, that in the presence of additional information, will be updated to a posterior instance.
2. To model the decision-maker preferences and their positions in relations to the risk of the expected multicriteria consequences, using a multiattribute utilily function.
3. To link every alternative with its expected multiattribute utility a posterior.
4. To propose the alternative which maximizes the expected posterior utility.

**7. The Robust Bayesian Analysis**

The practical motivation underlying the Robust Bayesian Analysis is the problem, which has the priori distribution evaluation.

A similar situation appears in the decision-maker preference modelling, in the sense that during the model development there is considerable imprecision in the data. In that case it's necessary to make a thorough analysis of the robustness model.

Berger et al (2000) have proposed three main approaches for studying the Bayesian Robustness:

a. Informal Approach.
b. Global Robustness.
c. Local Robustness

The *Informal Approach* has obtained a lot of popularity due to its simplicity, so that it is generally used. This approach represents a good initial measure to begin a sensibility analysis but it isn't enough and other more serious analyses should be carried out.

In the context of Bayesian Robustness Study, the best-known approach is the *Global Sensibility Analysis*. Every one of the likelihood measures in accordance with the available knowledge is considered and the robustness measures are computed as variations in the initial conditions inside a class.

The *Local Robustness* approach looks for a local sensibility and it studies the trade-off among the inferences and the decision by using differential techniques of functional analysis (Ríos-Insúa, 2004).

These different approaches, of the robustness study from the Bayesian point of view have given rise to an important but occasionally problematic discussion in relation with the meaning of robustness, in both, a decision and an expected utility function.

*If we want the robustness studies to actually have scientific strength it would be necessary to study their bases in depth.*

**8. Conclusions about the latest tendencies in Robust Bayesian Analysis**

The different approaches that the research has proposed have a procedure that could be summarized in the following way:

1. In a certain step of the analysis, some information with reference to the decision-maker's opinions, believes and preferences are obtained and the class of initial instances and utilities that are in accordance with such information are considered.
2. The next step consists of reaching an approximation of the non-dominated solutions set. If these alternatives are not very different from the expected utility, the analysis could stop; otherwise, it would be necessary to obtain additional information, probably, by using some of the Bayesian Decision Analysis appropriate tools.
3. The situation could limit the category even more: in this case, the non-dominated alternatives set will be smaller than the previous step and it could be possible that this iterative process could converge up to the limit where the non-dominated set is small enough to reach a final decision.
4. If in a certain step of the process it were not possible to obtain additional information, several non-dominated alternatives with different expected utility functions could be kept.

**9. General Conclusions**

In the broadest sense of the word, the robustness study requires us to determine: What is robustness? Why is robustness looked for? In relation to what is it studied?

- After having fulfilled this initial step we need to determine what is the robustness application environment.
- It is quite clear that the recent studies in Theory Decision have making the tendency to consider robustness as a very important tool in the Multiple Criteria Discrete Decision Aid; it is necessary to recognize the different points of view that exist in robustness analysis. The study of robustness must be outstanding not only in the Outranking Relations Methods but in Bayesian Decision Analysis as well.
- Obviously, the suggested approaches in every type of study have many differences among them; their bases and starting points are not the same. For that reason, they must be handled very carefully, and effort must be made to avoid wrong conclusions when the same "term" robustness could receive a different meaning in every field.

- In the present paper, the most important ideas that must be used in every field have been developed; the new approaches and the suggested terms for managing robustness analysis have been explained.
- Nevertheless, it is necessary to recognize that we are in a particular section of Decision Theory, in general terms, that needs to continue being researched not only through strong studies like the ones already presented, but in other directions that seem to be very promising.
- Independently of the point of view under which robustness is studied it is necessary to realize, without any doubt, that it's a powerful and useful tool to face the uncertainty that is usually present in every decision making process.

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## Some thoughts on the role of robustness analysis in decision-aiding processes

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This third series of our Newsletter, with José Figueira as Editor, has witnessed the appearance of a very interesting Forum on the theme of Robustness Analysis (RA), which already contains an excellent mix of articles. Bernard Roy opened the series with an enlightening set of questions (No. 6, Fall 2002), accompanied by Jonathan Rosenhead's article with the perspective behind the first uses of the "robustness analysis" expression, and followed by Philippe Vincke (No. 8, Fall 2003) who, like Roy, provides us a wide-scope perspective of the area. Four contributions followed, one focused on Bayesian inference / decision analysis, the others more focused on optimization contexts. This modest contribution will bring us back to a more general scope of multi-criteria decision aiding, to share some thoughts about the role that RA can play in such decision-aiding processes.

### Motivation

RA is motivated by the difficulties in setting the parameter values of decision-aiding models. Indeed, it is well known that setting technical and economical parameter values is often problematical: instruments and statistics can be imprecise (e.g., confidence intervals), measurement can be arbitrary and subjective (e.g., measuring noise pollution), some information (e.g. clinical data) may be controversial or contradictory, let alone uncertainties about the future. These are the type of difficulties that most easily come to our mind when talking about RA in classical optimization models.

When considering multi-criteria decision aiding, as we wish to do, we also incorporate in the models parameters related to the preferences of the Decision Maker (DM). Eliciting parameter values about preferences is also problematical. In cognitive terms, the parameters are artifacts whose semantic may be difficult to understand for the DM, not to mention biases related to the way questions are posed. For him or her, value judgments are naturally easier to express through words than through numbers. Furthermore, preferences may evolve, as they are often unstable outcomes of unresolved internal conflicts in the DM's mind. Adding to these fundamental difficulties, other constraints of a more pragmatic nature may be present, e.g., the DM is reluctant to divulge precise parameter values about his preferences in public, or his/her time and patience is rather limited.

Moreover, we often need to address the concerns of a group of actors, rather than a single DM. The above mentioned difficulties of fixing preference-related parameter values are still present, if not reinforced by the diversity of judgments. In such cases, the existence of "hidden agendas" may hinder an open discussion about parameter values. Even in case of consensus, one must be aware of phenomena such as groupthink.

### Concepts of Robustness Analysis

Sensitivity Analysis (SA) is a traditional answer to the difficulties in setting the parameter values. In optimization, it indicates how much the parameters may vary without changing some conclusion of interest. RA is often seen as a reverse perspective of SA, but that would depend on the notion of RA that is being considered. Indeed, we may find multiple perspectives about the concept. To Rosenhead (No. 6, Fall 2002), RA is used to choose one action that leaves many good options as regards the choices to be made in the future. Kouvelis and Yu [7] define robust solution to an optimization problem as the one which has the best performance under in its worst case (e.g., max-min rule). Another possibility is proposed by Aloulou et al. in this Forum (No. 12, Fall 2005). Mulvey et al. [9] differentiate between the quality of solution robust (that yields always a near-optimal value for every acceptable version of parameter values), from the quality of model robust (that is always feasible or almost feasible for every version). In this Forum (No. 10, Fall 2004), Sevaux and Sörensen introduce a concept of solution robustness meaning the solution (a plan) does not change much in optimization programs that are to be repeated regularly. More generally, Hites et al. [6] call for a multicriteria evaluation of robustness.

The perspectives that are nearer to the reverse of SA are Roy's definition of robust conclusion [11,12], as an assertion that is valid for set of results compatible with the different model versions envisaged, and Vincke's [13] definition of robust solution as one that is always near (or does not contradict) any other solution obtainable using an acceptable version ([13] has also introduced the notion of robust method).

Here, a version (to use the term recently proposed by Roy) of the model (or problem, in Roy's words) is formally a combination of parameter values defining a model (e.g., a linear programming model, or an Electre model). Usually, the model versions are considered as equally acceptable, without attempting to define a "meta-model" that would attribute different degrees of probability (or possibility, or importance…) to different versions.

**Roles for Robustness Analysis**

The role of RA in decision aiding does not seem to have been much discussed so far. Most of the proposed RA approaches can be separated according to their placement (ex-ante vs. ex-post) with respect to using a method to obtain a solution.

One of the possibilities is to consider RA as an ex-ante concern, which amounts to imbed this concern in a model to be optimized. In these cases, usually optimization problems, a model is built and an algorithm is used to obtain a solution that is robust according to some pre-specified criterion. The obtained solution will be optimal with respect to that criterion (e.g., it minimizes the maximum cost or the maximum regret), even though it might never have been optimal for any of the versions considered. Examples of these approaches are, e.g., [7,9]. An approach that seems particularly promising is to use several criteria rather than a single one to be optimized (as [6] suggested).

A second possibility is to consider RA as an ex-post concern, substituting or complementing SA, to assess how robust is a solution derived from a decision aiding process and to supply additional robust conclusions. Arguably, the first example of this type of approach is found in [12]. Such approaches may be useful to question the validity of the recommendation and how its evaluation might change from version to version, possibly identifying its limits and enriching the information that may be provided to the DM. For instance, rather than saying that $x$ is the best alternative in a choice problem, one may inform the DM that all alternatives are outranked by either $x$ or $y$, explaining what are the main differences between the versions that favour $x$ and those favouring $y$, and adding that $y$ is always a relatively good choice, while there are versions where $x$ receives a poor evaluation.

Before discussing a third possibility, we may note that for the approaches we mentioned before the set of versions is considered to have been defined a priori. As Roy notes in this Forum, this may cause a dilemma between the wish to take into account every conceivable version and the wish to obtain some useful conclusions. It is perhaps because of this dilemma that Roy [11] had earlier proposed the notion of approximately robust conclusion: a formal assertion that is verified for all the versions, except a few ones, which are considered negligible.

When we consider preference-related parameters, a third possibility is based on the idea of trying to progressively reduce the set of versions considered. This means using RA throughout the whole decision process as a tool to guide that process. The decision aiding process will reiterate phases of elicitation and RA. In elicitation phases, the DM will be questioned about parameter values, possibly indirectly, without requesting precise numbers (e.g., the answer can be an interval, or a comparison relation between two parameters), and noting that difficult elicitation questions may be avoided at early stages (allowing the DM to learn before answering). The DM's answers will then be used to constrain the set of versions considered. In RA phases, the robust conclusions corresponding to the versions are to be discussed. This may in turn motivate new elicitation questions, when returning to an elicitation phase.

If this third possibility is adopted, then RA becomes interactive, which is best achieved when there exists software to aid the DM and (possibly) an analyst during the successive iterations. We next provide two examples of such software.

*VIP Analysis (for details see [2])*

This software is intended to support choice decisions using additive value functions, allowing to draw robust conclusions when using different versions for the scaling weights ($k_1,\ldots,k_n$). In elicitation phases, the DM may indicate any information that can be translated as a linear constraint, such as intervals for weights or weight ratios, parameter comparisons (e.g., $k_1 \geq k_2$), or holistic comparisons (e.g., $a_1$ is not worse than $a_2$). In RA phases, VIP Analysis uses linear programming to identify the minimum and maximum value that each alternative may achieve, as well as the minimum and maximum differences of value between each alternative and the other ones.

The outputs of RA indicate which alternatives are most affected by imprecision, indicating also the versions leading to the extreme results (hence inviting the DM to ponder whether such versions are acceptable or not). In a choice problematic, RA also highlights which alternatives may be discarded (dominated or quasi-dominated with respect to versions), allowing a progressive reduction of the number of alternatives.

*IRIS (for details see [5])*

This software is intended to support sorting decisions using Electre Tri models, allowing different versions for the weights ($k_1,\ldots,k_n$) and cutting level ($\lambda$). It implements the idea of integrating RA with an aggregation/disaggregation approach (parameter inference) proposed by [4]. In elicitation phases, besides linear constraints on the weights, the DM may indicate sorting examples, which should be reproduced by IRIS. In RA phases, IRIS uses linear programming to show the range of categories where each alternative may be sorted, and to infer which of the versions would satisfy the constraints with maximum slack. It also provides some guidance when the inputs happen to be inconsistent.

IRIS encourages the DM to interact with it through communicating sorting examples, aiming to reduce progressively the interval of categories where each alternative may be sorted. As in VIP Analysis, IRIS indicates the versions corresponding to extreme results (worst and best categories for each alternative), thus inviting the DM to ponder the acceptability of such versions.

In common, these tools implement RA as a tool to guide a decision-aiding process, prompting questions for the DM to analyze, indicating what are the results more affected by his/her answers, and showing what can be robustly concluded. The aim will not be to select a version, but to highlight a set of robust conclusions that is found to be requisite (in the sense of [10]). This type of approach seems particularly well-suited when the RA concerns parameters related with preferences, in that the number of versions can be reduced as a result of learning or increased effort from the DM (it may also be indicated for other parameters than can be known with higher precision but at an additional cost, e.g., data from surveys or experimental data).

When the motivation for RA stems from the existence of multiple DMs, this type of approaches also seem promising as tools to guide a group decision process. In such processes, many versions may be needed to accommodate all the different views, and this set of versions can be discussed throughout an interactive process based on successive agreements. RA will show where disagreement is stronger, it will motivate the issues to be discussed, and will highlight robust conclusions (agreement). Some steps exploring these ideas have begun recently [1,3,8].

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# Consultancy Companies


**Catalyze Ltd**
**Multi-criteria Decision Analysis expertise**

Catalyze Ltd (http://www.catalyze.co.uk) provides a range of consulting services, education programmes, software tools and software development capabilities in the fields of Process Consulting and Decision Analysis. Associated with the London School of Economics and Political Science (LSE) through activities such as research project funding, discovery initiatives, knowledge transfer and practical sponsorships; Catalyze is at the leading-edge of Process Consulting and the Social Sciences.

Catalyze's mission is to help organisations to achieve alignment to their strategic objectives, through the creation, communication and application of usable scientific knowledge about decision making. Catalyze is a global organisation, helping many private and public sector organisations, developing innovative processes and software tools to support effective decision making.

The Company has five complementary streams to its business; Decision Conferencing, Decision Analysis Tools (Hiview3 & Equity3), Client Education, Custom Software Services and Process Consulting.

**Principal Facilitators**

Catalyze can boast some the best known and most experienced practitioners of decision theory in Europe, through its close working relationship with the LSE. Catalyzes Principal facilitators have over 35 years of commercial experience in delivering Multi-criteria Decision Analysis (MCDA) support and Decision Conferencing services to both the private and public sector. This level of experience and the highest of reputations has led to the implementation of Catalyze-led MCDA techniques into the direct decision making processes of many major and global organisations, including the UK MOD, BAE Systems, Local Authorities, DTi, DEFRA, The Environment Agency, Roche, Allergan and 3M.

