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Opinion Makers Section

(This section is prepared by J. Clímaco)

Between Science and Democracy: the Role of "Social Multi-Criteria Evaluation (SMCE)"

by

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1. The Issue of representation of Real-World Complex Systems

Real world is characterised by deep *complexity*. This obvious observation has important implications on the manner policy problems are represented and decision-making is framed. My firm conviction is that any representation of a complex system is reflecting only a sub-set of the possible representations of it. A system is then complex when the relevant aspects of a particular problem cannot be captured when using a single perspective (Funtowicz et al., 1999; O'Connor et al., 1996). To make things more difficult, human systems are *reflexive* complex systems. Reflexive systems have two peculiar properties: "*awareness*" and "*purpose*", which imply an additional "jump" in describing complexity. In fact, the presence of self-consciousness and purposes (*reflexivity*) means that these systems can continuously add new relevant qualities/attributes that should be considered when explaining and describing their behaviour (i.e. human systems are learning systems). One important feature of reflexivity is that the human representation of a given *policy problem* necessarily reflects perceptions, values and interests of those structuring the problem.

Moreover, the existence of *different levels and scales* at which a hierarchical system can be analyzed implies the unavoidable existence of non-equivalent descriptions of it (Giampietro, 1994; Giampietro and Mayumi, 2000). As discussed by Giampietro even a simple "objective" description of a geographical orientation is impossible without taking an arbitrary subjective decision on the system scale considered relevant. In fact the same geographical place, e.g., in the USA, may be considered to be in the north, south, east or west according to the scale chosen as a reference point (the whole USA, a single state and so on). The implications for multi-criteria evaluation of the scale issue are very important. For example, in generating evaluation criteria (e.g., in evaluating the impacts of building a ski infrastructure in a mountain region, who are the relevant social actors to interact with? The inhabitants of the mountain region, the potential users in urban areas and even the ecological preservationists all around the world might sound reasonable answers) or in computing the impact scores (e.g. a contamination indicator has to be computed locally, or should it be computed at a larger scale?)

Therefore, the problem of *multiple-identities* in complex systems cannot only be interpreted in terms of epistemological plurality (non-equivalent observers), but also in terms of *ontological characteristics* of the observed system (non-equivalent observations). A consequence of these deep subjectivities is that in any normative exercise connected to a public decision problem, one has to choose an operational definition of *"value"* in spite of the fact that social actors with different interests, cultural identities and goals have different definitions of "value". That is, to reach a ranking of policy options, there is a previous need for deciding about *what is important* for different social actors as well as *what is relevant* for the representation of the real-world entity described in the model. One should note that the representation of a real-world system depends on very strong assumptions about (1) the *purpose* of this construction, e.g. to evaluate the sustainability of a given city, (2) the *scale* of analysis, e.g. a block inside a city, the administrative unit constituting a Commune or the whole metropolitan area and (3) the set of dimensions, objectives and criteria used for the evaluation process. A reductionist approach for building a descriptive model can be defined as the use of just *one measurable indicator* (e.g. the monetary city product per person), *one dimension* (e.g. economic), *one scale of analysis* (e.g. the Commune), *one objective* (e.g. the maximisation of economic efficiency) and *one time horizon*.

An outcome of this discussion is that the political and social framework must find a place in multi-criteria decision aid. To give an example; in Spain about 30 years ago, there was an important policy criterion: safety of the north frontier with France. Nowadays nobody even remembers the existence of this Franco's attitude towards frontiers. What I want to emphasise here, is the fact that

policy criteria are the consequence of the social and political framework existing in a given historical period. To give another example, at the moment the environmental dimension is becoming more and more important in evaluation projects while this was almost irrelevant 30 years ago.

In general, these concerns have not been considered very relevant by scientific research in the past (where the basic implicit assumption was that time was an infinite resource). On the other hand, the new nature of the policy problems faced in this third millennium (e.g., the mad cow, genetic modified organisms, …), implies that very often when using science for policy-making, long term consequences may exist and scientists and policy-makers are confronting issues where, *"facts are uncertain, values in dispute, stakes high and decisions urgent"* (Funtowicz and Ravetz, 1991, 1994). In this case, scientists cannot provide any useful input without interacting with the rest of society and the rest of the society cannot perform any sound decision making without interacting with the scientists. That is, the question on "how to improve the quality of a policy process" must be put, quite quickly, on the agenda of "scientists", "decision makers" and indeed the whole society.

This extension of the *"peer community"* is essential for maintaining the quality of the process of decision making when dealing with reflexive complex systems. In relation to this objective Funtowicz and Ravetz have developed a new epistemological framework called *"Post-Normal Science"* (the name "post-normal" indicates a difference from the puzzle-solving exercises of normal science, in the Kuhnian sense), where it is possible to better deal with two crucial aspects of science in the policy domain: *uncertainty* and *value conflict*. When cases in which conclusions are not completely determined by scientific facts exist; inferences will (naturally and legitimately) be conditioned by the values held by the agents. When the stakes are very high (as when an institution is seriously threatened by a policy) then a defensive tactic will involve challenging every step of a scientific argument (this applies even to those cases in which systems uncertainties are actually small). Such a tactic should be considered wrong only when is conducted covertly, as by scientists who present themselves as impartial judges when, in reality, they are actually committed advocates of one view. When legitimate contrasting views are openly used to challenge scientific arguments, we are in the realm of Post-Normal Science.

2. Social Multi-Criteria Evaluation as a Tool for Aiding Policy Processes in Reflexive Complex Systems

The previous discussion can be synthesised by using the philosophical concept of *weak comparability* (Martinez-Alier et al., 1998; O'Neill, 1993). Weak comparability implies *incommensurability* i.e. there is an irreducible value conflict when deciding what common comparative term should be used to rank alternative actions. Remembering that the presence of multiple-identities in complex systems can be explained in terms of epistemological plurality and in terms of ontological characteristics of the observed system, I argue that it is possible to further distinguish the concepts of social incommensurability and technical incommensurability (Munda, 2002a). *Social incommensurability* can be derived from the concepts of reflexive complexity and Post Normal Science and refers to the existence of a multiplicity of legitimate values in society. *Technical incommensurability* comes from the multidimensional nature of complexity and refers to the issue of representation of multiple identities in descriptive models.

If one wants to implement technical incomemensurability, there is a clear need to take into account incommensurable dimensions using different scientific languages coming from different legitimate representations of the same system. This is what Neurath (1973) called the need for an *"orchestration of sciences"*. From the experience I have in different real-world case studies, I learnt that the use of a multi-criterion framework is a very efficient tool to make Neurath's idea operational. Here I refer to the idea of orchestration of sciences as a combination of multi/inter-disciplinarity (multi-disciplinarity: each expert takes her/his part; inter-disciplinarity: methodological choices are discussed across the disciplines). In terms of inter-disciplinarity, the issue is to find an agreement on the set of criteria to be used; in terms of multi-disciplinarity, the issue is to propose and compute an appropriate criterion score.

To deal with social incommensurability, there is a need to consider the public participation issue. For the formation of contemporary public policies, it is hard to imagine any viable alternative to *extended peer communities*. They are already being created, in increasing numbers, either when the authorities cannot see a way forward, or know that without a broad base of consensus, no policies can succeed. They are called "citizens' juries", "focus groups", or "consensus conferences", or any one of a great variety of names; and their forms and powers are correspondingly varied. But they all have one important element in common: they assess the quality of policy proposals, including the scientific and technical component. And their verdicts all have some degree of moral force and hence political influence. Here the quality is not merely in the verification, but also in the *creation*; as local people can imagine solutions and reformulate problems in ways that the accredited experts, with the best will in the world, do not find natural (De Marchi and Ravetz, 2001; Gowdy and O'Hara, 1996).