**Professor Larry Phillips**

Professor Larry Phillips is recognised as a world-leading expert in the field of Decision Sciences and has been a Professor at LSE for over 20 Years. During this time, he has written many papers on both the social and technical aspects of Decision science. Working closely with economists he was also one of the main authors of the MCA Manual, a UK Government commissioned guide to using decision making techniques in the Public Sector.

A visiting professor at the LSE, teaching the Masters course in Decision Sciences, Larry has worked both academically and commercially in the field of Decision Sciences for over 30 years, facilitating 100's of decision conferences for both private and public organisations around the globe. His many academic and commercial publications include books, papers and commissioned works for the UK government and other globally recognised organisations. He was also a key figure in the development of long-established and popular MCDA software support tools Hiview3 and Equity3. A founding director of Catalyze, Prof. Phillips continues to provide unique thought leadership in the field of Decision Analysis and the wider aspects of the Decision Sciences.

Recently, Prof. Phillips was honoured by the Decision Analysis Society by receiving the organisations highest award; the Frank P. Ramsey Medal. The award was presented to Prof. Phillips at the INFORMS meeting in San Francisco in November 2005. The Ramsey Medal recognises distinguished contributions to the field of decision theory and its application to important classes of real decision problems. Prof. Phillips is the 17th medallist and the first in an institution outside the United States.

**Bob Kitchen**

Bob Kitchen, a senior partner and director has 25 years experience in the consulting business holding a number of senior management positions including Business Consulting, Innovation, Strategy, and new Market development, becoming a Partner & Director of Hewlett Packard's European consulting business prior to forming the Catalyze spin-off from the LSE in 2001. Bob holds a degree in Engineering, is a Member of the IEE and an active Member of the practitioners' society, the International Decision Conferencing Forum (IDCF).

**Catalyze services and products:**

**A. Decision Conferencing**

Decision Conferencing is a proven socio-technical method of achieving more effective decisions. It is designed to bring together groups of people who need to deal with complex issues facing their organisation. Often these groups will include individuals responsible for addressing operational, planning or strategic matters, but with

different functional responsibilities, different measures and different personalities. The Decision Conferencing process assists these groups in:

- *Developing a shared understanding of the issues*
- *Generating a sense of common purpose*
- *Achieving alignment and commitment to action*

It has been applied to most major issues facing private organisations, government departments, charities and voluntary organisations. Topics can cover financial investment, strategy setting, budget optimisation, marketing targets and more.

These techniques are endorsed in the UK by the Office of the Deputy Prime Minister and by HM Treasury and have been used to achieve increased value-for-money or improvements in the effectiveness of the deployment of resources by an average of 30%. Through demonstrating auditable value-for-money decisions, this approach has streamlined and facilitated budget, business planning and governmental approvals.

Decision Conferencing is used for many strategic purposes, including:-

- strategy development
- strategic alignment
- budget consolidation
- policy setting
- crisis management
- resource allocation
- strategic systems design

**B. Decision Analysis Tools**

Catalyze develops and publishes commercially available MCDA software tools. These tools are designed to support MCDA methodology and Decision Conferencing techniques. These tools are also promoted and supported as part of the curriculum of business and OR courses at many universities around the world.

**C. Hiview3 – Option Evaluation**

Hiview3 is a decision modelling tool that supports the appraisal and evaluation of options. It is equally effective for individual decisions or group decision making, such as decision conferences. With a host of user-defined features, Hiview3 can be configured to address a variety of problem areas, supporting specific business objectives. Hiview3 incorporates some elements of the M-MACBETH approach to provide the optional elicitation of verbal judgements for scoring, weighting and value function development.

Hiview3 has enabled users to make informed decisions in areas such as strategic option evaluation & selection, scenario evaluation, gap analysis, procurement appraisals & site selection.

**D. Equity3 – Portfolio Analysis**

Equity3 is an MCDA tool that assists organisations in obtaining better value for-money, when allocating limited resources and budgets. It is highly adaptive and can be used to address a variety of problem areas including R&D investment, marketing portfolio management, project prioritisation, resource allocation, system requirements analysis, capital and revenue budgeting, sales territory reorganisation and negotiations. Equity3 is ideal for use with groups as in Decision Conferences.

**E. Client Education**

Catalyze is committed to making more people aware of MCDA and associated techniques, so offers a wide range of Client Education and open training Programmes, designed to transfer essential knowledge and integrate processes into client organisations. From specialist MCDA courses to custom implementation programmes for organisations; The cornerstone of these courses is the Advanced Decision Skills: Facilitation & Analysis course, which runs once a year in London School of Economics over 9-days. The 4-day Decision Skills: Theory & Analysis runs twice yearly (May & Nov). We also regularly run other educational courses covering Value-for-money in Procurement, Process Mapping and the Strategic Choice Approach (SCA).

**F. Software Services**

Catalyze also offers technical and creative capabilities to clients that require specialist Software Development, Implementation and Integration. We have an in-depth understanding of how technology can be used to improve our clients' businesses and we provide consultancy and technology-based solutions to a wide range of clients. Our in-house software team caters for every stage of software deployment: from concept to delivery.

**G. Process Consulting**

The final service stream falls under the banner of Process Consulting. Here we enable more effective business decisions through a number of process services, such as Process Mapping, Procurement Guidance, Gap Analysis, SCA and Strategic Planning; all of which draw upon aspects of Multi-criteria Decision Analysis and Decision Support.

**In practice**

Catalyze is involved in many on-going client projects with organisations in many different sectors and markets. The diversity of these clients is a testament to the versatility of MCDA as an approach, but every client shares common ground in the recognition of the need for a consistent and open approach to decision making, which involves and engages groups to work together to make decisions in the

context of the strategy of the organisation. Here are a few recent examples of how these techniques work in practice.

**Case 1 - UK Ministry of Defence**

The UK Ministry of Defence are a long-standing Catalyze client, which has engaged the company on a number of specific decision making projects over the past few years. This decision project centred round procurement Specification, Guidance & Negotiation services to support the outsourcing of their IT system.

Catalyzes involvement included the development of the cross-organisational user requirements, with a focus on the benefits of each aspect delivered. The development of a negotiation / trade-off model covering all aspects of functionality and service requirements of the bidder's proposed solutions. An initial series of Decision Conferences were run to facilitate the cross-functional group's evaluation of all the proposed options against the agreed strategic criteria. Further Decision Conferences were designed to engage the senior decision makers in the evaluation of the bids and the preparation for negotiation with a understanding of the value in addition functionality of all aspects of the systems' design. Using MCDA techniques at every stage, Catalyze was able to facilitate the alignment of the whole organisation with the trade-off of benefits, enabling it to negotiate the best practical value-for-money solution and not just project affordability.

Catalyze were also engaged in a subsequent project to align the whole of the MoD behind the prioritisation of the roll-out of solution, maximising the benefits over the implementation timeframes.

**Case 2 – The Environment Agency**

This recent project for the UK Environment Agency centred on developing a process for prioritising resources for science projects over the next 3 years. Using MCDA techniques, including Decision Conferencing, the Environment Agency were taken through the process for the first time, helping them to develop the options and strategic assessment criteria.

The structured approach was used to bring user-groups and stakeholders together to discuss and define requirements during the specification phase; defining and outlining the requirements, promoting a clear understanding and alignment of the goals with the organisation's stakeholders.

The approach was refined and adapted to their precise social requirements. The project ensured alignment and agreement on the best value portfolio of science investments for their available budget, whilst ensuring that they meet the overall objectives of the programme. The techniques employed ensured that the requirements were met for the specification to be defined and decisions made on a transparent and auditable basis. Catalyze also provided essential skills transfer, formal training, coaching and documentation of the business processes, so that Environment Agency could continue to use the tools and techniques into the future.

**Case 3 – UK Radioactive Waste Management**

Catalyze were engaged to help the Committee on Radioactive Waste Management (CoRWM) review the disposal and storage options for all of the different forms of UK's accumulated radioactive waste.

Catalyze ran a large number of decision conferences with radioactive specialists, public stakeholders, local / central government representatives and other interested parties such as; Greenpeace and Friends of the Earth. An MCDA approach was employed to develop a structured evaluation process of the 14 options against 26 decision criteria for each of 7 different waste streams. A series of workshops were facilitated to draw out the preferences of the various representatives to create and agree scales, value functions, scoring and weighting values. A series of scenarios have been developed and sensitivity analyses conducted in a public forum.

The CoRWM project will be completed in June 2006, using the MCDA evaluation approach supported by the Hiview3 software to make a recommendation to the UK Government on the most appropriate disposal and/or storage options for the UK's radioactive waste inventory.

**Conclusion**

Whether clients use software tools as a sanity check to their thought processes, base their decisions on the outcomes of fully-fledged MCDA-led Decision Conferences or bring MCDA techniques and tools into everyday use through training, they have all realised the operational power and potential of MCDA methodology and processes.

For more information, product downloads, academic papers and case studies, visit: http://www.catalyze.co.uk

# Software

## DSS Site Tools Version 1.0

by
**Nabil Belacel, René Richard**
*National Research Council of Canada*
*Institute for Information Technology*

**News**

We are pleased to announce a new web site dedicated to on-line decision support systems. This web site was supported by the Institute for Information Technology at the National Research Council of Canada (NRC).

**DSS Site**

The Decision Support System Site (DSS Site version 1.0) **www.dss-belacel.net** is a web site consisting of a series of data mining tools designed to explore data in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data.

There are varieties of techniques for data mining such as Cluster Analysis, Neural Network and Decision Trees. Here, we introduce new data mining methodology tools, developed recently by Dr Nabil Belacel, for Decision Support Systems.

Among the tools that have already been implemented in DSS version 1.0, we have:

***Fuzzy J-Means*:** Fuzzy Clustering with Fuzzy J-Means method provides a solution for the fuzzy clustering problem with a new local search heuristic, in which the neighborhood is defined by all possible centroid-to-pattern relocation [1].

***Fuzzy classification method PROAFTN: PROAFTN*** is a fuzzy classification method for assigning objects to predefined classes. This method belongs to the class of supervised learning algorithms and based on fuzzy outranking approach [2].

In order to use the web based algorithms found on the site, a user must create an account by registering with the site. The registration process is fully automated and follows a process typically found in self registration web applications.

Figure 1 illustrates the site registration form. The user’s input is validated using JavaServer Faces’ validation mechanisms [3, 4]. The site’s architecture and JavaServer Faces are discussed further in this article.


Figure 1- Registration Form

If the registration data is valid, the user is sent an e-mail with a unique link to confirm the account creation (see Figure 2).


Figure 2 - Account creation (confirmation)

When the account creation process is complete, the user can then login and use the classification algorithms on a limited set of data. Figure 3 illustrates the interface for applying the fuzzy *J-Means* algorithm, to a dataset which is uploaded using the web interface.

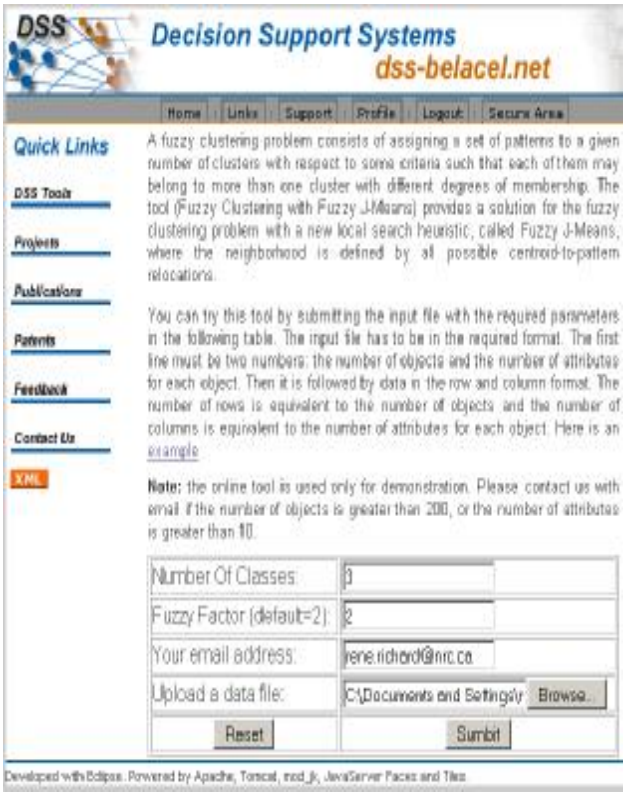


Figure 3 - Fuzzy J-Mean Algorithm Interface

The DSS version 1.0 web site includes two classification methods Fuzzy J-Means for clustering or unsupervised problems and *PROAFTN* for supervised learning problems. The fuzzy *J-Means* method is a local search method, where moves belong to the neighborhood of the current solution defined by all possible centroid-to-pattern relocations. This crisp solution found is then transformed into a fuzzy one by an alternate step, i.e., by finding centroids and membership degree for all patterns and clusters. The fuzzy *J-Means* heuristic is then embedded in the variable neighborhood search metaheuristic framework. More details are in [1]. The recent application in bioinformatics shows the efficiency of Fuzzy *J-Means* to cluster genes from Microarray data [5]. The second tool that has been implemented in this version is the *PROAFTN* method. The *PROAFTN* method belongs to the class of supervised learning and it is used for solving multiple criteria classification problems. The *PROAFTN* method has been applied to the resolution of many real-world practical problems including medical diagnosis [6], asthma treatment [7] and crew scheduling problems [8]. In this version, we have implemented the Chebyshev's theorem with variable neighborhood search metaheuristic for determining the parameters of *PROAFTN* method as described in [9]. Two validation techniques were considered to test *PROAFTN* methodology: 10-cross validation and leave-one-out techniques.

For this version, we have implemented fuzzy *J-Means* and *PROAFTN* methods for only small datasets. To use DSS for large datasets, a license will be required.

The next version of the DSS web site (DSS 1.1) will include:

- New classification methods such as Fuzzy choice approach for fuzzy classification problems *PROCFTN* [10] and automatic clustering method known as Inter-cluster.

- On-line clinical decision support system. We will incorporate a web based application, which integrates a fuzzy classification method *PROAFTN* in Acute leukemia Diagnosis. The on-line clinical decision support system has been implemented to be a complete useful reference for clinical practice and an e-learning resource [11].

**Site Architecture**

This section gives a broad overview of the web site's architecture. Please see Figure 4 for the architecture diagram.

The user interacts with the application using a web browser. He can select a classification algorithm and submit a dataset for processing. This represents the Presentation tier.

The Web / Business Logic tier is implemented on top of JavaServer Faces and the Tomcat servlet container. The business objects in the servlet container create batch jobs based on user interactions. This represents the Web / Business Logic tier.