This need of public participation has been more and more recognized in a multi-criteria decision-aid (MCDA) framework too. Banville et al., (1998) offers a very well structured and convincing argumentation in this direction. I agree with them on the need of extending MCDA by incorporating the notion of stakeholder; this is the reason why a social multi-criteria process must be as *participative* and as *transparent* as possible; although I argue that participation is a *necessary* condition but not a *sufficient* one. This is the main reason I propose the concept of "Social Multi-criteria Evaluation" (SMCE) in substitution

of "Participative Multi-criteria Evaluation" (PMCE) or "Stakeholder Multi-criteria Decision Aid" (SMCDA).

One should not forget that even a participatory policy process can always be conditioned by heavy value judgements. Have all the social actors the same importance (i.e. weight)? Should a socially desirable ranking be obtained on the grounds of the majority principle? Should some veto power be conceded to the minorities? Are income distribution effects important?

A clear example of the difference between a participatory multi-criteria study and a social multi-criteria one can be found in the determination of criterion weights. As we know in society there are different legitimate values and points of view. This creates social pressure for taking into account various policy dimensions, e.g. economic, social and environmental. These dimensions are then translated by analysts into objectives and criteria. At this point a question arises who should attach criterion weights and how? To answer this question we have to accept a basic assumption: to weigh different criteria implies to ponder different groups in society. This assumption has the following main consequences:

1. In social decision processes, weights cannot be derived as inputs coming from participatory techniques. This is *technically* very difficult (e.g., which elicitation method has to be used? Which statistical index is a good synthesis of the results obtained? Do average values of weights have meaning at all?), *pragmatically* not desirable (since strong conflicts among the various social actors are very probable to occur) and even *ethically* unacceptable.
2. *A plurality of ethical principles* seems the only consistent way to derive weights in a SMCE framework.
3. Weights in the framework I am proposing are clearly meaningful only as *importance coefficients* and not as trade-off (since different ethical positions leads to different ideas on criterion importance). This also implies that the aggregation conventions used should be non-compensatory mathematical algorithms. Non-compensability implies that minorities represented by criteria with smaller weights can still be very influent. This is for example clear in the use of the discordance index in the ELECTRE methods.
4. *Sensitivity and robustness analysis* have a complete different meaning with respect to the case of single person and technical decisions (Roy, 2002; Rosenhead, 2002). In fact in the case of SMCE, weights derive from a few clear cut ethical positions. This means that sensitivity or robustness analysis have to check the consequences on the final ranking of only these positions and not of all the possible combinations of weights. Sensitivity and robustness analysis are then a way to improve transparency.

The main principles of Social Multi-criteria Evaluation can be summarised as follows (Munda, 2002a):

1. One should not forget that the classical schematised relationship decision-maker/analyst is indeed embedded in a social framework, which is of a crucial importance in the case of public policy.
2. The combination of various participatory methods, which has been proved powerful in sociological research, becomes even more so when integrated with a multi-criterion framework.
3. The use of a cyclic evaluation process allows incorporating the concept of learning of the scientific team on the case study tackled. It is extraordinary important that different participatory and interaction tools are used in different points in time. This allows for continuous testing of the assumptions used.
4. According to the geographical scale chosen, the relevant social actors with an interest at stake can be found thanks to institutional analysis. Institutional analysis is an essential step to identify possible "stakeholders" for a participative process. However, besides the unavoidable mistakes that may happen in carrying out an appropriate institutional analysis, I think there are even stronger reasons why I do not believe desirable a pure participatory study.
5. In synthesis, the scientific team cannot simply accept uncritically the inputs of a participatory process, since:
    a) In a focus group, powerful stakeholders may influence deeply all the others.
    b) Some stakeholders might not desire or be able to participate, but ethically the scientific team should not ignore them.
    c) The notion of stakeholder only recognises relevant organised groups; this is the reason why I prefer the term *"social actor"*.
    d) Focus groups are never meant to be a representative sample of population. As a consequence, they can be a useful instrument to improve the knowledge of the scientific team of the institutional and social dimensions of the problem at hand, but never a way for deriving consistent conclusions on social preferences.

These conclusions lead to the following personal (and thus arguable) *convictions:*

1. Transparency is an essential component to guarantee the quality of any study based on science for policy. In fact all these studies should be *accountable* (accountability is a concept recently proposed by the European Commission in the White Book on Governance) to the public at large for peer-reviewing.

2. Multi-criteria methods supply a powerful framework for policy analysis since this type of evaluation processes can be very effective since it accomplishes the goals of being *inter/multi-disciplinary* (with respect to the research team), *participatory* (with respect to the local community) and *transparent* (since all criteria are presented in their original form without any transformations in money, energy or whatever common measurement rod).
3. Since decision-makers search for *legitimacy* of the decisions taken (Roy and Damart, 2002), it is extremely important that public participation or scientific studies do not become instruments of political de-responsibility. I strongly believe that the deontological principles of the scientific team and policy-makers are essential for assuring the quality of the evaluation process. Social participation does not imply that scientists and decision-makers have no *responsibility* of policy actions defended and eventually taken.
4. As a consequence, *ethics matters.* Let's imagine the extreme case where a development project in Amazon will affect an indigenous community with no contact with other civilizations yet. Would it be ethically more correct to invite them in a focus group… or ethically compulsory to take into account the consequences of the project for their survival?
5. A positive externality of participatory approaches is that sometimes the results obtained by the research team, i.e. data, findings, interpretations and insights, can also be returned to the community which may use them not as just given, but rather as an input for deliberative democracy.

In my opinion the substantial meaning of multi-criteria evaluation in a social context is simply tolerance and democracy. Complexity is a property of the appraisal process rather than a property inherent to the system it-self. As a consequence, any model is the representation of reality resulting from a number of arbitrary assumptions, implying the existence of two or more different correct representations of the same real-world system.

With these arguments I want just to remind that, as pointed out by authors such as B. Roy (1985) and H. Simon (1976), in a multi-criteria context what really matters is *the process* since the problem structuring will determine the result. This discussion leads to the need of defining the concept of evaluation as the combination of *representation, assessment and quality check* connected to a given policy problem in relation to a given objective. This is the reason why I use the term "multi-criteria evaluation" and not "multi-criteria decision" when a social context is implied. Of course this does not mean that mathematical models are useless. On the contrary, I strongly believe that they play the fundamental role of guaranteeing consistency between the assumptions used and the results obtained, in terms of rankings of the available policy options. For this reason I think that multi-criteria algorithms to be used in a social context should be as simple as possible (i.e. with the minimum number of exogenous parameters) and that their axiomatization should be complete and clear (Munda, 2002b).

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MCDA Research Groups

MCDA in Scotland

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For quite some time José has been trying to persuade us to write an article on the "MCDA group at Strathclyde" – and I've resisted, partly because there are always so many things to do and never enough time to do them, but also because I've never really thought of us as a "MCDA group". Indeed MCDA is one of the wide range of inter-related research areas that are covered by residents in and visitors to the department of Management Science at Strathclyde.

The University of Strathclyde's mission statement, which dates from its foundation as Anderson's College in 1796, is "The Place of Useful Learning". This is something that is strongly reflected in the practical orientation of all the department's research, including in MCDA, which seeks to combine "excellence with relevance". Thus, a key underlying theme to our work is how to better support decision making in organizations through the use of MCDA.

Recent research focusing on this orientation is that on Intelligent User Support and the GDSC (Glasgow Decision Support Centre) project. The research on Intelligent User Support, with Julie Hodgkin (now at Stirling University, also in Scotland) led firstly to the development of enhanced decision support tools targeted at "naïve" users (tested extensively on MBA students) and secondly on tools for skilled facilitators. The latter tools were used by myself and Tasso Koulouri in working with a client group as part of the GDSC project. This project, funded by the Glasgow Enterprise Agency, aimed to provide multicriteria decision support to small and medium enterprises in the Glasgow area. Working with a range of organizations during this project provided us with a wealth of experience, in particular in supporting decisions of small charitable and community-based organizations.