The submitted batch jobs are stored on in a relational database. This represents the Storage tier. Batch jobs are processed on a scheduled basis and produce results which are emailed to the user.

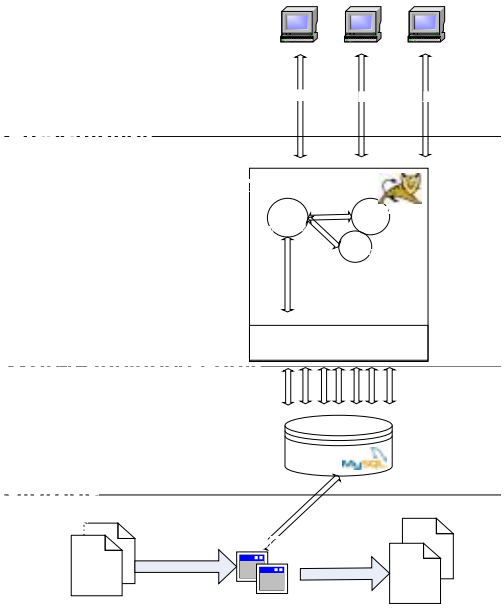

Figure 4- Site architecture

**JavaServer Faces**

JavaServer Faces (JSF) is a web application framework for creating user interfaces. JSF enables the web developer to create and re-use server-side custom components. It also enables the web developer to attach event handling code to these components and manage their state. Events are generated on the client side and handlers are executed on the server side. Additional framework features include: page navigation, input validation and internalization.

JSF is also a technology specification, which is managed by the Java Community Process (JCP) [12]. Because JSF web applications are developed in a standard way, Integrated Development Environment (IDE) vendors can create products, which automate redundant tasks and enhance a developer's productivity.

The JSF specification in combination with other existing server side specifications enables web applications to be deployed in a variety of servlet containers without modifications [12].

The latest version of the JavaServer Faces technology is version 1.2, which is currently being developed through the Java Community Process under JSR-252.

The most recent implementation of the JavaServer Faces technology is version 1.1. The DSS Web Site uses version 1.1.01 of the JavaServer Faces Reference Implementation.

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## Persons and Facts

**International Society on MCDM - Elections for the Executive Committee:**

There are nine candidates (**Ami Arbel**, **Fouad Ben Abdelhaziz**, **Luiz F. Autran M. Gomes**, **Salvatore Greco**, **Jacinto Gonzalez-Pachon**, **Kathrin Klamroth**, **Antonie Stam**, **Daniel Vanderpooten**, **Luis Vargas**) for the four posts in the Executive Committee. The voting will be electronic. The members of the Society will receive further information about the voting procedure by email. All those who were members of the Society before the conference or joined before end of July can vote.

## About the 63rd Meeting

by

**Manuel Matos, Jorge Pinho de Sousa**

The 63rd meeting of the European Working Group "Multiple Criteria Decision Aiding" was held in Porto, Portugal, in 30-31 March 2006, at INESC Porto and FEUP (Faculdade de Engenharia da Universidade do Porto). Manuel Matos and Jorge Pinho de Sousa were the organisers, with the support of Paula Castro, Sónia Pinto and Rute Ferreira.

The organisation was supported by INESC Porto, FEUP, the Department of Electrical Engineering and Computers of FEUP and by two important companies of the region: UNICER (a large brewery and drink company) and STCP (the public transport authority in the city). EURO supported the participation of some PhD students.

The meeting was attended by almost 60 participants from 16 different countries, around the preferential theme of Performance Evaluation (individuals, institutions, services, etc), but with a large diversity of contributions from different areas, as reported in the programme (see below).

Besides the usual documentation, the participants received a copy of a book edited by Carlos Antunes, José Figueira and João Clímaco with papers based on the communications made to the 56th meeting of the group, kindly offered by the editors.

**Special session**

An important feature of the meeting was the special session on Fundamental Issues in the practice of Decision Aid. This session was organised in the sequence of discussions carried out in previous meetings and gave the opportunity to the members of the group for a free exchange of points of view about methodology and MCDA practice.

One of the main points of discussion was the robustness of the conclusions of the decision-aid process. The identification of possible points of fragility of the procedures and the need for sensitivity analysis was emphasised. The use of synthetic data was advocated as a means to help detecting fragilities in the procedures, but the accent was placed in the interpretation of decision-aid as a social process, where some questions about parameters, weights, etc, may either have no sense to the decision maker or lead to arbitrary answers. The importance of the technical conditions for the application of decision-aid tools was also stressed.

Modeling issues were also discussed. Structuring difficulties were reported and the lack of a complete vision by the experts when building models was emphasised. Presenting sub-models to the stakeholders, in order to validate models was suggested in this context.

Student training experience regarding decision-aid methodologies was reported and the difficulties of self-study (i.e. without the access to a Decision Maker) were pointed out.

**Social programme**

The social programme included a small visit to Port Wine cellars, followed by the banquet in the premises of the same Port Wine Company, and the traditional excursion on Saturday.

The excursion began by a bus trip around Porto that ended in the historical part of the city, where a guided visit to the Palace of the Commercial Association was organised, followed by a tour by boat in the river Douro and ending with a lunch on a restaurant over the river.

**PROGRAMME**

**Jeudi 30 mars / Thursday, March 30**

10:30-11:15 Inscription / Registration

**11:15-11:30 Session d'ouverture / Opening session**

**11:30-13:00 Session 1**
***Décision en groupe et comportement des clients***
**Group Decision Making and Customer Behavior**
*Président/Chairman : Carlos Bana e Costa*

Claude Lamboray, "An approach to support the search for a group ranking based on robust conclusions with prudent orders"

Dhmos Loukas, Iannis Papadimitriou, "Group decision-making using correspondence analysis"

Yannis Siskos, Nikos Tsotsolas, Nikos Christodoulakis, "Data Set Generator for Customer Satisfaction Surveys"

13:00–14:00 Déjeuner / Lunch

**14:00-16:00 Session 2**
***Questions environnementales et soustenabilité***
**Environmental and sustainability issues**
*Président/Chairman : Maria Franca Norese*

Abdelkader Mendas, "Combination of GIS and multi-criterion analysis methods to help to the decision making. Application on water resources"

Benjamin ROUSVAL, « Vers une aide multicritère à l'évaluation de l'impact des transports sur l'environnement »

Jaroslava Hálová, Martin Aust, Lucia Austová, "MCDM as a tool of Setubal principles as applied to toxicology"

Stéphane Andre, « Evaluation de la performance environnementale pour un site d´une entreprise industrielle »

16:00-16:30 Pause café / Coffee break

**16:30-18:00 Session 3**
***Sélection de projets et évaluation de performances***
**Project selection and performance evaluation**
*Président/Chairman : Willem Brauers*

Maria Franca Norese, Valentina Torta, "Project selection activities in the public administration"

Mounir Bouter, « Elaboration d´un modèle d´aide à la sélection des projets : l´intégration de l´analyse multicritère et la programmation mathématique à objectifs multiples »

Patrick Meyer, "Kappalab: an R package for Choquet integral based MAUT"

*Papiers soumis à discussion / Papers submitted for discussion*

- Chrysovalantis Gaganis, Fotios Pasiouras, Constantin Zopounidis, "External auditors decisions in EU credit institutions: a Multicriteria approach"
- María A. de Vicente y Oliva, Jaime Manera Bassa, Mónica Martín del Peso, « Conception d'une méthodologie d´évaluation et contrôle du rendement académique d'une université composée de différents Campus Thématiques: Les cas global/université et particulier/campus »
- Nikolaos F. Matsatsinis, Vassilios Chr. Fortsas, "Using the lexicographic optimization method for the assessment of distance education trainees"
- Holger Rosencrantz, "Rational performance in complex goal systems – Comparing different procedures for evaluation"
- Kyriaki Kosmidou and Constantin Zopounidis, "Competitiveness of European Countries Using a Multicriteria Methodology"
- Fernando Tavares Pereira, José Figueira, Vincent Mousseau, Bernard Roy, "Comparing two territory partitions in the districting problems: Measures and practical issues"

**18:00-18:30 Session UNICER**
*Président/Chairman : Jorge Pinho de Sousa*

**Vendredi 31 mars / Friday, March 31**

**9:00-10:30 Session 4**
***Applications en Economie***
**Applications in Economy**
*Président/Chairman : Mª Carmen Escribano Ródenas*

Willem Karel M. Brauers, Edmundas Kazimieras Zavadskas, "MOORA a new method for multi-objective optimization and performance management"

Edmond Vardumyan, "MCDA problems addressing"

*Papiers soumis à discussion / Papers submitted for discussion*

- Georgios Samaras, Nikolaos Matsatsinis, "A Multicriteria Methodology for the evaluation of the Athens Exchange stocks"
- Mª Carmen Escribano Ródenas, Gabriela M. Fernández Barberis, Mª Carmen García Centeno, «Application d´un modèle de Décision Multicritère au problème de la distribution des héritages dans al-Andalus (VIII-XV siècles) »
- Mª Carmen Escribano Ródenas, Gabriela M. Fernández Barberis, Mª Carmen García Centeno, "Estimation of Asymmetric Stochastic volatility for Stock Index Returns. Order of financial indexes through the PROMETHEE Methods"

– Vladimir I. Kalica, "A new MCDM methodology accounting for uncertainty and its application for modelling stock buying-selling on stock exchange"

10:30-11:00 Pause café / Coffee break

**11:00-13:00 Session Spéciale / Special Session**
***Aspects Fondamentaux dans la pratique de l'Aide à la Décision***
**Fundamental Issues in the practice of Decision Aid**
*Président/Chairman: Manuel Matos*

13:00-14:00 Déjeuner / Lunch

**14:00-14:30**
***Vie du groupe et prochaines réunions***
**Working group matters and next meetings**
*Président/Chairman: Bernard Roy*

**14:30-16:00 Session 5**
***Aspects théoriques***
**Theoretical aspects**
*Président/Chairman: Yannis Siskos*

Risto Lahdelma, Pekka Salminen, "The effect of the Shape of the utility/value function in SMAA"

Thierry Marchant, "An axiomatic characterization of different majority concepts"

Vasila Postilicã, "Choquet boundaries and recent related topics"

*Papiers soumis à discussion / Papers submitted for discussion*

– Indrek Kaldo, Inga Parts, "On some methods for solving multiobjective optimization problems"
– Jean-Luc Marichal, "The weighted lattice polynomials as aggregation functions"
– Michel Grabisch, « Les approches lexicographiques pour l´intégrale de Sugeno »
– Valentin Bertsch, Jutta Geldermann, Otto Rentz, "Preferential Uncertainties in Multi-Attribute Performance Evaluation"

16:00-16:30 Pause café / Coffee break

**16:30-18:30 Session 6**
***Classification et modélisation de préférences***
**Classification and preference modeling**
*Président/Chairman: Nikolaos F. Matsatsinis*

Iryna Yevseyeva, "Assisting in Attention Deficit Hyperactivity Disorder diagnostics with Multicriteria Decision Aiding"

Juscelino Almeida Dias, José Rui Figueira, « L´analyse de cohérence dans les méthodes du tipe électre »

## Forthcoming Meetings

(This section is prepared by Carlos Henggeler Antunes)

### Forthcoming EWG Meettings/Prochaines réunions du Groupe

**Note:**

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

**September 28-30, 2006. 64th Meeting of the European Working Group on MCDA. Organisers: Georgios Samaras, Pandelis Ipsilandis and Nikolaos Matsatsinis. Main Topic: Multicriteria Decision Support Systems. Place: Larissa – Greece. Contacts emails:**
**G. Samaras (samaras@teilar.gr)**
**P. Ipsilandis (ipsil@teilar.gr)**
**N. Matsatsinis (nikos@ergasya.tuc.gr)**
**Web page: http://dde.sdo.teilar.gr/mcda64. E-mail: mcda64@teilar.gr**

**65th Meeting of the EURO Working Group on *Multiple Criteria Decision Aiding.* Poznań, Poland. March 22-23 or March 29-30, 2007. Hosted by the Laboratory of Intelligent Decision Support Systems of the Institute of Computing Science, Poznań University of Technology. Organizer: Roman Słowiński (roman.slowinski@cs.put.poznan.pl).**

### Other Meetings

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

6th European Conference on Evolutionary Computation in Combinatorial Optimization Budapest, Hungary. April 10 - April 12, 2006. [http://evonet.lri.fr/eurogp2006/?page=evocop]

35th Western Decision Sciences Institute Conference Waikoloa, Hawaii, USA. April 11 - April 15, 2006. [http://wdsinet.org/call.html]

1st Nordic Optimization Symposium Copenhagen, Denmark. April 20, - April 22, 2006, [http://www.nordicmps.org/]

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

INFORMS Practice Conference 2006: Applying Science to the Art of Business Hotel InterContinental Miami, FL. April 30 - May 2, 2006. [http://www.informs.org/Conf/Practice06]

The Second International Workshop in Modelling Complex Systems Glasgow, Scotland. May 8 - May 11, 2006. [http://computing.dcu.ie/~jburns/iccsa2006/cfp.htm]

2006 Meeting on Network Data Analysis and Data Mining DIMACS Center, Rutgers University, Piscataway, NJ, USA. May 10 - May 13, 2006. [http://www.classification-society.org/csna/csna.html]

ECCO XIX - CO 2006 Joint meeting of the European Chapter on Combinatorial Optimization working group and the Combinatorial Optimization Conference, Porto, Portugal. May 11- May13, 2006. http://www.apdio.pt/ECCOXIX-CO2006/

Special Track on Evolutionary Optimization at the 19th International FLAIRS Conference Melbourne, Florida, USA. May 11 - May 13, 2006. [http://eden.dei.uc.pt/~jast/evoopt2006/]

2006 IEEE Swarm Intelligence Symposium Indianapolis, IN, USA. May 12, 2006 - May 14, 2006, [http://www.computelligence.org/sis/]

The International Conference on Information System, Logistics and Supply Chain (ILS'06) Lyon, France. May 15 - May 17, 2006. [http://www.fucam.ac.be/redirect.php3?id=36960]

5th Int Conf on Operational Research: Simulation and Optimization in Business and Industry Tallinn, Estonia. May 17 - May 20, 2006. [http://majandus.ttu.ee/SOBI/]

INCOM06: An OR and Industrial Engineering Symposium. Saint Etienne, France. May 17- May 19, 2006. http://www.emse.fr/incom06

OPERATIONAL RISK MANAGMENT FORUM Boston, MA. May 22 - May 24, 2006.. [http://www.acius.net]

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

Fifth International Workshop on Experimental Algorithm Menorca Island, Spain. May 24 - May 27, 2006. [http://www.lsi.upc.edu/~wea]

6th Int. Conf. on Algorithms and Complexity (CIAC '06) Rome, Italy. May 29 - May 31, 2006. [http://www.dsi.uniroma1.it/~ciac/]

Third International Symposium on Neural Networks (ISNN 2006 ) Chengdu, China. May 29 - May 31, 2006, [http://www.acae.cuhk.edu.hk/~isnn2006]

ELEVENTH INTERNATIONAL WORKSHOP ON NON-MONOTONIC REASONING Lake District, England. May 30 - June 1, 2006,

Integration of AI and OR Techniques in Constraint Programming for COP (CP-AI-OR'06) Cork, Ireland. May 31 - June 2, 2006. [http://tidel.mie.utoronto.ca/cpaior/]

The 16th International Conference on Automated Planning and Scheduling The English Lake District, Cumbria, U.K. June 6 - June 10, 2006. [http://icaps06.icaps-conference.org/]

INFORMS Marketing Science Conference The Westin Convention Center Pittsburgh, Pittsburgh, Pennsylvania. June 8 - June 10, 2006. [http://www.katz.pitt.edu/mks2006]

ACM Conference on Electronic Commerce (EC'06) University of Michigan, Ann Arbor, MI, USA. June 11 - June 15, 2006. [http://stiet.si.umich.edu/ec06/]

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

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

The 11th M&SOM Conference Georgia Institute of Technology's campus. June 19 - June 20, 2006,. [http://www.isye.gatech.edu/msom2006/]

CMWR XVI - Computational Methods in Water Resources XVI International Conference Copenhagen, Denmark. June 19 - June 22, 2006. [http://www.cmwr-xvi.org/]

MCDM 2006 Conference. Chania, Greece. June 19 – June 23, 2006. http://www.dpem.tuc.gr/fel/mcdm2006/

APMOD 2006. Madrid, Spain. June 19 – June 21, 2006. apmod2006@bayes.escet.urjc.es,apmod2006@iit.icai.upcomillas.es. http://www.apmod.org.uk/

The International MultiConference of Engineers and Computer Scientists 2006, Hong Kong. June 20 – June 22, 2006. http://www.iaeng.org/IMECS2006/index.html

The Second International Conference on Algorithmic Aspects in Information and Management (AAIM'06) City University of Hong Kong, Hong Kong, China. June 20 - June 22, 2006. [http://www.cs.cityu.edu.hk/~aaim06/]

3rd European Performance Engineering Workshop Budapest, Hungary. June 21 - June 22, 2006. [http://webspn.hit.bme.hu/~epew2006]

Third IEEE Int Conf on Management of Innovation and Technology (ICMIT'2006) Singapore. June 21 - June 23, 2006.[http://www.ntu.edu.sg/mae/admin/divisions/systems/icmit2006/]

CASPT 2006: 10th International Conference on Computer-Aided Scheduling of Public Transport. Leeds, U.K. June 21 - June 23, 2006. http://www.comp.leeds.ac.uk/rsk/caspt06/index.php

13th SIAM Conference on Discrete Mathematics (DM 2006) University of Victoria, Victoria, British Columbia, Canada. June 25 - June 28, 2006. [http://www.siam.org/meetings/dm06/index.php]

CEC’06 and EEE’06 Joint Conferences San Francisco, California. June 26 - June 29, 2006. [http://linux.ece.uci.edu/cec06/]

5th EUROPT Workshop on ADVANCES IN CONTINUOUS OPTIMIZATION Reykjavik, Iceland. June 30 - July 1, 2006. [http://wwwhome.math.utwente.nl/~stillgj/COPT06/ ]

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

26th National Congress on Operational Research and Industrial Engineering (YA/EM 2006). Kocaeli, Turkey. July 3 - July 5, 2006. http://www.yaem2006.org/

10th Scandinavian Workshop on Algorithm Theory SWAT 2006 Riga, Latvia. July 6 - July 8, 2006,. [http://www.lumii.lv/swat].

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

Genetic and Evolutionary Computation Conference (GECCO-2006) Seattle, WA, USA. July 8 - July 12, 2006. [http://isgec.org/gecco-2006/]

12th International Congress on Computational and Applied Mathematics Katholieke Universiteit Leuven, Leuven, Belgium. July 10 - July 14, 2006. [http://www.cs.kuleuven.be/conference/iccam2006/]

The European Conference on IT Management, Leadership and Governance Paris, France. July 12 - July 13, 2006. [http://academic-conferences.org/index.htm]

INFORMS Teaching Management Science Workshop 2006 San Francisco State University. July 13 - July 16, 2006.[http://www.informs.org/Edu/TMSWorkshop/TMS06]

IEEE World Congress on Evolutionary Computation 2006 (WCCI 2006) Vancouver, BC, Canada. July 16 - July 21, 2006. [http://www.wcci2006.org/home.html]

2nd SIPTA School on Imprecise Probabilities. Madrid, Spain. July 24 - July 28, 2006,. http://bayes.escet.urjc.es/~emiranda/sipta

The 19th International Symposium on Mathematical Programming (ISMP 2006) Rio de Janeiro, Brazil. July 30 - August 4, 2006. [http://www.ismp2006.org/]

AMCIS 2006 Minitrack "Decision Support Systems in the Environment" Acapulco, Mexico. August 4 - August 6, 2006.[http://www.homepages.dsu.edu/elgayaro/AMCIS06-Call%20for%20papers.htm]

First International Conference on Knowledge Science, Engineering and Management (KSEM'2006) Guilin City, China. August 5 - August 8, 2006. [http://www.cs.ust.hk/ksem06]

The 6th International Symposium on Operations Research and Its Applications Xinjiang, China. August 8 - August 12, 2006. [http://www.orsc.org.cn/conferences/isora06/ISORA2006_CallforPapers.htm]

EURO Summer Institute 2006 Lutherstadt Wittenberg, Germany. August 18 - September 2, 2006, [http://www.mathematik.tu-darmstadt.de/events/esi2006]

14th INTERNATIONAL SYMPOSIUM ON INVENTORIES - Call for Papers: Demand Forecasting for Inventory Management. Budapest, Hungary. August 21, 2006 - August 25, 2006. http://www.isir.hu

Multidisciplinary ECAI-06 Workshop on ADVANCES IN PREFERENCE HANDLING Riva del Garda, Italy. August 28, 2006 - August 29, 2006. [http://www.mycosima.com/ecai2006-preferences/]

The 6th International Conference on the Practice and Theory of Automated Timetabling (PATAT 2006) Brno, Czech Republic. August 30 - September 1, 2006. [http://patat06.muni.cz/]

Topics in Mathematical Analysis and Graph Theory Belgrade, Serbia and Montenegro. September 1 - September 4, 2006. [http://magt.etf.bg.ac.yu]

EURO Summer Institute 2006 Optimization challenges in engineering: Methods, software and applications, Lutherstadt Wittenberg, Germany. August 18- September 2, 2006. [http://www.mathematik.tu-darmstadt.de/events/esi2006]

The 6th International Conference on the Practice and Theory of Automated Timetabling (PATAT 2006) Brno, Czech Republic. August 30 - September 1, 2006. [http://patat06.muni.cz/]

Fifth International Workshop on Ant Colony Optimization and Swarm Intelligence (ANTS 2006) Brussels, Belgium. September 4 - September 7, 2006. [http://iridia.ulb.ac.be/ants2006/index.php]

19th Mini-EURO Conference on Operational Research Models and Methods in the Energy Sector, Coimbra, Portugal. September 6 - September 8, 2006. [http://www.inescc.pt/ormmes06]

Operations Research 2006. Karlsruhe, Germany. September 6 - September 8, 2006. http://www.or2006.de

OR48 - The Annual Conference of the UK Operational Research Society. University of Bath, UK. September 11 - September 13, 2006. http://www.theorsociety.com

11th International Conference on Operational Research (KOI 2006) Pula, Croatia. September 27 - September 29, 2006. [http://www.efpu.hr/koi06]

IWDL 2006 International Workshop on Distribution Logistics Brescia (Italy). October 2 - October 4, 2006. [http://fausto.eco.unibs.it/~iwdl2006/]

Fourth Annual International Symposium on Supply Chain Management Toronto, ON, Canada. October 4 - October 6, 2006. [http://merc.mcmaster.ca/symposium/SCMSymposium2006.html]

BIOMA2006 - The 2nd International Conference on Bio-inspired Optimization Methods and their Applications Ljubljana, Slovenia. October 9 - October 10, 2006. [http://bioma.ijs.si/conference/2006/]

HYBRID METAHEURISTICS - HM 2006 Gran Canaria, Spain. October 13 - October 15, 2006,. [http://www.lsi.upc.edu/~hm2006/]

INFORMS Annual Meeting 2006, Pittsburgh Pittsburgh, PA, USA. November 5 - November 8, 2006,. [http://www.informs.org/Conf/Pittsburgh06]

5th Columbia Optimization Day Columbia. December 5, 2006,. [http://www.corc.ieor.columbia.edu/meetings/c5/c5.html]

ISFUROS 2006 - International Symposium on Fuzzy and Rough Sets. Santa Clara, Cuba. December 5 - December 8, 2006. http://isfuros06.uclv.edu.cu

10th. Annual Conference of the Society of Operations Management Ahmedabad, India. December 21 - December 23, 2006. [http://www.socopm.org/conferences/acsom2006]

INOC 2007. Spa, Belgium. April 22- April 25, 2007. enog@euro-online.org. http://www.euro-online.org/enog/

INFORMS Computing Society Conference Omni Colonnade Hotel, Coral Gables, Florida. Puerto Rico International 2007 Rio Grande, Puerto Rico. July 8 - July 11, 2007. [http://www.informs.org/Conf/PuertoRico2007/]

EURO XXII, 22nd European Conference on Operational Research. Praha, Czech Republic. July 9 - July 13, 2007. euro2007@vse.cz. http://euro2007.vse.cz

INFORMS Annual Meeting 2007, Seattle Seattle, WA, USA. November 4 - November 7, 2007.

IFORS 2008, 18th Triennial Conference of the International Federation of Operational Research Societies. Sandton, South Africa. July 7 - July 11, 2008. http://www.orssa.org.za

## Annoucements

Dear Colleague,
Please find below the weblink of a new journal for the publication of your papers.

http://www.worldscinet.com/nmnc/mkt/editorial.shtml

Best regards,

Prof. Constantin Zopounidis

*** *** ***

Dear Colleague,

We are very pleased to inform you that the 64th Meeting of the European Working Group (MCDA'64) **on "Multiple Criteria Decision Aiding"** will be held in Larissa Greece.

The meeting which is organized by the Technological Education Institute of Larissa (TEI/L) and the Greek Multicriteria Analysis Group of the Hellenic Operational Research Society (HELORS), will take place on **September 28-30, 2006**,.

The main theme of this meeting is:

**Multicriteria Decision Support Systems**

Detailed information about the conference topics, the programme committee the call for papers, the conference venue, the registration as well as the hotel accommodation, is available on the web site:

http://dde.sdo.teilar.gr/mcda64

Kindly be informed that the deadline for abstracts submission is until July 10, 2006.

Attached please find the call for papers.

We expect to welcome you in Larissa.

On behalf of the organizers

Georgios Samaras

Pandelis Ipsilandis

Nikos Matsatsinis

## Call for Paper

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

## Books

*** *** ***

**Evaluation and Decision Models with Multiple Criteria: Stepping stones for the analyst**
by
**Bouyssou**, D., **Marchant**, T., **Pirlot**, M., **Tsoukiàs**, A., **Vincke**, P.

Springer Science + Business Media, Inc.
Series: International Series in Operations Research & Management Science , Vol. 86
2006, XVI, 448 p., 47 illus., Hardcover
ISBN: 0-387-31098-3

**About this book**

Formal decision and evaluation models are sets of explicit and well-defined rules to collect, assess, and process information in order to be able to make recommendations in decision and/or evaluation processes. They are so widespread that almost no one can pretend not to have used or suffered the consequences of one of them.

In our earlier companion volume, Evaluation and Decision Models, we heavily criticised formal models but we also argued that they could be useful. On the other hand, Evaluation and Decision Models with Multiple Criteria is a guide, a way of reasoning aimed at helping the analyst to choose a model and use it consistently. We propose, often using an axiomatic point of view, a sound analysis of techniques aimed at supporting the decision aiding process. Our presentation is carried out within a unique framework that can be extended to most decision and evaluation models, as a "decision aiding methodology".

Evaluation and Decision Models with Multiple Criteria is intended for the aware or enlightened practitioner, for anyone who uses decision or evaluation models---for research or for applications---and is willing to question his practice, to have a deeper understanding of what he does.

The authors of this book are European academics working in four different universities and research institutions. They teach in engineering, mathematics, computer science and psychology schools. Their background is quite varied: mathematics, economics, engineering, law and geology, but they are all active in decision support and more particularly in multiple criteria decision support. Preference modelling, fuzzy logic, aggregation techniques, social choice theory, artificial intelligence, problem structuring, measurement theory and Operational Research are among their special interests.

The authors are active in theoretical research on the foundations of decision aiding, mainly from an axiomatic point of view. Moreover, all the authors have been involved and continue to be engaged in a wide range of applications from software evaluation to location of a nuclear repository, through the rehabilitation of a sewer network or the location of high-voltage lines.

http://www.springer.com/west/home/business/operations+research?SGWID=4-40521-22-116132747-0

*** *** ***

**Optimization Methods for a Stakeholder Society: A Revolution in Economic Thinking by Multi-objective Optimization**

by

William K. Brauers

Kluwer Academic Publishers (www.wkap.nl)
(Nonconvex Optimization and Its Applications)
(Hardcover)

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**Vector Optimization**
by
**Jahn, Johannes**

Springer Science + Business Media, Inc
Theory, Applications, and Extensions
2004, XIII, 465 p., 62 illus., Hardcover
ISBN: 3-540-20615-9

**About this book**

This book presents fundamentals and important results of vector optimization in a general setting. The theory developed includes scalarization, existence theorems, a generalized Lagrange multiplier rule and duality results. Applications to vector approximation, cooperative game theory and multiobjective optimization are described. The theory is extended to set optimization with particular emphasis on contingent epiderivatives, subgradients and optimality conditions. Background material of convex analysis being necessary is concisely summarized at the beginning.