A second important theme in our work, reflected in the recent book by Belton and Stewart (2002), is that of integration – both within the broad church of MCDA and of MCDA with other OR/MS and Management methodologies. This approach, which has grown from collaboration with colleagues at Strathclyde and around the world, has also involved many PhD scholars and visiting researchers. In all cases we have sought to explore how MCDA and other methodologies can be used in an integrated way to add value to an organizational intervention.

I hope that the following list will give a sense of the wide range of topics covered and mentions everyone else that has been involved in recent years:

- MCDA and Cognitive/Cause Mapping
  Professor Fran Ackermann (Strathclyde), Dr Gilberto Montibeller (Strathclyde),
- MCDA and DEA
  Professor Theo Stewart (University of Cape Town), Derek Crowe (Strathclyde)
- MCDA and Discrete Event Simulation (and recently EMO)
  Dr Mark Elder (Simul8), Dr Julie Hodgkin (University of Stirling), Dr Gilberto Montibeller
- MCDA and Production Scheduling
  Dr Mark Elder
- MCDA and System Dynamics
  Sergio Santos (PhD, Strathclyde – University of Algarve), Dr Susan Howick (Strathclyde)
- MCDA and Conflict Analysis
  Dr Fabio Losa (Ufficio di Statistica, Switzerland)
- MCDA and the Balanced Scorecard
  Nur Anisah Abdullah (PhD Strathclyde- International Islamic University, Malaysia), Mik Wisniewski (Audit Scotland)
- Project Prioritisation
  Brett Malyon (PhD Strathclyde), Vicky Mabin (Victoria University of Wellington, New Zealand), Professor Fran Ackermann
- Fuzzy MCDA *Tasso Koulouri (PhD Strathclyde)*
- Links between MAVT and Outranking
  Jacques Pictet (Bureau d'aide à la decision, Switzerland)

- Intelligent User Support for MCDA
  Julie Hodgkin (University of Stirling)

There are two other Professors at Strathclyde who are interested in MCDA as part of their broader research areas. Tim Bedford, who joined the department from University of Delft in 2000, focuses on Risk and Decision Analysis; and George Wright, at the Graduate Business School, is interested in Strategic Decision Making and Scenario Analysis. If you are interested to follow up on any of the work outlined above, visit the departmental website at www.mansci.strath.ac.uk , where you will find a list of publications and current PhD studies. If you would like to visit us at any time, you would be most welcome – please email us.

And finally, who am I? I’ve worked in the field of MCDA since 1981 when I started my PhD, a comparative study of methods for multicriteria decision aiding (Cambridge 1986). My own approach to MCDA evolved from this research. It is based primarily on the use of MAVT but is significantly informed by the strengths of other approaches. We place a lot of emphasis on visual interactive modelling (supported by the software VŸIŸSŸA which we first launched in 1988) and on group facilitation. Over the past 20 years we have been fortunate to work with a wide range of organizations, large and small, in the public, private and voluntary sectors. It is these opportunities which both motivate and provide the arena for much research. I am currently honoured to be President of the International Society for MCDM and editor of the Journal for Multicriteria Decision Analysis.

Forum

The Flaw of Averages

by
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If you count on the stock market's average return to support you in retirement, you could wind up penniless.

``The only certainty is that nothing is certain." So said the Roman scholar Pliny the Elder. And some 2000 years later, it's a safe bet he would still be right. The Information Age, despite its promise, also delivers a dizzying array of technological, economic and political uncertainties. This often results in an error I call the Flaw of Averages, a fallacy as fundamental as the belief that the earth is flat.

The Flaw of Averages states that: Plans based on the assumption that average conditions will occur are usually wrong.

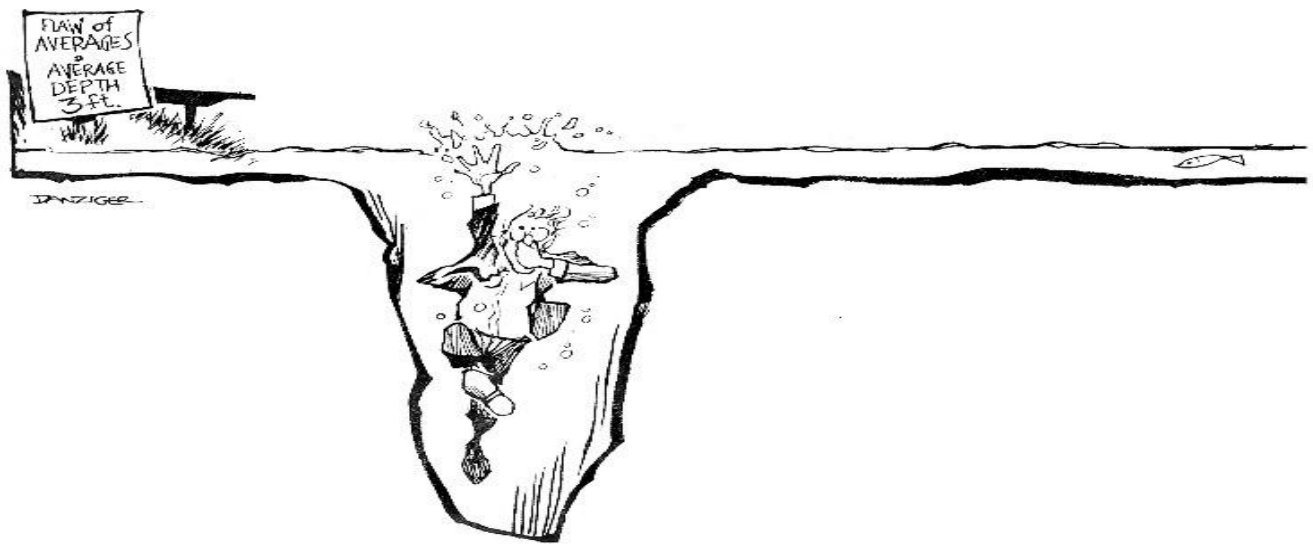
A humorous example involves the statistician who drowned while fording a river that was, on average, only three feet deep.

But in real life, the flaw continually gums up investment management, production planning and other seemingly well-laid plans. The Flaw of Averages is one of the cornerstones of Murphy's Law (What *can* go wrong *does* go wrong).

Fortunately, superfast computers can overcome this problem by bombarding our plans with a whole range of inputs instead of single average values. Today, this technique, known as simulation, is at the center of such diverse activities as Wall Street investing and military defense planning.

But back to the flaw, and an area that's important to all of us: investing for the future.

Suppose you want your $200,000 retirement fund invested in the Standard & Poor's 500 index to last 20 years. How much can you withdraw per year? The return of the S&P has varied over the years but has averaged about 14 percent per year since its inception in 1952. You use an annuity workbook in your spreadsheet that requires an initial amount ($200,000) and a growth rate for the fund. ``I need a number," you say to yourself, so you plug in 14 percent. Now you can play with the annual withdrawal amount until your money lasts exactly 20



years. If you do this you will be pleased to find that you can withdraw $32,000 per year. (see Figure A).

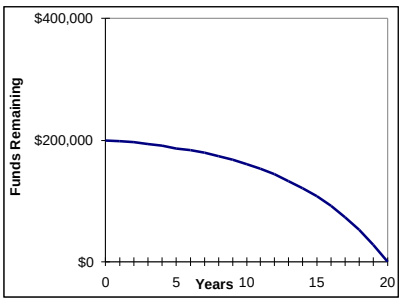


Figure A. Funds remaining with annual withdrawal of $32,000 , assuming 14% return every yea.

Even if the return fluctuates in the future, as long as it averages 14 percent per year, the fund should last 20 years, right?

Wrong! Given typical levels of stock market volatility there are only slim odds that the fund will survive the full time. The following charts simulate this retirement strategy with actual S&P 500 returns starting in various years.