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**Soft Computing for Complex Multiple Criteria Decision Making**
by
**Kaliszewski**, **Ignacy**

Springer Science + Business Media, Inc
Series: International Series in Operations Research & Management Science , Vol. 85
2006, XX, 172 p., 48 illus., Hardcover
ISBN: 0-387-30243-3

**About this book**

There are numerous books on Multiple Criteria Decision Making. Soft Computing for Complex Multiple Criteria Decision Making concentrates on providing technical (meaning formal, mathematical, algorithmical) tools to make the user of Multiple Criteria Decision Making methodologies independent of bulky optimization computations. These bulky computations up to now have been a necessary, but limiting, characteristic of interactive MCDM methodologies and algorithms. This book removes these limitations of MCDM problems by reducing a problem's computational complexity. The book systematically applies the approximate — soft — treatments to major MCDM solving methodologies. As a result, it provides a wider and more functional general framework for presenting, teaching, implementing and applying a wide range of MCDM methodologies. The book seeks to provide a stimulus for a broader development and application of MCDM methods.

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**Metaheuristics for Hard Optimization: Methods and Case Studies**
by
**Johann Dréo, Alain Pétrowski, Patrick Siarry & Eric Taillard**
Book coordinated by Patrick Siarry

SPRINGER
ISBN 3-540-23022-X. December 2005.
369 p. 140 illus. Hardcover
Recommended Retail Price: US $ 99.00
http://www.springer.com/sgw/cda/frontpage/0,11855,4-40109-22-52101430-0,00.html

Metaheuristics for Hard Optimization comprises of three parts. The first part is devoted to the detailed presentation of the four most widely known metaheuristics: the simulated annealing method, the tabu search, the evolutionary and the genetic algorithms, the ant colony algorithms. Each one of these metaheuristics is actually a family of methods, of which the essential elements are discussed. In the second part, the book presents some other less widespread metaheuristics, then extensions of metaheuristics and some ways of research are described . The problem of the choice of a metaheuristic is posed and solution methods are discussed. The last part concentrates on three case studies from telecommunications, air traffic control, and vehicle routing.

**Keywords**: Metaheuristics, Multiobjective optimization, Global optimization.

**Contents:**
Introduction.- Simulated annealing.- Tabu search.- Evolutionary algorithms.- Ant colony algorithms.- Some other metaheuristics.- Extensions.- Methodology.- Optimization of UMTS radio access networks with genetic algorithms.- Genetic algorithms applied to air traffic management.- Constraint programming and ant colonies applied to vehicle routing problems.- Conclusion.- Appendix A: modeling of simulated annealing through the Markov chain formalism.- Appendix B : complete example of implementation of tabu search for the Quadratic Assignment Problem.- References.- Index.

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**Stochastic Local Search Algorithms for Multiobjective Combinatorial Optimization: Methods and Analysis**
by
**Luís Paquete**

**Volume** 295 Dissertations in Artificial Intelligence-Infix
February 2006, 372 pp., softcover
**ISBN:** 1-58603-596-7 NEW
**Price:** US$66 / €55 / £38

Multiobjective Combinatorial Optimization Problems (MCOPs) arise in many real-life applications and they are among the hardest optimization problems. Therefore, high-quality approximations that can be obtained in reasonable time are, in practice, preferable to the often infeasible long computation times required for finding the optimum. Stochastic Local Search (SLS) algorithms were shown to give state-of-the-art results for many other problems, but little is known on how to design and analyse them for MCOPs. The main purpose of this book is to fill this gap. We start by defining two search models that correspond to two distinct ways of tackling MCOPs by SLS algorithms. Notions of local optima for MCOPs are formally introduced and related to the typical outcome of SLS algorithms. Moreover, we present a systematic approach for the design of these algorithms based on the notion of SLS components and a general guideline to empirically analyse algorithm performance. Finally, several SLS algorithms and SLS components are tested on the Multiobjective Traveling Salesman Problem and the Multiobjective Quadratic Assignment Problem. The effect of instance features and SLS components on the performance of the SLS algorithms are identified by experimental design techniques. The results obtained clearly indicate that the best performing variants are new state-of-the-art algorithms

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## Articles Harvest

(This section is prepared by Juscelino Almeida Dias)

MAVROTAS, George and TRIFILLIS, Panagiotis (2006) – Multicriteria decision analysis with minimum information: combining DEA with MAVT, *Computers & Operations Research*, 33 (8), 2083-2098.

JIMÉNEZ, António; RÍOS-INSUA, Sixto and MATEOS, Alfonso (2006) – A generic multi-attribute analysis system, *Computers & Operations Research*, 33 (4), 1081-1101.

DUARTE, Belmiro and REIS, A. (2006) - Developing a projects evaluation system based on multiple attribute value theory, *Computers & Operations Research*, 33 (5), 1488-1504.

LACOMME, P.; PRINS, C. and SEVAUX, M. (2006) - A genetic algorithm for a bi-objective capacitated arc routing problem, *Computers & Operations Research*, 33 (12), 3473-3493.

KIM, Byung-In; KIM, Seongbae and SAHOO, Surya (2006) - Waste collection vehicle routing problem with time windows, *Computers & Operations Research*, 33 (12), 3624-3642.

KROS, John F.; LIN, Mike and BROWN, Marvin L. (2006) - Effects of the neural network s-Sigmoid function on KDD in the presence of imprecise data, *Computers & Operations Research*, 33 (11), 3136-3149.

WANG, Ling, ZHANG, Liang and ZHENG, Da-Zhong (2006) - An effective hybrid genetic algorithm for flow shop scheduling with limited buffers, *Computers & Operations Research*, 33 (10), 2960-2971.

WRIGHT, M.B. (2006) - Scheduling fixtures for Basketball New Zealand, *Computers & Operations Research*, 33 (7), 1875-1893.

CHURILOV, L. and FLITMAN, A. (2006) - Towards fair ranking of Olympics achievements: the case of Sydney 2000, *Computers & Operations Research*, 33 (7), 2057-2082.

KIM, Jaehee and KIM, Sheung-Kown (2006) - A CHIM-based interactive Tchebycheff procedure for multiple objective decision making, *Computers & Operations Research*, 33 (6), 1557-1574.

CHEN, Ye; KILGOUR, D. Marc and HIPEL, Keith W. (2006) - Multiple criteria classification with an application in water resources planning, *Computers & Operations Research*, 33 (11), 3301-3323.

ESTEVE, B.; AUBIJOUX, C.; CHARTIER, A. and T'KINDT, V. (2006) - A recovering beam search algorithm for the single machine Just-in-Time scheduling problem, *European Journal of Operational Research*, 172 (3), 798-813.

NAGURNEY, Anna and KE, Ke (2006) - Financial networks with intermediation: Risk management with variable weights, *European Journal of Operational Research*, 172 (1), 40-63.

HAHN, Eugene D. (2006) - Link function selection in stochastic multicriteria decision making models, *European Journal of Operational Research*, 172 (1), 86-100.

LABREUCHE, Christophe and GRABISCH, Michel (2006) - Generalized Choquet-like aggregation functions for handling bipolar scales, *European Journal of Operational Research*, 172 (3), 931-955.

YANG, J.B.; WANG, Y.M.; XU, D.L. and CHIN, K.S. (2006) - The evidential reasoning approach for MADA under both probabilistic and fuzzy uncertainties, *European Journal of Operational Research*, 171 (1), 309-343.

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# Dissertations

ÖZTÜRK, Meltem. « Les Structures Mathématiques et Logiques pour la Comparaison des Intervalles ». Jury : Directeur de thèse: Alexis TSOUKIAS, Directeur de recherche au CNRS. Rapporteurs: Patrice PERNY, Professeur à l'Université Paris VI, Marc PIRLOT, Professeur à la Faculté Polytechnique de Mons ; Suffrageants: Denis BOUYSSOU Directeur de recherche au CNRS, Pierre MARQUIS Professeur à l'Université d'Artois, Fred ROBERTS Professeur à l'Université de Rutgers, Philippe VINCKE Professeur à l'Université Libre de Bruxelles

ABSTRACT: This thesis deals with the mathematical and logical structures utilized for interval comparisons. The use of interval representation is natural and brings interesting results for decision processus trying to model preferences having complex nature and/or situations covering uncertain information. This thesis aims to improve the knowledge on the preference structures having interval representation. We distinguish two cases: "crisp case" and "fuzzy case". In crisp case, we propose a general framework for interval comparisons while in fuzzy case we propose two "fuzzy" methods for interval comparison. In both cases, we make use of logics as formal languages for our models. Within this perspective, we analyze the use of the classic logic, the fuzzy logic, the four valued logic and its continuous extension. We conclude by an analysis of the continuous extension of a four valued logic that we interpret in the possibility theory.

PUSCEDDU, Clara. "Managing Actors' interaction for Public Decision Aiding in Urban Planning. PhD Thesis, University of Pisa, Lamsade Université Paris Dauphine. Supervisors: Professor Giovanni Maciocco, Professor Alexis Tsoukiàs.

ABSTRACT: This thesis comes within the scope of strategic and prospective reflection about the efficiency of decision aiding methods for urban planning. The emergence of the concept of sustainability for public urban policies, as well as more and more complex decision contexts, tends to reinforce the needs of decision aiding methods for public actors in a perspective of urban governance. In the same time, these two new factors also challenge the ability of traditional decision aiding methods to take properly into account participation and communication, especially for implementation of urban planning public projects. In this framework, the thesis proposes a model of public actors' interaction and validates it in the decision processes concerning the implementation of projects composing the strategic urban plan of Pesaro's city in Italy. Validation shows how the model provides analytic-cognitive and prescriptive-normative guidelines to Pesaro's decision makers. Precisely analytic-cognitive guidelines provide insights on actors involved, their respective roles and legitimacies, their relative positions, potential conflicts and help decision makers to represent the complexity of urban decision problems. Prescriptive-normative guidelines provide insights in defining appropriate actors' interaction strategies according to the complexity of urban decision problems.

ROUSVAL, Benjamin. "Multiple criteria evaluation aiding of the impacts of transports on the environnement", PhD Dissertation, University: Paris IX Dauphine Jury: ***Luc ADOLPHE*** (Professeur des Universités à l'IFU), ***Jacques BEAUMONT*** (Directeur de recherches à l'INRETS), ***Denis BOUYSSOU*** (Directeur de recherches au CNRS), ***Michel LAMURE*** (Professeur des Universités à Lyon 1), ***Jean LATERRASSE*** (Professeur des Universités à Marne La Vallée), ***Michel MAURIN*** (Chargé de recherches à l'INRETS) et ***Bernard ROY*** (Professeur des Universités à Paris IX Dauphine).

ABSTRACT: This PhD thesis is driven by Inrets and Lamsade. It leads to contributing to the conception of a computer science tool for the public in charge who would wish to use a model in order to manage environmental problems due to transports in a sustainable way, and in the context of participative democracy. We thus propose a "multicriteria evaluation aiding of environmental impact of transports" which consists of structuring a set of objectives as a hierarchy, then to apprehend their achievement using criteria, with the goals of: establishing a diagnosis, giving alarm or carrying out a trend analysis and not systematically considering a decision problem. That naturally leads us to compare traditional "decision aiding" with "evaluation aiding". Taking into account the complexity of the problem and to face the conflict between the simplicity and the transparency of an evaluation's result, we propose, at all the levels of the hierarchy of objectives, a multicriteria aggregation which is strongly inspired by the Electre Tri method and the Atmo index. We illustrate that by a modelisation of the problem, functional specifications and a prototype.

**Announcement:**

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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).

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

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

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

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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.

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**European Working Group "Multiple Criteria Decision Aiding"**

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## Supplément Nº 2

# Des Critères Multiple en Recherche Opérationnelle : Pourquoi ?

**par**

**Bernard ROY**

## Supplement Nº 2

# Why use Multiple Criteria in Operational Research?

**by**

**Bernard ROY**

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# DES CRITÈRES MULTIPLES EN RECHERCHE OPÉRATIONELLE : POURQUOI ?

**Why use multiple criteria in Operations Research?**

*National Contribution of FRANCE*

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Résumé : Le schéma classique pour expliquer et gouverner l'évolution d'un système consiste à déterminer une grandeur (entropie, utilité, profit, valeur, satisfaction,…) que le système (ou un agent) et censé optimiser spontanément ou devrait tendre à optimiser. C'est à partir de ce paradigme monocritère que s'est historiquement développée la Recherche Opérationnelle. Dans cet article, nous montrons que, pour comprendre ce qu'apporte la prise en compte de critères multiples, il convient de faire référence à un autre paradigme. Après l'avoir expliqué et illustré, nous efforçons de répondre à la question posée par le titre.

Abstract: The usual scheme followed in order to explain or govern the evolution of a system is to determine a numerical entity (entropy, utility, profit, value, satisfaction,…) that the system (or an agent) is supposed to spontaneously optimize, or that it should tend to optimize. The "monocriterion" paradigm was the historical basis for the development of Operations Research. Our article demonstrates that, in order to understand the full impact of taking several criteria into account, one has to refer to a quite different paradigm. In the first part, we shall expose and illustrate this paradigm; in the second part, we shall try to answer the question we put as a title.

Analyse multicritère, aide multicritère à la decision, multicriteria decision models ou encore multicriteria decision making sont des expressions de plus en plus couramment employées. Depuis une vingtaine d'années, la place dévolue à la prise en compte de critères multiples n'a cessé de croître, que ce soit dans les congrès de Recherche Opérationnelle, dans les publications à caractère théorique ou dans les études concrètes. Est-ce là un simple phénomène de mode ? Est-ce, au contraire, le signe d'une évolution plus profonde de l'émergence de quelque chose de radicalement nouveau dans la façon d'envisager l'apport de la science à la conduite des processus de décision ?

Aux yeux de certains, l'introduction de plusieurs critères peut apparaître comme l'indice d'une réflexion insuffisante ou d'une déficience dans la formulation du problème. En effet, la présence d'un critère unique (fonction économique, fonction d'utilité,…) peut être jugée nécessaire si l'on veut avoir affaire à un problème bien posé : ce que l'on cherche peut être clairement défini en termes d'optimum du critère considéré. Cet optimum peut être plus ou moins difficile à découvrir mais une fois délimité le champ des possibles, ce que l'on cherche est défini sans ambiguïté. Il en va tout autrement dès lors qu'il y a plus d'un critère. Il convient donc de se demander en quoi consiste le gain face à ce qui peut apparaître comme une perte.

Les deux parties qui suivent sont des ébauches de réponse à ces questions.

## 1. PASSAGE D'UN PARADIGME ANCIEN À UN PARADIGME NOUVEAU

### *1.1 Un critère unique pour expliquer et gouverner*

La Recherche Opérationnelle s'est constituée à partir de modèles qui postulent l'existence d'un critère unique (voir notamment Churchman ***et al.***, 1957). Durant fort longtemps, on a admis (sans beaucoup d'examen critique) que, pour aider des entreprises à « mieux décider », il y avait, en règle générale, un critère qui s'imposait aux yeux de tous pour caractériser la « bonne direction » dans laquelle il convenait de faire évoluer le système auquel on s'intéressait. C'était là se placer, en matière de management, dans un schéma de pensée qui paraissait naturel parce que familier. C'est en effet en prenant appui sur ce même schéma que, dans d'autres domaines, on s'est efforcé d'expliquer et de gouverner l'évolution d'un système fort varié. Pour bien me faire comprendre sur ce point, je crois utile d'évoquer quelques exemples bien connus.

Les physiciens sont parvenus à décrire l'évolution de divers systèmes naturels en mettant en évidence une fonction (potentiel, entropie,…) et en vérifiant que tout se passe comme si le système avait spontanément tendance à aller vers le minimum ou le maximum de cette fonction. En un certain sens, une telle fonction explique et gouverne l'évolution du système. Les économistes mathématiciens, lorsqu'il ont cherché, avec Samuelson, Debreu,…, à bâtir des modèles pour décrire le fonctionnement d'une économie, ont eu recours à un schéma semblable : ils ont introduit, dans l'espace des biens et des productions, un ordre de préférence, lequel peut être décrit par une fonction d'utilité, et ils ont admis que tout se passe comme si chaque consommateur, chaque producteur « tiraient le système dans le sens de son utilité croissante ». Dans le même ordre d'idées, en matière de gestion publique, on a cherché à expliciter un critère d'intérêt général alors que, en théorie de la firme, on prend appui sur le critère d'intérêt du profit maximum. En sociologie, on trouve de nombreux travaux qui visent à faire jouer au « pouvoir » ce rôle de critère directeur. Un rôle analogue est dévolu au « plaisir » dans les théories freudiennes.

Ces exemples montrent que dans des domaines très divers de la pensée, la recherche d'une explication pour comprendre l'évolution d'un système et, éventuellement, pour agir sur cette évolution, a été articulée autour de cette idée d'un **critère unique directeur**, principe fondamental qui gouverne ou devrait gouverner l'évolution du système. Ce schéma de pensée apparaît donc comme une base d'accord pour raisonner et produire des connaissances valables. Il y a donc là une manière de faire reconnue comme valide aussi bien dans une optique descriptive que normative. Je m'y référerai désormais en parlant du **paradigme** [1] **monocritère**.

Avec le paradigme monocritère, c'est un aspect de la réalité qui est privilégié et qu'il faut traquer au travers d'une grandeur, d'une fonction de façon à pouvoir affirmer que tout se passe comme si, ou que tout devrait se passer comme si, le système recherchait spontanément, ou les acteurs qui interviennent dans le système recherchaient naturellement, un extremum de cette grandeur ou de cette fonction.

### *1.2 Des critères multiples pour comprendre et arbitrer*

La fécondité du paradigme monocritère ne peut être mise en doute. Pourtant, ce que l'on voit à l'œuvre sous l'étiquette multicritère, fait très fréquemment [2] référence à un autre paradigme. Je l'appellerai le **paradigme multicritère**. Avant de préciser en quoi il consiste, je voudrais souligner qu'il ne me paraît nullement destiné à remplacer le paradigme monocritère : il est différent et il a sa place à côté, en complément. Cela signifie en particulier que le fait de passer d'un critère à plusieurs ne peut pas être vu comme une généralisation : le paradigme monocritère n'est pas un cas particulier du paradigme multicritère. Ce nouveau paradigme repose sur une autre façon de regarder et/ou de construire le réel. C'est ce que je voudrais montrer maintenant.

Afin de caractériser le paradigme multicritère, je dirai que, dans ce nouveau schéma de pensée, pour comprendre et agir sur un système, on considère que :

*a) plusieurs critères sont à l'œuvre pour conduire le système ou guider son évolution,*
*b) ces critères sont, au moins localement, conflictuels,*
*c) ils tendent à faire se succéder des compromis ou invitent à procéder à un arbitrage,*
*d) ces compromis ou arbitrages ont pour objet de conférer au critère des valeurs compatibles avec une certaine forme d'équilibre et, s'il y a succession, cela tient au caractère transitoire de l'équivalent atteint.*

Ces quatre points appellent quelques développements. Tout comme le critère unique, les divers critères à l'œuvre apparaissent comme des forces ou des valeurs qui « tirent ou devraient tirer » le système et donnent sens au « mieux » et au « moins bien ». Dire que ces critères entrent en conflit localement (cf. b)), c'est dire que, au moins dans certaines circonstances, aller dans le sens du mieux pour un critère conduit obligatoirement à aller dans le sens du moins bien pour un autre critère. Supposer que de telles circonstances n'existent pas revient à regarder tous les critères comme la réplique du même,

[1] Cf. Kuhn (1972). Voir aussi Boudon (1977) et Girin (1981).
[2] Précisons que ce changement de paradigme n'est pas véritablement accompli lorsque (comme dans Keeney et Raiffa, 1976 ou Hwang *et al.*, 1979) l'on postule l'existence d'une fonction d'utilité prédéterminée qui, prenant en compte les critères ou attributs multiples, dicte ou doit dicter le comportement.

autrement dit à revenir au paradigme monocritère. Alors que ce dernier postule ***a priori*** l'existence d'un sens clairement défini pour l'évolution naturelle ou souhaitée, le paradigme multicritère, du fait de l'existence des conflits, ne conduit pas à regarder la voie suivie ou à suivre comme toute tracée. Il n'y a plus d'optimum à découvrir ou à atteindre mais seulement des compromis possibles, des arbitrages à inventer. Le compromis ou l'arbitrage (qui demeurent des notions imprécises [3]) correspond à un état du système qui confère aux différents critères des valeurs suffisamment satisfaisantes ou en harmonie pour se trouver compatibles avec une certaine forme d'équilibre face aux différents conflits. Cet équilibre peut être fragile, transitoire ; c'est pourquoi le paradigme multicritère amène à envisager la succession possible de compromis (cf. c) et d)) sans pour autant devoir faire référence à un principe de convergence. Le lecteur qui souhaiterait approfondir ce point pourra se reporter à Vincke (1982), Vanderpooten (1987 [4]) ainsi qu'à Roy (1985, section 11.4). Je réserverai dans la suite le terme arbitrage au cas où une telle succession n'est pas envisagée.

### *1.3 Illustrations et remarques*

Afin d'illustrer ces deux paradigmes, intéressons-nous tout d'abord à un exemple familier : celui du choix d'une voiture par un particulier, Monsieur M, que l'on supposera être le seul acteur du processus de décision.

On peut regarder M comme un homo-economicus qui porte en lui (sans qu'il sache nécessairement l'expliciter) une fonction d'utilité lui permettant de comparer, de façon stable, deux modèles quelconques de voitures dès lors qu'il en connaît les caractéristiques. Ce schéma conduit à admettre que Monsieur M se déterminera sans peine en faveur du modèle de voitures qui, parmi tous ceux dont il a pu avoir connaissance, maximise sa fonction d'utilité (tout au plus sera-t-il amené à hésiter si deux modèles sont ex æquo à l'optimum). Aussi longtemps qu'il n'aura pas connaissance d'un modèle ayant une utilité dépassant celle du modèle choisi, il n'aura aucune raison de regretter le choix antérieur.

Une autre façon de faire pour comprendre le processus par lequel Monsieur M choisit finalement une voiture consiste à privilégier différents axes de comparaison qui semblent significatifs à ses yeux. Il peut s'agir du prix d'achat, de la consommation en milieu urbain, de la tenue de route (reprises, comportement à grande vitesse,…), du confort ou de l'habitabilité,… A chacun de ces axes se trouve naturellement associé un critère (plus ou moins bien explicité) qui peut entrer en conflit avec les autres : plus la voiture est confortable ou spacieuse et plus elle est chère, plus elle est puissante et plus elle consomme,… Certains modèles que Monsieur M connaît bien constituent sans doute, à ses yeux, des solutions inacceptables : trop cher eu égard à l'habitabilité, consommant trop en ville pour des performances sur route insuffisantes,… Ayant ainsi éliminé un certain nombre de modèles, on peut imaginer que Monsieur M examine, l'un

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[3] Il ne faut pas perdre de vue l'impossibilité affirmer par Kuhn de réduire un paradigme à un ensemble de règles précises.

[4] Voir aussi :

- D. Vanderpooten : "The interactive approach in MCDA: A technical framework and some basic conceptions", ***Mathematical and Computer Modelling*** 12(10/11), 1989, 1213-1220.
- D. Vanderpooten: "Modelling in decision aiding", in ***Aiding decisions with multiple criteria – Essays in Honor of Bernard Roy***, edited by Denis Bouyssou, Eric Jacquet-Lagrèze, Patrice Perny, Roman Słowiński, Daniel Vanderpooten, Philippe Vincke, Kluwer Academic Publishers, 2001, 195-210.

après l'autre, chacun de ceux qui restent en se demandant s'il réalise un compromis acceptable ; en les comparant, il pourra par exemple se demander si le supplément de dépense qu'implique l'un par rapport à un autre est ou non équilibré par des gains suffisants selon les autres critères. De proche en proche, il pourra être amené à remettre en question certains des jugements de préférences portés préalablement. Il pourra admettre qu'aucun modèle ne constitue un compromis valable et qu'il convient d'aller regarder d'autres marques qu'il ne connaît pas. Lorsqu'il aura finalement choisi, il se pourra fort bien que, sans connaître de modèles nouveaux, il soit amené à regretter son choix.

Revenons maintenant à la Recherche Opérationnelle. Elle a pour vocation d'éclairer des décisions. Décider, c'est agir sur un système. Ce système peut être, dans certains cas un processus de décision (quelquefois individuel comme ci-dessus mais plus fréquemment multi-acteurs) ou, le plus souvent, ce dont un tel processus s'occupe. Il peut alors s'agir d'un processus de production (raffinerie), de réalisation (chantier, atelier), d'approvisionnement (matières premières ou outillage), d'entretien (matériels, locaux), d'affectation de ressources limitées (équipage, véhicule),… Comprendre l'évolution de tels systèmes et plus encore, rendre celle-ci conforme à des desiderata plus ou moins explicites ne relèvent qu'exceptionnellement de la recherche de la solution à un problème posé de telle sorte qu'il en admette une et une seule ou plusieurs qui soient équivalentes. Il s'agit bien plus souvent de faire surgir des éclairages propices pour construire, cerner, faire accepter certains compromis ou arbitrages. Le modèle d'interprétation de la réalité et d'intervention sur elle qui découle du paradigme multicritère semble (ne serait-ce que pour cette première raison) mieux approprié, dans bien des cas que celui qui découle du paradigme monocritère. Les deux exemples qui suivent illustrent ce point de vue.

Afin d'automatiser ses principaux centres de tri de paquets, la poste française a lancé un appel d'offres concernant la réalisation d'un prototype pour une nouvelle machine à trier les paquets. Divers responsables de la Direction des Postes devaient, à partir des dossiers de réponse (conformes à un cahier des charges), sélectionner un constructeur pour réaliser le prototype puis la série de machines. Il est vite apparu impossible (cf. Renard, 1986 [5]) de cerner un critère susceptible d'être reconnu par ces responsables comme pouvant, à lui seul, déterminer le choix. Les dirigeants de la poste raisonnent en fonction d'objectifs stratégiques (délai, possibilité d'extension,…), de considérations financières (coût d'investissement, de fonctionnement) mais aussi commerciales (qualité de service vis-à-vis des usagers) ; ils doivent également prendre en compte les conditions de travail dans les bureaux de tri (ergonomie, vitesse de tri, sécurité,…). Pour dire qu'une offre est meilleure qu'une autre, il faut regarder tous ces aspects de la réalité et supputer (à partir des seuls dossiers) toutes les conséquences qu'aura la décision sur le fonctionnement des divers services de la poste. Pour aider à sélectionner une offre, il est apparu utile d'analyser, relativement à un petit nombre d'axes de signification (à chacun desquels était attaché un critère), les performances de chaque offre. Sur cette base, il a été possible de comparer certaines offres entre elles et d'en éliminer le plus grand nombre de façon à en isoler quelques unes (deux à quatre selon certaines hypothèses) apparaissant comme des compromis intéressants sur lesquels les dirigeants devaient focaliser leur attention.

Décider, en France, du tracé d'une ligne à très haute tension devant relier deux stations $A$ et $B$ oblige souvent à rechercher un compromis délicat entre des exigences

[5] Pour une présentation plus détaillée voir chapitre 8 dans B. Roy et D. Bouyssou : *Aide Multicritère à la Décisiion : Méthodes et cas*, Paris, Economica, 1993.

contradictoires. Il convient ente autres de minimiser la longueur de la ligne tout en contournant les zones de population dense. Il faut également éviter les nuisances que cause la présence de pylônes dans les étendues cultivées. La beauté des sites les projets touristiques, sportifs et autres doivent également être pris en compte. De surcroît, la plupart des riverains voient d'un mauvais œil l'arrivée d'une ligne (cela pour des raisons fortement chargées d'éléments symboliques ou imaginaires). Les processus par lesquels Electricité de France, en relation avec d'autres acteurs (collectivités locales, services extérieurs de ministères,…), fixe le tracé entre ***A*** et ***B*** met en jeu des systèmes de valeurs multiples : accent mis sur les aspects techniques, économiques, écologiques, qualité de vie,… De nombreux entretiens, diverses enquêtes ainsi qu'une étude visant à prendre en compte le point de vue des habitants dans le processus de décision (cf. Grassin dans Brans ***et al.***, 1986 et Barouch, 1986) ont montré la fécondité du paradigme multicritère aussi bien pour analyser le processus de décision que pour intervenir dans son déroulement afin de parvenir à des décisions mieux acceptées par l'ensemble des acteurs et mieux en harmonie avec les divers systèmes de valeurs et certains objectifs affichés.

Je voudrais souligner enfin que, dans bien des contextes, la « qualité » d'une décision dépend étroitement de la qualité d'un certain vécu et donc d'une possibilité de négociation. Des études techniques, scientifiques ne me paraissent aptes à orienter effectivement les décisions que si elles servent de point de départ ou de cadre à des négociations conduites à des niveaux appropriés. La démarche que suscite le paradigme monocritère peut certes convaincre techniciens ou scientifiques. Elle enferme toutefois les autres acteurs dans une voie qui leur impose la solution. De ce fait, elle se prête mal à la négociation. Le paradigme multicritère au contraire, en reconnaissant l'existence de plusieurs rationalités, en acceptant la présence de logiques d'acteurs diversifiés, non seulement échappe à ce risque d'enfermement mais est naturellement tourné vers la production d'éléments utiles dans un processus de négociation, d'élaboration de ce qui apparaîtra, en fin de compte, comme un compromis, un arbitrage, une décision.