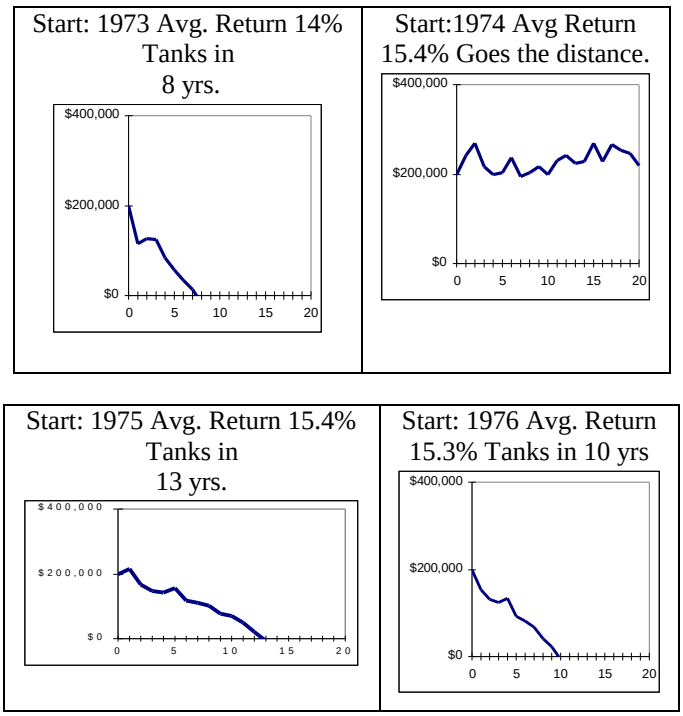


Figure B. Simulated Fund performance if started in various years.

Notice that the level of average returns over any particular 20-year period is no guarantee of success. The real key is to get off to a good start, which is what separates 1974 from its neighbors.

For this example the Flaw of Averages states that: If you assume each year's growth at least equals the average of 14 percent, there is no chance of running out of money. But if the growth fluctuates each year but averages 14 percent, you are likely to run out of money.

The results above are not the result of a rigorous scientific study, and should not be used for making investment decisions, but they should at least have you asking yourself: Why isn't someone doing something about this? People are. One of the first was William F. Sharpe, a Nobel laureate in Economics, who recently left Stanford to spend full time simulating retirement benefits. ``I expected people to question the specifics of our simulation algorithms," reflects Sharpe about the launch of Palo Alto-based Financial Engines Inc., ``but to my surprise, everyone else out there was just plugging in averages." (As in Figure A).

The Flaw of Averages distorts everyday decisions in many other areas. Consider the hypothetical case of a Silicon Valley product manager who has just been asked by his boss to forecast demand for a new-generation microchip.

``That's difficult for a new product," responds the product manager, ``but I'm confident annual demand will be between 50,000 and 150,000 units."
``Give me a number to take to my production people," barks the boss. ``I can't tell them to build a facility with a capacity of between 50,000 and 150,000 units!"

So the product manager dutifully replies: ``If you need a single number, the average is 100,000."

The boss plugs the average demand and the cost of a 100k capacity fab into a spreadsheet.The bottom line is a healthy $10 million, which he reports to his board as the average profit to expect. Assuming that demand is the only uncertainty, and that 100,000 is the correct average, then $10 million must be the best guess for profit. Right? Wrong! The Flaw of Averages ensures that average profit will be less than the profit associated with the average demand. Why? Lower-than-average demand clearly leads to profit of less than $10 million. That's the downside. But greater demand exceeds the capacity of the plant, leading to a maximum of $10 million. There is no upside to balance the downside.

This leads to a problem of Dilbertian proportion: The product manager's correct forecast of average demand leads to an incorrect forecast of average profit, so he gets blamed for giving the correct answer.

A computerized cure for the Flaw of Averages is Monte Carlo Simulation, first used for modeling uncertainty during development of the atomic bomb. It generates thousands of scenarios covering all conceivable real world contingencies in proportion to their likelihood.

In the 1950s, Harry Markowitz, a brash young graduate student at the University of Chicago, dealt another blow to the flaw. ``I was reading the contemporary investment theory, which was strictly based on averages," recalls Markowitz. ``I said to myself: `this can't be right.' " His resulting portfolio theory, which was based on both risk and average outcomes, revolutionized Wall Street and won him a Nobel Prize. Markowitz also

devoted much of his career to designing simulation systems.

Simulation-based acquisition is now used routinely in the military. Its instigator was William J. Perry, who in spite of a bachelor's degree, master's degree and doctorate in math, has had a remarkably well-rounded career as a Silicon Valley entrepreneur, U.S. Secretary of Defense and Stanford professor.

In 1996, while at the Pentagon, Perry issued a directive stating that models and simulations must be used to reduce the time, resources and risks of the acquisition process. Perry says in retrospect: ``With tens of thousands of uncertainties, it was just a perfect application for simulation."

A dramatic example of the savings that resulted from Perry's directive is related by John D. Illgen of Santa Barbara-based Illgen Simulation Technologies Inc., who says: ``In response to improvements in foreign weapon systems, the Navy was preparing to spend tens of millions of dollars to upgrade its shipboard defensive systems. With a $250,000 simulation we were able to show that the present defensive system was adequate to meet the increased threat."

While many of today's managers still cling tenaciously to ``flat earth" ideals, the innovators are abandoning averages and facing up to uncertainty. Those who dare discover a New World of managerial tools including simulation, decision trees, portfolio theory and real options.

And what happens when one of these innovators is confronted by someone cloaking themselves behind a single number? The story of the emperor's new clothes says it all.

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Sam Savage *is senior research associate at Stanford University, where he directs the Industrial Affiliates Program for the Management Science & Engineering Department. See www.stanford.edu/~savage/flaw for animations and downloadable simulations of the examples in this article.*

Jeff Danziger *is a widely syndicated cartoonist. See www.danzigercartoons.com for more of his work.*

Software

WWW-NIMBUS for Interactive Multiobjective Optimization

by

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Introduction

Software for solving multiobjective optimization problems is not easy to find. The task gets even more difficult if the problem involves nonlinear functions. WWW-NIMBUS [8], an interactive software system operating on the Internet, has been developed to answer this need. It can be used for solving nonlinear and even nondifferentiable and nonconvex multiobjective optimization problems. Because the Internet is easily accessible, the system is automatically available to large numbers of people. In 1995, the first version of WWW-NIMBUS was the first interactive multiobjective optimization software operating on the Internet. Even now, when version 3.3 of WWW-NIMBUS is available at http://nimbus.mit.jyu.fi/ it continues to be a unique software system. WWW-NIMBUS has changed quite a lot during the years but it can still be used free of charge for teaching and academic research proposes.

WWW-NIMBUS is based on the principles of centralized computing and distributed interface. This means that all the calculations take place in a server computer at the University of Jyväskylä and the user interface is the browser of each individual user. In this way, the system sets no requirements on the user's computer and the operating system used and/or compilers available play no role. There is nothing to be installed and the latest version of the system is always available. Furthermore, the World-Wide Web (WWW) provides a convenient and graphical user interface with visualization possibilities.

The NIMBUS method is the core of WWW-NIMBUS. NIMBUS (Nondifferentiable Interactive Multiobjective BUndle-based optimization System) is an interactive method where preference information is acquired from the decision maker in the form of a classification of the objective functions. The method has been applied, for example, in structural design problems [11], in the optimal control problems of the continuous casting of steel [12] and in the optimal shape design of paper machine headboxes [3]. Results with both small-scale and large-scale problems give evidence of the reliability and efficiency of the method. Different versions

of NIMBUS are described in [5,6, 7]. Here we concentrate on the latest, so-called synchronous, version [10].

In NIMBUS, the decision maker can iteratively learn about the problem and can conveniently direct the solution process. NIMBUS has been designed to be easy to use and, unlike many interactive methods, it does not require consistent information from the decision maker. Furthermore, the information handled is straightforward. The objective function values have a direct meaning to the decision maker and no artificial concepts are needed.

NIMBUS Method

The multiobjective optimization problems to be considered are of the form

$$\begin{aligned} &\text{minimize} && \{f_1(\mathbf{x}), f_2(\mathbf{x}),..., f_k(\mathbf{x})\} \\ &\text{subject to} && \mathbf{x} \in S \end{aligned}$$

with *k objective functions* $f_i : \mathbf{R}^n \to \mathbf{R}$ to be minimized simultaneously. The *decision vector* $\mathbf{x}$ belongs to the (nonempty) compact *feasible set S*. The images of the feasible decision vectors are called feasible *objective vectors*.

The idea of the interactive NIMBUS method is to move around the set of Pareto optimal solutions. Thus, we need information about the ranges of the feasible objective vectors in the Pareto optimal set. We refer to the best values of each objective function as their *ideal values*.

In the interactive solution process, the decision maker can at each iteration indicate what kind of a solution would be more satisfactory than the current with the help of a classification. Thus, the user can evaluate the problem to be solved and adapt one's preferences during the solution process in an iterative and flexible way. Let $\mathbf{x}^h$ stand for the Pareto optimal decision vector at the iteration *h*. Then the decision maker is asked to classify the objective functions into up to five classes for objective functions f_i whose values should be decreased $(i \in I^<)$, should be decreased till some aspiration level $\bar{z}_i < f_i(\mathbf{x}^h)$ $(i \in I^\leq)$, are satisfactory at the moment $(i \in I^=)$, are allowed to increase till some upper bound $e_i > f_i(\mathbf{x}^h)$ $(i \in I^>)$ and are allowed to change freely $(i \in I^\diamond)$.

The difference between the first two classes is that the objective functions in the first class are to be minimized as far as possible but the functions in the second class only till the aspiration level specified. The decision maker is asked to specify the aspiration levels and upper bounds, if needed. Since improvement in the Pareto optimal set in any objective function value is possible only by allowing impairment in some other objective function, the classification is feasible only if neither $I^< \cup I^\leq$ nor $I^> \cup I^\diamond$ is empty.

After the classification, a *subproblem* [8] is formed based on the information specified as

$$\begin{aligned} \min \quad & \max_{i \in I^<, j \in I^\leq} \left[w_i (f_i(\mathbf{x}) - z_i^*), w_j \max\left[f_i(\mathbf{x}) - \bar{z}_j, 0 \right] \right] \\ \text{s.t.:} \quad & f_i(\mathbf{x}) \leq f_i(\mathbf{x}^h), \ i \in I^< \cup I^\leq \cup I^= \qquad (1) \\ & f_i(\mathbf{x}) \leq e_i, \ i \in I^> \\ & x \in S, \end{aligned}$$

where z_i^* are the ideal objective values. We set $w_i = 1/|z_i^*|$ if $|z_i^*| > d$ for some small positive scalar d. Otherwise, we set $w_i = 1$.

As shown in [9], different subproblems may lead to different solutions even though they are based on the same preference information. Usually method developers select one subproblem, which means that they select the solution to be generated. Yet, there is no general way how to identify the best solution without involving the decision maker.

In the synchronous version of NIMBUS [10], there are three subproblems available in addition to (1). This means that if the decision maker wants so, (s)he can see up to four different solutions after one classification. In other words, by classifying the objective functions once, the decision maker can get a better picture of different Pareto optimal solutions satisfying the preference information specified. Besides, the method developers do not have to make the choice related to the subproblem. Based on the experiments and comparison of different subproblems [9], we have selected subproblems extracted from the STOM, GUESS and Wierzbicki's reference point methods (see, e.g. [7]). They all involve reference point information that can be derived from the classification.

In NIMBUS, the decision maker can also explore a desired number of intermediate solutions between any two solutions. Note that the solutions generated using different subproblems or as intermediate solutions are not all necessarily different [9]. In this case, we only show the different ones.

The algorithm is terminated if the decision maker does not want to decrease any objective value or is not willing to let any objective value increase. Otherwise, the search continues iteratively by moving around the Pareto optimal set.

WWW-NIMBUS System available at http://nimbus.mit.jyu.fi

The WWW-NIMBUS system is capable of solving nonlinear problems involving even nondifferentiable and nonconvex functions where the variables can be continuous or integer-valued. The constraints may be linear, nonlinear or bounds for variables.

Personal usernames and passwords enable saving and handling private problems so that the user can return to

them later. One can also visit WWW-NIMBUS as a guest but then it is not possible to save any problems to the system. Each page of WWW-NIMBUS has an individual help page. The system has also a tutorial.

The problem to be solved can be specified either by filling a web form or by preparing a Fortran subroutine. The possibility of specifying the problem as a subroutine enables the solution of large-scale problems and/or problems that do not have explicit formulas of functions. (However, this possibility is available for local users only.)

After the optimization problem has been specified, the starting point, either given by the decision maker or generated automatically by the system, is projected onto the Pareto optimal set. This point is the basis of the first classification. The classification of the objective functions can be carried out either symbolically or graphically by indicating desirable values in a bar chart with a mouse. The bars include information about the current objective values as well as the estimated ranges of each objective function in the Pareto optimal set.

After the classification, the user selects the maximum number (between one and four) of different new solutions to be generated. The system produces them by solving different subproblems using some of the underlying optimizers. The user can select the optimizer for each iteration individually. If the user wishes to use a computationally efficient local solver, it is possible to use the proximal bundle method [4]. This method can solve even nondifferentiable problems but it assumes the objective and the constraint functions to be locally Lipschitz continuous and it needs (sub)gradient information. If the problem has been specified using the web form, the user does not have to derive (sub)gradients because the software contains a symbolic (sub)differentiator.

If the user prefers global optimization, (s)he can select between two variants of genetic algorithm. In this case, the problem to be solved may contain also integer-valued variables. The two variants use different constraint-handling techniques. One of them is based on adaptive penalties [2] and the other is a method of parameter free penalties [1]. All the optimizers contain technical parameters and the user can change the default values, if necessary.

Whenever the user attains an interesting solution (s)he can save it in a solution database. This means that the user can comfortably return to previous solutions if they turn out to be interesting, after all. The comparison task between any set of solutions is facilitated by using visualizations of the alternatives. The user can select between bar charts, value paths and petal diagrams in both absolute and relative scales. The user can also drop some of the alternatives from further consideration.

In the implementation of WWW-NIMBUS, the goal has been to keep the system as general as possible. This means that special features available only in certain browsers have been avoided. The size of the problems that can be solved has not been limited in the implementation.

WWW-NIMBUS opens up a worldwide possibility for any Internet user to utilize the achievements of the Optimization Group (http://www.mit.jyu.fi/optgroup/) working at the University of Jyväskylä.

Acknowledgements
The research was supported by the Academy of Finland (grant #65760) and the National Technology Agency of Finland. The author wishes to thank Dr. Marko M. Mäkelä for his share in developing NIMBUS and WWW-NIMBUS as well as Jari Huikari and Vesa Ojalehto for maintaining WWW-NIMBUS.

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Persons and Facts

Oleg I. Larichev (20.09.1934-19.01.2003)

With great sadness, we regret to inform that Professor Oleg I. Larichev passed away on 19 January 2003.

Oleg I. Larichev graduated with honours from N.E.Bauman Moscow State Technical University, USSR, in 1958. For a long time (1960-1976), he was affiliated with the Institute of Control Problems, USSR Academy of Sciences. Since 1976, Oleg I. Larichev worked in the Institute for System Studies, USSR Academy of Sciences (now the Institute for System Analysis of the Russian Academy of Sciences).

Over the last forty years, the studies of Professor Oleg I. Larichev were related to various fields of multiple criteria decision making (MCDM), artificial intelligence (AI), and cognitive sciences. He was the author of several books, textbooks, and more than 200 articles both in Russian and in English, the editor of some volumes. Larichev's ideas and results of his research attracted attention of the international scientific community.