## 2. MAÎTRISE DE RÉALITES COMPLEXES, MOUVANTES ET AMBIGUES

### *2.1 L'approche par un critère unique de synthèse*

Admettre que plusieurs critères sont à l'œuvre dans le fonctionnement d'une organisation, d'un processus de décision ou de négociation n'interdit en rien au chercheur opérationnel d'en imaginer ou d'en construire une synthèse prenant la forme d'un critère. Il peut ensuite utiliser ce **critère unique de synthèse** pour comparer des possibles ou choisir une solution (l'optimum de ce critère). C'est là une approche qui a fait la preuve de son efficacité mais dont il faut néanmoins bien percevoir les limites.

Pour agréger les différents critères en un seul selon une formule précise et fixe, il est généralement nécessaire de recourir à des prix de référence, des taux d'équivalence, des barèmes de conversion afin de ramener à une unité commune les performances hétérogènes dans lesquelles s'expriment les différents critères. De tels coefficients sont difficiles à évaluer de façon objective ou consensuelle [6]. Il est d'autre part souvent difficile de trouver un juste milieu entre une formule d'agrégation trop simple qui place ex æquo des possibilités d'action entre lesquelles l'indifférence n'est pas acceptable et une for-

[6] Ces aspects ont été récemment illustrés dans S. Damart et B. Roy : « Débat public et expertise : Entre rationalité et légitimité », *Annales des Mines – Gérer et Comprendre* n° 82, décembre 2005, 4-22.

mule trop complexe fondée sur une logique obscure peu propice à la communication. Enfin, la présence du critère unique de synthèse risque fort d'annuler bon nombre des avantages du paradigme multicritère (cf. fin du § 1.3 précédent).

Le fait d'expliciter une famille de critères cohérente (exhaustive, non redondante,…, cf. Roy et Bouyssou, 1987 [7] b,c), intelligible pour les différents acteurs que l'aide à la décision concerne et acceptée par eux comme base de travail fournit, dans bien des cas, un instrument de communication à partir duquel se raisonnent, se transforment, s'argumentent des préférences. De nombreuses expériences m'ont convaincu que, de façon plus générale, expliciter une telle famille présente fréquemment un réel intérêt pour soulever de bonnes questions auprès de ceux qui ont la responsabilité de la décision, pour aider ces derniers à se forger des convictions, comprendre les positions d'autrui et dépasser les oppositions de points de vue (toutes choses dont on ne saurait trop souligner l'importance avec Crozier, 1987, lorsque l'on cherche à « bien décider »). Dans cet esprit, l'approche du critère unique de synthèse ne paraît être ni la plus féconde, ni la plus convaincante.

D'autres approches opérationnelles (cf. Roy, 1985 [8], chapitre 11), ne faisant référence à aucun critère unique de synthèse, sont de plus en plus étudiées et appliquées. Les procédures auxquelles elles conduisent sont, d'une certaine manière, plus fondamentalement multicritères. En examinant, dans la fin de cet article, trois des raisons qui expliquent, à mon sens, le développement de ces approches opérationnelles (lesquelles n'ont de sens qu'en présence de critères multiples), j'apporterai d'autres réponses aux questions posées dans l'introduction.

### *2.2 Des possibles trop complexes*

a) Quelques caractéristiques du modèle engendré par le paradigme monocritère

En Recherche Opérationnelle, un critère sert avant tout à comparer ce qui apparaît comme une solution, un plan, un programme, une offre, un tracé,…, je dirai ici, pour éviter tout particularisme, une **action** susceptible d'être mise à exécution ou digne d'intérêt dans le cadre du processus de décision. J'ai souligné plus haut le caractère souvent fort hétérogène des conséquences à prendre en considération pour comparer de telles actions. J'ai évoqué les difficultés qui en résultaient pour passer d'une famille $F$ de $n$ critères à un critère unique de synthèse. Le paradigme monocritère, en faisant l'économie de l'explication de $F$, ne peut qu'accentuer ce genre de difficultés.

Une première façon de surmonter les difficultés en question consiste à regarder certains types de conséquences comme négligeables, non évaluables ou encore comme des externalités étrangères au problème. Citons, à titre d'exemple, l'incidence sur l'équilibre de certains milieux naturels de décisions d'aménagement. Ceci risque de rendre le critère mal adapté à la comparaison des actions.

Une seconde façon de faire consiste à tenter d'incorporer les conséquences en les évaluant dans la « monnaie » qui sert à exprimer la valeur du critère retenu. Cette voie a par exemple conduit à des travaux sur le prix du temps, du bruit, d'une mort, d'un monument, d'un risque.

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[7] Les documents cités en référence ont été repris dans B. Roy et D. Bouyssou, *op.cit*.

[8] Pour une synthèse des approches et méthodes récentes accompagnées d'une bibliographie, voir ***Multiple criteria decision analysis – State of the Art Surveys***, edited by José Figueira, Salvatore Greco, Matthias Ehrgott, Springer-Science+Business Media, Inc., 2005.

Je voudrais m'intéresser ici davantage à une troisième voie. Elle consiste à mettre des limites aux actions jugées possibles de telle sorte que, sur l'ensemble $A$ ainsi délimité, la variation de certaines des conséquences, source de difficultés, soit suffisamment faible pour être regardée comme négligeable. Le critère $g$ peut alors ne pas les prendre en compte (raisonnement toutes choses égales par ailleurs). Cela revient à internaliser, sous forme de contraintes, certains aspects des conséquences qui, sans cela, auraient à intervenir dans la comparaison. En pratique, le paradigme monocritère conduit, dans bien des cas, à utiliser cette troisième voie conjointement aux deux précédentes.

b) Faiblesse de cette conception des possibles

Le partage entre critères et contraintes peut tout d'abord paraître artificiel et porteur d'erreurs d'interprétation. Que penser par exemple d'une solution optimale pour le critère $g$ situé sur une frontière du champ des possibles ? Si cette frontière modélise une limite effective en deçà de laquelle il y a impossibilité radicale, la fragilité d'une solution située sur une telle frontière conduit à s'interroger sur son optimalité hors du modèle. Si cette frontière est au contraire un critère « déguisé » en contraintes, peut-on encore parler d'optimalité de la solution ? Pour en juger, on peut réintégrer la contrainte comme critère mais c'est abandonner le paradigme monocritère. On peut aussi exploiter les ressources de l'analyse de sensibilité, lesquelles, bien que très étroitement liées aux techniques d'optimisation, nous éloignent elles aussi du paradigme monocritère.

Le fait qu'un champ de possibles soit délimité de façon contingente à la définition du critère unique $g$ amène à travailler sur un ensemble $A$ d'actions possibles qui est regardé comme étant fixé. Pourtant, intervenir dans un processus de décision consiste, dans bien des cas, à faire évoluer un tel ensemble $A$. Cela s'opère de deux manières : d'une part en suscitant la prise en considération de nouveaux possibles (notamment par remise en question de certaines règles ou frontières), d'autre part en justifiant l'élimination de la plupart de ces possibles sans que ce soit pour autant d'un seul coup, tous sauf un avec, comme seul argument, une propriété d'optimalité.

Les approches opérationnelles du « surclassement de synthèse acceptant l'incomparabilité » et du « jugement local interactif avec itération essais-erreurs « (cf. Roy, 1985, chapitre 11) permettent de s'affranchir, au moins pour une part, des difficultés qui viennent d'être mentionnées. Lorsque la complexité des actions rend la frontière entre le possible et l'impossible mal définie, le paradigme multicritère s'accommode mieux que le paradigme monocritère d'une définition extensive du champ des possibles. Toutefois, s'il permet d'être moins réducteur face à cette complexité, cela ne va pas sans contrepartie : ce que l'on recherche n'est plus aussi rigoureusement défini. Je reviendrai sur ce point en conclusion.

### *2.3 Des préférences trop mouvantes et des rationalités trop diversifiées*

Lorsque, en Recherche Opérationnelle, on travaille sur un critère unique, on fait généralement référence, de façon plus ou moins explicite, à l'un ou à l'autre des deux présupposés suivants :

– **chaque acteur sait ce qu'il veut** : il discerne de façon claire et stable le mieux et le moins bien, l'essentiel et le négligeable, ce qui est prioritaire et ce qui peut attendre ; ses préférences sont autrement dit bien établies et le conduisent à ranger

sans ambiguïté, le long d'une dimension de préférences, les actions de n'importe quel ensemble *A* (structure de préordre complet, voir théorie de l'utilité, Keeney et Raiffa, 1976) ;

– **il existe une rationalité globale** : le système concerné possède une finalité, les différents acteurs qui interviennent conformément à leurs préférences individuelles sont censés agir ou doivent agir en conformité avec un objectif d'ensemble (cf. le schéma classique de l'arbre de décision qui prend pour racines un objectif unique).

Dès lors qu'on accepte de tels présupposés, il est naturel de chercher à traquer ces préférences, cette rationalité. Le critère unique a alors pour objet de cerner, avec la plus grande approximation possible, une structure ordonnée dont on postule l'existence « quelque part ». En pratique, ce « quelque part » est souvent introuvable. Il renvoie à un décideur mythique.

Le paradigme multicritère n'implique pas de tels présupposés. Comme on l'a souligné au 1.3, il s'accommode de rationalités multiples, d'acteurs ayant chacun leurs systèmes de préférences ; ce système peut, le cas échéant, ne pas être complètement défini ou stabilisé. Travailler dans le cadre du paradigme multicritère, c'est seulement postuler l'existence d'une « superstructure » constituée par les axes de signification des différents critères. Chacun d'eux est en effet censé prendre appui sur une dimension de préférence (stratégique, financière, commerciale, ergonomique,…) reconnue comme pertinente par les différents acteurs pour effectuer des comparaisons toutes choses égales par ailleurs. Cette superstructure laisse cependant place à des zones de flou, de conflit, de choc de rationalités différentes. Il devient alors possible de discuter, à l'intérieur de ces zones, de ce qui est mieux et de ce qui est moins bien sans faire référence à une réalité objective ou consensuelle, suffisamment « dure » pour être découverte par questionnement (cf. Roy, 1987a).

Les approches opérationnelles typiquement multicritères (auxquelles j'ai déjà fait allusion plus haut) visent à ne traquer que ce qui paraît suffisamment « solide » dans un ou plusieurs systèmes de préférences. A partir d'une telle armature, elles offrent des moyens pour procéder à des comparaisons plus délicates, justifier des restrictions de l'ensemble *A*, cheminer au sein de cet ensemble et, plus généralement, tirer parti de ce qui est peu contestable pour mieux raisonner ce qui est mouvant ou conflictuel. Que l'on songe par exemple à l'importance relative des différents critères.

### *2.4 Des facteurs d'ambiguïté trop importants*

Les hommes d'action (responsables politiques, managers, ingénieurs,…), tout comme les hommes d'étude (chercheurs opérationnels, économistes,…), ont une tendance parfois excessive à admettre que les décisions auxquelles ils s'intéressent peuvent être argumentées à partir de grandeurs susceptibles (au moins en théorie) d'être chiffrées avec une précision suffisante. Une telle précision ne signifie pas que, dans tous les cas, la grandeur puisse être connue avec certitude mais qu'elle peut l'être en probabilité. Ils admettre ce faisant que ces grandeurs sont objectives en ce sens qu'elles existent indépendamment de ce que l'on veut en faire, de la manière dont on envisage de procéder pour les connaître et pour décider. De telles grandeurs sont communément appelées des **données**.

Les présupposés théoriques que je viens de rappeler et qui sont indispensables pour qu'une donnée puisse jouer le rôle qu'on lui assigne sont moins souvent réalistes qu'on ne veut bien le laisser croire. La trace qu'on donne d'un fait, d'un événement, d'une situation suppose une interprétation, un recodage, un modèle implicite, autrement dit des hypothèses simplificatrices, des conventions, des omissions. Qui plus est, les chiffres et les lois de probabilités que l'on adopte, dans la mesure où ils sont le fruit dune procédure interactive (questionnaires, interviews, débats, mise en place d'instruments de mesure,…), ne sont pas indépendants de la manière dont a été conçue et conduite cette interaction, laquelle peut plus ou moins contribuer à perturber, voire à créer, ce que l'on espérait seulement observer (cf. Roy, 1987a).

Il serait trop long d'approfondir ici ces facteurs d'ambiguïté, ces sources d'imprécision, d'incertitude, de mauvaise détermination. Nous leur avons consacré un autre article (cf. Roy, 1988 [9]). Je me suis en particulier efforcé de montrer, dans cet article, que le paradigme multicritère (au travers des approches opérationnelles nouvelles qu'il suscite) paraît plus apte que le paradigme monocritère à maîtriser, dans une perspective d'aide à la décision, ces facteurs d'ambiguïté.

## 3. CONCLUSION

Comme je l'ai signalé en introduction, recourir à un critère unique présente un avantage : celui de contribuer à « bien poser » le problème. Cela ne garantit pas cependant que le problème soit bien formulé eu égard à la réalité concernée. Cela veut dire que le problème est posé en des termes tels que la solution en est entièrement déterminée par sa seule formulation. C'est donc la façon de poser le problème qui crée l'existence et le contour de la solution. Cette dernière n'est, en aucun cas, contingente au mode de résolution. Celui-ci a pour principale fonction de découvrir ce que l'énoncé a antérieurement fabriqué.

En matière d'aide à la décision, il peut pourtant être avantageux de ne pas dissocier le travail de formulation de celui d'investigation. Le paradigme multicritère invite à progresser sur ces deux fronts simultanément. Les résultats obtenus deviennent alors contingents au procédé employé pour les trouver mais peut-il en être autrement dès lors qu'on cherche à s'insérer dans un processus de décision ? On reconnaît l'existence d'ambiguïtés, de marges de liberté et de logiques contradictoires. Ceci explique la diversité des procédures multicritères et le fait qu'elles ne conduisent pas nécessairement à préconiser les mêmes solutions (cf. Roy et Bouyssou dans Gal et Roy, 1986 [10]).