Oleg I. Larichev together with his colleagues developed a number of new interactive multi-criteria methods for decision aid (STEM, ZAPROS, ORCLASS, PARC, DIFCLASS, CYCLE, and others). These tools allowed to solve problems of ordering and classifying multi-criteria alternatives while taking into account Decision Maker's preferences. Later, while studying processes of the knowledge acquisition for solving classification problems, Oleg I. Larichev proposed a new original approach to fast and efficient construction of complete and contradiction-free expert knowledge bases for the diagnostic-type problems. The success of the STEM and other techniques influenced Oleg I. Larichev to study the field of psychological aspects of decision-making, the subject, which attracted his attention all his life. Oleg I. Larichev researches in the fields of MCDM, AI and cognitive psychology culminated in a new scientific approach – verbal decision analysis. In the framework of this approach, abilities and skills of a human being are combined with the possibilities of modern computers in solving ill-structured problems, while taking into account subjective preferences as well as models based on both qualitative and quantitative information.

Professor Oleg I. Larichev was not only a talented researcher but also a highly qualified practitioner, a brilliant teacher, and a mentor. He has taught several courses at the Moscow Institutes, and was a visiting professor in universities in the USA, Germany, France, Great Britain, and Italy.

Multiple awards and appointments to highest positions in many Russian and international scientific organizations, societies, research councils, and journals recognized Oleg I.Larichev's contribution to science. In 1990, Professor Oleg I. Larichev was elected as a Corresponding Member of the USSR Academy of Sciences, and in 1997, as a Full Member of the Russian Academy of Sciences. In 1994, Oleg I. Larichev was awarded the Gold Medal of the International Society on Multiple Criteria Decision Making.

Undoubtedly, the international scientific community has lost one of its most outstanding members. For all of us – friends, colleagues and close collaborators of Professor Oleg I. Larichev, it is still very difficult to accept his loss.

Emilia Brouk, Eugenia Furems, Alexander Lotov, Alexey Petrovsky.
Moscow, January 2002.

About the 57th Meeting

by

Antonio Scarelli

The 57th Meeting (27-29 march 2003) took place at the University of Tuscia in Viterbo (Italy) and has been organized by Faculty of Sciences and Dpt. of Environmental Sciences. It took place at the New Assembly Hall, Via S. Maria in Gradi, just outside the historic old walls. Dating from 1979, the University of Viterbo is one of the youngest in Italy; it comprises six faculties (Agricultural Science, Languages, Science, Cultural Heritage, Economics and Political Sciences) where today more than 9000 students attend their studies. The Faculty of Sciences of the University of Viterbo was established in 1984 and leading to the degree the following year with a first degree in Biology. Throughout its 18 years, the Faculty of Sciences has been expanding its teaching to other scientific domains and specialities, by the establishment of the degrees in Environmental Sciences (1990), Education and Environmental Extension (1998), Bio-technologies (2000), and several Master's degrees and postgraduate courses. Currently, students' attendance approximates 800 with 90 lecturers.

The main theme of the meeting *"MCDA and Economic Evaluation of Environmental Goods"* has been chosen in order to gather all the cultural components present in this

University and as a token of the outstanding cultural and environmental quality of the Tuscia surroundings. 18 papers have been presented at the meeting, two papers extending for 40 minutes and 16 papers for 20 minutes (about twelve papers are available at www.unitus.it/mcda57). The participants have been 66 from 18 countries (Australia, Belgium, Canada, Czech Republic, Estonia, France, Germany, Greece, Italy, Lithuania, Luxemburg, Morocco, Romania, Spain, Sweden, Tunisia, UK). Among the participants, 19 were new welcome entrance; here their names: Silvia Angilella, Martin Aust, Lamia Belfares, Khalid Belkeziz, Hella Ben Brahim, Enrico Benetto, Simona Borrelli, Marina Di Giacinto, Claudio Falciano, Gretel Gambarelli, Kiriaky Kosmidou, Giuseppe Las Casas, Simone Martino, Driss Mentagui, Novello Vito, Maciej Nowak, Vasile Postolica, Claudia Trotta, Ernesto Volpe.

Very few papers have been presented bilingually (i.e. French with English slides, or conversely). It is clear that, according to the recommendations of prof. Bernard Roy, more efforts should be undertaken to have bilingual presentations (in both directions). Should this policy be favoured by a free of charge banquet to bilingual presentations? About 20 papers have been submitted for discussion and finally there was also a "*Communication Surprise*" by the authors X. Yeeeee and W. Huuuuu (read Yannis Siskos and Nikolaos Matsatsinis), which has shown to the participants the nice Ceremony of Honorary Degree awarded by University of Chania to prof. Bernard Roy.

A few last minute cancellations were due to the contemporary middle-east crisis. Some inconveniencies to the participants have been created by moving the Conference Hall just one week before the meeting; the announced distance from the chosen hotels increased, but not more than 300 hundred meters. Anyway, I think that the New Conference Hall had satisfied the participants not only for its historic location, but also for the possibility to have more rooms for buffet and colloquial interests. On Thursday morning, the YMCDA3, the Young Researchers Session, gathered ten participants (Jacobo Feas Vazquez, Simona Borrelli, Claudio Falciano, Claudia Trotta, Simone Martino, Gretel Gambarelli, Martin Aust, Ben Brahim Hella, Nowak Maciej) conducted by Maria Franca Norese for a short presentation of the new members and discussion on the main topics of their research activity.

The excursion on Saturday (36 participants) took us to three locations: to Tarquinia, an Etruscan town with a well preserved Necropolis and with one of the most important Museum of the Etruscan civilization. We have been impressed by the customs of those people, so very well advanced in culture to reign over the Romans at the age of Kings. Crossing the countryside of southern Tuscia (or northern Latium) we admired well preserved landscapes. The lunch, near the Bolsena Lake has been a taste of Italian freshwater fish ended with a dip on "*Cannaiola*" wine. At the end of the trip we admired the magnificent Cathedral of Orvieto, one of the most wonderful of the Italian gothic.

In addition to the official programme, on Sunday March 30th, a little group of participants, on minibus conducted by an unreliable driver, had an enthusiastic wine trip along southern Toscana, just about two specific aromas: the first "*Brunello*" in Montalcino and the second "*Nobile*" in Montepulciano. At Chiusi-Chianciano Terme railway station, on the fast trunk Firenze-Roma, the last participants left and the 57th Meeting had its end.

Final Program / Programme Définitif

Thursday March 27 Jeudi 27 mars

Session I Chair: Maria Franca Norese

14.30 R. Bisdorff, M. Roubens: "On clear choice with ordinal valued binary relations"

15.30 A. Frini, A. Guitouni, J. M. Martel: "Démarche d'aide multicritère à la décision dynamique"

16.00 T. Marchant: "Le mesurage de l'appartenance"

Papers submitted for discussion/Papiers soumis à discussion

- S. Greco, B. Matarazzo, R. Slowinski: "Handling of positive and negative interactions among criteria by a bipolar Sugeno integral"
- A. B. Petrovsky, A. Litvinova: " Ordering Multi-Attribute Objects in Multi-set Metric Space"
- O. Vaarmann: "On methods for weighted non-linear least squares problems"

16.30 ***Coffee break / Pause café***

Session II Chair: Roman Slowinski

17.00 M. Gagnon, G. D'Avignon, F. Boctor: "Tabu Search within a Multicriteria Approach for the Multiobjective RCPS Problem"

17.30 J. Geldermann, O. Rentz: " Multi-criteria group decision support for integrated technique assessment "

18.00 S. Angilella, S. Greco, B. Matarazzo, V. Novello: "Determining weights for interactive criteria with a Simos' type procedure"

Papers submitted for discussion/Papiers soumis à discussion

- M. Matoussi: "Aide à la décision multicritères pour la promotion de la réutilisation des EUT"
- P. Oberti, M. Rombaldi: "L'évaluation participative et multicritère : une illustration à la mise en oeuvre du plan d'aménagement et de développement durable en région corse"
- R. M. Ciobanu: "Decision Making for the Optimization of the Complex Objects Concerning the Environmental Protection, using value Analysis and Enginering"

20.30 ***Reception at the Town Hall / Reception à la Mairie de Viterbo***

Friday March 28 Vendredi 28 mars

Session III Chair: Marc Roubens

9.00 A. Guitouni, J. M. Martel, L. Belfares: "Pianification multicritères de suites d'actions"

10.00 W. Proctor, M. Drechsler: " Deliberative Multi-criteria Evaluation - A case study of recreation and tourism options in Victoria, Australia

10.30 N. Belacel, A. Ghorbani: "A Multi-agent system based e-hospital"

Papers submitted for discussion/Papiers soumis à discussion

- A. H. Arakelyan, E. Dnielyan : "The dynamic MCDM model for the monitoring and management the carbon-dioxide emission "
- G. Condurache, R. M. Ciobanu: "Some Particular Aspects Concerning ELECTRE Method Applications"
- B. Reichelt, F. Peldschus: "An application on Multi-Criteria decision analysis (MCDA) in risk management of large scale projects"

11.00 ***Coffee break / Pause café***

Session IV Chair: Wendy Proctor

11.30 K. Zaras: " L'approximation approchée de la relation de préférence par la dominance multi-attributs pour les problèmes d'évaluation déterministe, stochastique et floue"

12.00 M. Nowak: "Efficient solution in multicriteria analysis based on stochastic dominance"

12.30 E. Benetto, C. Dujet: "Uncertainty Analysis and MCDA; a case study in the Life Cycle Assessment (LCA) practice"

Papers submitted for discussion/Papiers soumis à discussion

- K. Belkeziz, A. Metrane: "Optimisation d'une fonction linéaire sur l'ensemble des solutions efficaces d'un problème multicritère quadratique convexe"
- L. Sakalauskas**:** "On Stochastic Approach to Multiobjective Optimization"
- V. Noghin: "General Edgeworth-Pareto Principle"

13.00 ***Lunch / Déjeuner***

Session V Chair: Yannis Siskos

14.15 Working Group matters and next meetings/ La vie du groupe et prochaines réunions

14.45 P. Abbozzo, A. Boggia, G. Massei, S. Nardi P. : "Integrated GIS-Multicriteria Approach to set up compensation measures for quarries"

15.15 H. Ben Brahim, L. Duckstein, S. Matoussi, T. Aregai: "Multicriteria analysis for treated wastewater management"

15.45 N. Matsatsinis, Y. Siskos, G. Anestis, E. Grigoroudis, E. Krassadaki: "Skill evaluator: a multicriteria decision support system for the evaluation of qualification and skills in information technology "

16.15 X. Yeeeee, Y. Huuuu: "*Communication surprise*"

Papers submitted for discussion/Papiers soumis à discussion

- A. Chevalier, J. Gupta: "Mergers and acquisitions in the banking sector: the criteria for measuring the performance"
- J. Mysiak: "Geographic Information added value to environmental decision making"
- S. Martino, L. Venzi : "State of the Art in term of Environmental Issues Considered in MCDA"
- V. Postolica, L. Venzi : "New proposals for the study of the equilibria in the fish wars using the splines in H-locally convex spaces and Pareto efficiency"

16.30 ***Coffee break / Pause café***

Session VI Chair: Gilles Roland D'Avignon

17.00 J. Halova, M. Aust: "Multicriteria models in radioactive waste management"

17.30 M. Doumpos, K. Kosmidou, F. Pasiouras, C. Zopounidis: "A Multicriteria approach for the evaluation of foreign and domestic banks in the UK"

18.00 D. Mentagui**:** "Une modèle de convergence et de stabilité en programmation mathématique "

18.30 K. Vaillancourt, J. P. Waaub: "Equity and Efficiency in International Greenhouse Gas Abatement Scenarios: A Multicriteria Approach"

Papers submitted for discussion/Papiers soumis à discussion

- M. Drechsler: "Ecological uncertainty in multi-criteria analysis: assessing population extinction risks "
- P. Kunsch, A. Chevalier: " Applying the adaptative control methodology to the case of recurrent mergers in the banking sector "
- G. Munda, J. R. Martin: "A Multicriteria approach to evaluate European progress towards sustainability"

20.30 ***Dinner at "Taverna dei Templari" / Dîner au "Taverna dei Templari"***

Forthcoming Meetings

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

May, 22-24, 2003. Towards Electronic Democracy : Internet-based Multi-Criteria Decision Supporrt, Madrid, Spain. Bayes.escet.urjc.es/ted/madrid_workshop.html.

June 2-4, 2003, Vancouver, Canada, CORS 2003 National Conference (Congrès SCRO 2003), URL: http://www.coe.ubc.ca/cors2003/.

June 5-7, 2003, Molde, Norway, XVI Conference of the European Chapter on Combinatorial Optimisation, URL: http://www.himolde.no/arrang/eccoXVI/.

June 9-13, 2003, Venice, Italy, European Applied Business Research Conference, URL: http://www.wapress.com/EABRCMain.htm.

June 16-20, 2003, Queen Elizabeth Hotel, Montreal, QC, Canada, First Joint Meeting of CAIMS and SIAM 24th Annual Meeting of CAIMS/SCMAI 2003 SIAM Annual Meeting, URL: http://www.siam.org/meetings/an03/index.htm

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

July 6-10, 2003, Istanbul, Turkey Euro XIX/INFORMS Conference URL: http://www.istanbul2003.org/.

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

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

July 13-16, 2003. The 7th International Conference of the International Society for Decision Support Systems (ISDSS'03). DSS in the Uncertainty of the Internet Age. Ustron, Poland. E-mail: isdss@sulu.ae.katowice.pl.

July 27-30, 2003, Orlando, Florida, USA, THE 7th WORLD MULTI CONFERENCE ON SYSTEMICS, CYBERNETICS AND INFORMATICS SCI 2003, URL: http://www.iiisci.org/sci2003/.

July 30 - August 1, 2003, Ontario, Canada, 3rd Annual McMaster Optimization Conference: Theory and Applications (MOPTA 03), URL: http://www.cas.mcmaster.ca/~mopta/.

July, 26-30, 2003. CE2003, 10th ISPE Int. Conference on Concurrent Engineering: Research and Applications, Madeira Island, Portugal. www.ispe-net.org/ce2003.

July 31, 2003. Special Focus Symposium on Decision Technology and Intelligent Information Systems. Baden-Baden, germany. www.iona.edu/faculty/kengemann/dtiis2003.htm

July 25 – August 7, 2003. EURO Summer Institute ESI XXI on Stochastic and Heuristic Methods in Optimization. Neringa, Lithuania. www.mii.lt /ESIXXI.

August 13-16, 2003, University of Nottingham, UK, The 1st Multidisciplinary International Conference o Scheduling: Theory and Applications (MISTA 2003), URL: http://www.mistaconference.org/.

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

August 25-29, 2003, BUDAPEST 17th IMACS WORLD CONGRESS, Information http://www.ifors.org/panorama/conferences/conf_02_03.html.

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

September, 4-6, 2003. Decision Support for Telecommunication and Information Society. Warsaw, Poland. Site: www.itl.waw.pl/dstis.

September 15-19, Havana, Cuba, 5th Workshop on Operations Research: Applications to the Economy Information. http://www.ifors.org/panorama/conferences/conf_04_03.html.

September 17-19, Kenya, Africa Operations Research and Development for Africa URL: www.tanzaniaports.com/orda1/conference.htm.

September 24-26, Valparaíso, Chile, OPTIMA 2003 The Fifth Chilean Operations Research Conference, URL: http://www.ind.utfsm.cl/optima2003/.