La prise en compte de critères multiples va de pair avec une quête non pas d'une Vérité mais d'un mode d'insertion dans un processus de décision pour y apporter des éclairages ou des éléments de réponse à des questions dont la formulation peut être plus ou moins confuse et évolutive. Elle peut fort bien conduire à mettre momentanément l'accent sur un critère unique privilégié (critère de synthèse ou autre) afin de mettre en évidence un optimum ou une succession d'optimums dans des cadres théoriques variés.

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[9] Voir aussi *Mathematical and Computer Modelling*, Vol. 12, No.10/11, 1989, 1245-1254.

[10] Pour des développements ultérieurs, voir :

- B. Roy : "Decision science or decision-aid science?", *European Journal of Operational Research*, Volume 66, Number 2, April 1993, 184-203.
- J.L. Genard, M. Pirlot : "Multi-Criteria Decision-Aid in a Philosophical Perspective", in *Aiding Decisions with Multiple Criteria – Essays in Honor of Bernard Roy*, edited by Denis Bouyssou, Eric Jacquet-Lagrèze, Patrice Perny, Roman Słowiński, Daniel Vanderpooten, Philippe Vincke, Kluwer Academic Publishers, 2001, 89-117.

Ces calculs d'optimisation constituent un autre mode de connaissance que celui attribué couramment par le paradigme monocritère. D'une façon plus générale, ce qu'apporte le paradigme multicritère, c'est une autre façon d'envisager la réalité et d'articuler la compréhension que l'on en a avec l'action qu'on cherche à avoir sur elle.

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# 64th Meeting of the European Working Group on MultiCriteria Decision Aiding
# 28-30 September 2006, Larissa, Greece

## Conference Topics of Interest

The conference has a focus on the frontier topics in the theoretical and applied science subjects on Multicriteria Decision Support Systems. The Conference aims to bring together researchers and practitioners who address Multiple Criteria Decision Aiding and Decision Support Systems. The conference theme **"Multicriteria Decision Support Systems"** emphasizes the advanced methodologies and techniques in the development of Multicriteria Decision Support Systems. Participants are particularly welcomed to submit work relevant to this theme. However, all contributions relating to the wider area of multi criteria decision analysis are also welcomed. Specific topics of interest include (but are not restricted to):

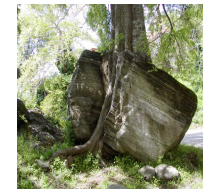
- **Multicriteria Decision Support Systems and Methodologies**
- **Theoretical Issues**
- **Artificial Intelligence - Multicriteria Decision Aiding - Decision Support Systems**
- **Internet - Web - Electronic Business**

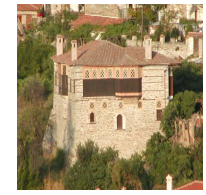
We particularly welcome application papers, which clearly show benefits of Multicriteria Decision Aiding and Decision Support Systems in:

- Marketing
- Finance
- Human Resource Management
- Management
- Manufacturing & Engineering
- Public Administration – Government
- Military
- Environment & Water Resource Management
- Agriculture - Urban Planning
- Health
- Teaching, Learning, Training
- Culture & Tourism







## Paper Acceptance-Publications

All submitted papers will be under peer review and accepted papers will be published in the conference proceedings CD ROM. The abstracts will be indexed and available at major academic databases.
Accepted papers will also be considered for publication in the special issue of the Operational Research: An International Journal (ORIJ), published by the Hellenic Operational Research Society.
The organizers are also in contact with Springer Publishers for publishing a Special Volume with conference articles in the Lecture Notes for Computers Science (LNCS) series.

## Submission Instructions

Prospective authors are invited to submit their draft paper in abstract format (one page) or in full paper format by e-mail to mcda64@teilar.gr by 10 July, 2006.
For more information about submission instructions visit the Conference Site: http://dde.sdo.teilar.gr/mcda64

## Place- Organizers

The 64th Meeting of the European Working Group - MCDA64 is going to take place in Larissa-Greece, 28-30 September 2006. The MCDA64 is organized by the Technological Education Institute of Larissa, and The Greek Multicriteria Analysis Group of the Hellenic Operational Research Society with the support of the EURO Working Group on Multicriteria Decision Aiding and Hellenic Operational Research Society.

## Important Dates

| | |
|---|---|
| • Call for papers | May 31 |
| • Registration | July 10 |
| • Paper-Abstract submission | July 10 |
| • Applications for grants | July 10 |
| • Acceptance Acknowledgement | July 20 |
| • Camera-Ready Papers | August 21 |
| • Scientific Programme | September 10 |

MCDA64
28-30 Septembre 2006
Larissa, Grèce

Groupe de Travail Européen
Aide Multicritère à la Décision

# 64èmes Journées du Groupe de Travail Européen "Aide Multicritère à la Décision"
# 28-30 Septembre 2006, Larissa, Grèce

## Matières d'intérêt de la conférence

La conférence est centrée sur les matières de frontière entre les sujets théoriques et appliqués des Systèmes Multicritères d' Aide à la Décision. La conférence vise à rassembler les chercheurs et les praticiens qui s'adressent à l' Aide Multicritère à la Décision et aux Systèmes d'Aide à la Décision. Le thème de la conférence **"Systèmes Multicritères d'Aide à la Décision"** souligne les méthodologies et les techniques avancées dans le développement des Systèmes Multicritères d'Aide à la Décision. Les participants seront en particulier accueillis pour soumettre leur travail concernant ce thème. Cependant, toutes les contributions concernant le domaine le plus large de l' analyse multicritères de la décision sont également bien accueillies. Les matières spécifiques d'intérêt incluent (mais ne sont pas limités):

- **Systèmes Multicritères d' Aide à la Décision et Méthodologies**
- **Issues Théoriques**
- **Intelligence Artificielle - Aide Multicritère à la Décision - Systèmes d' Aide à la Décision**
- **Internet - Web - Affaires électroniques**

Nous ferons bon accueil en particulier aux papiers d'application en lesquels sont montrés clairement les avantages de l' Aide Multicritère à la Décision et des Systèmes d'Aide à la Décision.

- Vente
- Finances
- Gestion de Ressource Humaine
- Gestion
- Fabrication et Technologie
- Gouvernement–Administration Publique
- Militaire
- Gestion d' Environnement & de Ressources d' Eau
- Agriculture - Planification urbaine
- Santé
- Enseignement, Apprentissage, Formation
- Culture et Tourisme

## Acceptation de papiers-Publications

Tous les papiers soumis vont être référés par des reviewers extérieurs et les papiers admis seront édités dans le CD-ROM d' actes de la conférence. Les résumés seront classés et disponibles aux bases de données académiques.
Les papiers admis vont être également référés par des reviewers extérieurs pour la publication dans l'édition spéciale de la revue: Operational Research An International Journal (ORIJ), éditée par la Société Hellénique de la Recherche Opérationnelle.
Les organisateurs sont également en contact avec Springer Publishers, pour éditer un volume spécial avec les articles de conférence dans le Lecture Notes for Computers Science (LNCS) series.

## Instructions de soumission

Les auteurs sont invités à soumettre leurs papiers au format résumé (une page) ou au format papier entier par E-mail à mcda64@teilar.gr jusqu'au 10 Juillet 2006.
Pour plus d'informations sur les instructions de soumission vous pouvez visiter le Web site de Conférence: http://dde.sdo.teilar.gr/mcda64

## Lieu- Organisation

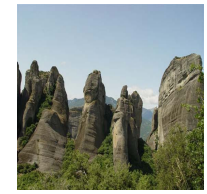
Les 64èmes Journées du Groupe de Travail Européen- MCDA'64 se tiendront à Larissa–Grèce, le 28-30 Septembre 2006. Le MCDA'64 est organisée par l' Institut de l' Education Technologique de Larissa et le Groupe de l' Analyse Multicritère de la Société Hellénique de la Recherche Opérationelle (HELORS) avec l' assistance du Group de Travail EURO sur l' Aide Multicritère à la Décision et de la Société Hellénique de la Recherche Opérationelle.

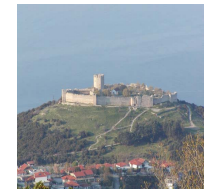
## Dates limites

| | |
|---|---|
| • Appel aux Communications | 31 Mai |
| • Inscription | 10 Juillet |
| • Appel aux papiers | 10 Juillet |
| • Demandes de financement | 10 Juillet |
| • Avis d'Acceptation | 20 Juillet |
| • Text Complete (Camera-Ready) | 21 Août |
| • Programme Scientifique | 10 Septembre |












**Project**

EURO mini-conference and satellite conference of ISBIS

# Statistics and Data knowledge in Finance, Business and Industry

August 19-21, 2007, Vilnius, LITHUANIA

Vilnius

2005

EURO mini-conference and satellite conference of ISBIS

# Statistics and Data Knowledge in Finance, Business and Industry

August 19-21, 2007

Vilnius, LITHUANIA, http://www.mii.lt/ISBIS-2007

## 1. Introduction

Promotion of the value of statistics and data knowledge in finance, business and industry help us not only in knowledge discovery, that is, the identification of new phenomena, but it is also useful in enhancing our understanding of known phenomena. Discovery of uncovering patterns, associations, anomalies, and statistically significant structures and events in data becomes a key competitive variable in many fields of business and industry.

The scope of the conference ISBIS-2007 is as follows:

- To promote the advancement and exchange of knowledge in business, financial and industrial statistics;
- To build international collaboration among statisticians and users of statistics of all the world working in business and industry;

ISBIS-2007 will provide a forum for presenting and exchanging ideas in statistical methods applicable to industry and business. Invitees are specialists in risk analysis, reliability, warranty modeling, forecasting, credit scoring, data mining, Six Sigma, business management, quality management, design of experiments, statistical quality control and other related areas.

## 2. Scientific Programme

The Programme of the conference consists of contributed papers and tutorials.
The main subject of the conference is

Statistics and Data Knowledge in Finance, Business and Industry

We encourage those interested in the following topics to overview current trends and gain a common attitude towards:

- Reliability;
- Financial Statistics, Risk Analysis and Management;
- Large Data Sets in Business and Industry;
- Design of Experiments;
- Process Control;
- Six Sigma and Other Quality Management Paradigms;
- Case Studies and Novel Statistical Applications;
- Information Technology and Network Modelling;
- Software Engineering;

- New Developments and Applications in Data Mining and Machine Learning;
- Market Research;
- Action/decision systems in E and M-commerce;
- Panel Discussions on current research and future needs/challenges;

## 3. Time and location

The conference will be held in Vilnius, Lithuania, on August 19-21, 2007.

The sittings will take place in the Hotel "Reval Hotel Lietuva", located in the center of Vilnius, by the address: Konstitucijos pr. 20, Vilnius**, L**ithuania,
(see http://www.revalhotels.com/eng/lietuva)

Vilnius, the capital of Lithuania, becomes one of the most beautiful cities in Central and Eastern Europe. It stretches along both banks of the fast flowing Neris River and is situated among hills and pine forests. Vilnius is a very old city indeed, and its Old Town with beautiful buildings in the late Gothics and Renaissance style merits to be explored.

## 4. Abstract and paper submission

Abstracts (300 words) should clearly state the purpose, results and conclusions of the work to be described in the final paper.

**The deadline for registration/abstract form submission** : *April 5, 2007*
**Notification of acceptance** *: May 15, 2007.*

We encourage the submission of abstracts electronically either through our website or via email.

**Through our website** http://www.mii.lt/ISBIS-2007

**By e-mail**: Submit your abstract via email to isbis2007@ktl.mii.lt with ISBIS-2007 in the subject line.

Please include your name, full address and conference topic.

The special issue of papers presented during the Workshop and strictly selected by the Programme Committee will be published in the top-rating journal (European Journal of Operational Research, Journal of Global Optimization, Informatica, etc.).

## 5. Registration Fees

| | Before 15 June 2007 | After 15 June 2007 |
|---|---|---|
| **ISBIS Member** | 240 (EUR) | 290 (EUR) |
| **Non ISBIS Member** | 265 (EUR) | 315 (EUR) |

## 6. Travel

For ticket reservations please contact:
**Baltic Travel Agency**
Subaciaus st 2
2001 Vilnius, LITHUANIA
**Phone:** +370 5 2120220
**Fax:** +370 5 2120714
**E-mail:** Baltic.Travel.Agency@post.omnitel.net

Vilnius, the capital of Lithuania, is directly connected by plane with Amsterdam, Berlin, Copenhagen, Frankfurt/Main, Helsinki, Kiev, London, Madrid, Moscow, Paris, Prague, Stockholm, Tallinn, Warsaw and other cities in Europe.

The following companies can take you to Vilnius: AUSTRIAN AIRLINES, ESTONIAN AIR, FINNAIR, LITHUANIAN AIRLINES, LOT, LUFTHANSA, SAS.

There is a convenient connection to Vilnius by train or bus with Berlin, Kiev, Minsk, Moscow, Prague, Riga, St-Petersbourg, Warsaw, etc.

## 7. Accommodation

We reserved a certain number of rooms in several hotels close the meeting place and Old Town.

## 8. Organization

### Organizing Institutions

1) European Association of Operational Research Societies (EURO, http://www,euro-online.org)

2) International Society on Statistics in Business and Industry (International Statistical Institute, ISI);

3) Institute of Mathematics and Informatics (Vilnius, Lithuania),

4) Vilnius University (Lithuania),

5) Vilnius Gediminas Technical University (Lithuania),

6) Lithuanian Operational Research Society,

7) Lithuanian Statistical Society

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consists of:

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2) Dr. Daniel Berze (Director of ISI PO, Netherlands);

3) Bovas Abraham (University of Waterloo, Canada);
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6) Prof. Vygandas Paulauskas (Vilnius, Lithuania);
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# International Journal of Theoretical and Applied Computer Sciences

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## Call for Papers

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Dear Colleagues,

We are pleased to announce the launching of our new journal "**International Journal of Theoretical and Applied Computer Sciences (IJTACS)**". We would like to invite you to submit manuscripts of your original papers, for possible publication in IJTACS which is a peer-reviewed periodical dedicated to the proliferation and dissemination of scholarly research results covering all disciplines and branches of computational sciences. Its Editorial Board is comprised of internationally known peers from across the globe. We are proud to have attracted some of the global leaders in their respective fields. All submissions should be made electronically to the editor-in-chief through:(EIC: pmahanti@unbsj.ca). More information of the journal, and the publishing process can be obtained at: www.gbspublisher.com/ijtacs.htm

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**Frequency:** The first issue of Journal (IJTACS) is expected to be launched from the month of July 2006 with two issues this year.

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With Kind Regards,

**P. K. Mahanti**, Editor-in-chief
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