Octobre 9-11, 2003. 58èmes Journées du Groupe de Travail Européen « Aide Multicritère à la Décision », Moscou, Russia, Istitute of System Analysis, Russian Academy of Science. Thème : MCDA and Verbal Decision Analysis (In Memoriam of Oleg I. Larichev). Organisateur: Prof. Alexey Petrovsky (pab@isa.ru). Web site: www.isa.ru/mcda58.

October 19-22, 2003, Atlanta, GA, USA, INFORMS Annual Meeting Atlanta 2003, URL: http://www.informs.org/conf/Atlanta2003/.

October 27-29, 2003, Evry/Paris, France, International Network Optimization Conference, URL: http://www.int-evry.fr/INOC2003/.

November 4-7, 2003, Natal, Brazil, XXXV Brazilian Symposium of Operational Research (SBPO), URL: http://www.sobrapo.org.br/simposios/XXXV/Ingles.htm.

November 18-21, 2003, Switzerland, 2nd International Workshop on Global Constrained Optimization and Constraint Satisfaction (Cocos'03), URL: http://liawww.epfl.ch/cocos03/.

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

December, 8-12, 2003. The Congress on Evolutionary Computation, co-sponsored by the IEEE Neural Networks Society, the Evolutionary Programming Society, the IEAust, and the IEE, is the leading international

conference in the field. The 2003 Congress will be held in Canberra, Australia (http://www.cs.adfa.edu.au/cec_2003-/index.html).

15th Mini EURO Conference on "Managing Uncertainty in Decision Support Models" / University of Coimbra, Coimbra, Portugal, September 2004.

April 22-23 or 29-30, 2004. 59èmes Journées du Groupe de Travail Européen « Aide Multicritère à la Décision », Brest, France. Theme : "banque et finance". Organisateurs : Jean-Pierre Barthelemy et Philippe Lenca. www-iasc.enst-bretagne.fr/~mcda59/

Books

BOOK REVIEWS

The book **Multiple Criteria Decision Analysis: An integrated Approach** (Kluwer Academic Publishers, 2002, ISBN 0-7923-7505-X), by Valerie Belton and Theo Stewart, provides an excellent overview of the different multiple criteria approaches developed in divergent schools of thought which emerged in the last three decades. This book is not only a theoretical document, but also provides good coverage of practical issues. It can be recommended to a broad audience, ranging from those in academic institutions to practionners, as well as those who are interested in finding information on multiple criteria approaches, methods and techniques. It is an excellent book in the main area of Operations Research and Decision Analysis, with a special focus on Multiple Criteria and suitable for undergraduate and graduate students. A quick glance through the book shows it is well-structured and clearly written; methods and techniques are presented in a very comprehensive way. In addition, this book is very well illustrated, and has numerous examples, which renders it very accessible to the reader. Chapter One points out some key questions, starting with a brief discussion of what MCDA is, and what we can expect from it. Then, this introductory chapter presents the notion of the process of MCDA, and the meaning of an integration approach. From the authors viewpoint integration means: the integration between "different MCDA approaches", "MCDA and other operations research methodologies", "MCDA tools and other management science, operations research or/and statistics based tools".

Chapter Two reviews some major concepts in MCDA, and gives several motivational case studies. It is an excellent starting point for those who are searching for applications of MCDA approaches.

Chapter Three is a good overview of structuring problem methods. In my opinion, this is one of the most important contributions of this book to the MCDA literature. Prior to modeling and "solving problems", structuring activity is a crucial step in the process of decision-making. It is rare to find a book on MCDA which covers these topics simultaneously.

Chapter Four introduces useful concepts, definitions, and results on preference modeling theory. Scales, weights, aggregation procedures, uncertainty, aspiration and reference levels, pairwise comparisons, fuzzy and rough sets, are some of the concepts we can find in this chapter.

In this book MCDA techniques are structured into three main blocks: value and utility based methods, goal and reference level methods and outranking methods. Chapters Five and Six are dedicated to multiple criteria utility based techniques. Chapter Seven is devoted to goal and reference point methods. Finally, Chapter Eight presents and discusses outranking methods (mostly ELECTRE and PROMETHEE) for choosing, ranking and sorting alternatives.

While the previous three chapters are more or less technical, Chapter Nine is devoted to practical issues on the implementation of MCDA methods. It is a worthwhile chapter, where we may learn from the practical aspects of implementing MCDA techniques. The authors discuss several interesting questions arising from practice, for example, issues on the initial negotiation process before establishing the contract between an expert and a client or a group of clients, the relative importance of criteria weights in MCDA.

Chapter Ten discusses MCDA in a broader context. Here, the authors point out the synergies we can get when linking MCDA to others areas, with a strong multiple dimensional characteristic (Multivariate Statistical Analysis, DEA, Soft System Methodology, Game Theory, Environmental Analysis, Scenario Analysis,…). This discussion is also very interesting and improved the quality and originality of the book.

Chapter Eleven presents the main issue of the book; the integrated approach in different ways as a point to the development and strengthening of MCDA. The authors gave their own notion of integration as a challenge for MCDA in the future. MCDA must be an open field, receptive to the development from other disciplines, and also contributing with its techniques, methods and approaches to other fields of research. The authors' perspective on this topic is quite interesting and must be pointed out.

Finally, the book provides a good survey on software for MCDA and an important list of references.

In my opinion the major contributions of this book are: integrated approach, structuring problems, implementing and practical issues, as well as the main features of the different and divergent schools of thought, which are quite well explained. This provides the reader with a good understanding of the field of MCDA. The issue of an integration approach is a fascinating idea. It is a vision for the future of MCDA, and it can raise some questions that need to be discussed by the overall MCDA community.

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Multiple Criteria Optimization
State of the Art Annotated Bibliographic Survey
(Volume 1)

edited by

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Xavier Gandibleux
Université de Valenciennes, France

The roots of Multiple Criteria Decision Making and Multiple Criteria Optimization were laid by Pareto at the end of the 19th century, and since then the discipline has prospered and grown, especially during the last three decades. Today, many decision support systems incorporate methods to deal with conflicting objectives. The foundation for such systems is a mathematical theory of optimization under multiple objectives.

Since its beginnings, there have been a vast number of books, journal issues, papers and conferences that have brought the field to its present state. Despite this vast body of literature, there is no reliable guide to provide an access to this knowledge. Over the years, many literature surveys and bibliographies have been published. With the ever rapidly increasing rate of publications in the area and the development of subfields, these were mostly devoted to particular aspects of multicriteria optimization: Multiobjective Integer Programming, Multi-objective Combinatorial Optimization, Vector Optimization, Multiobjective Evolutionary Methods, Applications of MCDM, MCDM Software, Goal Programming. Hence the need for a comprehensive overview of the literature in multicriteria optimization that could serve as a state of the art survey and guide to the vast amount of publications. Multiple Criteria Optimization: State of the Art Annotated Bibliographic Surveys is precisely this book. Experts in various areas of multicriteria optimization have contributed to the volume. The chapters in this book roughly follow a thread from most general to more specific. Some of them are about particular types of problems (Theory of Vector Optimization, Nonlinear Multiobjective Programming, Fuzzy Multiobjective Programming, Multiobjective Combinatorial Optimization, Multicriteria Scheduling Problems), while the others are focused on multi-objective methodologies (Goal Programming, Interactive Methods, Evolutionary Algorithms, Data Envelopment Analysis). All contributing authors invested great effort to produce comprehensive overviews and bibliographies and to have references that are as precise as possible.

CONTENTS: List of Figures. List of Tables. Preface; R.E. Steuer. Introduction; M. Ehrgott, X. Gandibleux. References. 1. Theory of Vector Optimization; C. Tammer, A. Gopfert. 2. Nonlinear Multiobjective Programming; T. Tanino, H. Kuk. 3. Goal Programming in the Period 1990-2000; D.F. Jones, M. Tamiz. 4. Fuzzy Multiobjective and Multilevel Optimization; M. Sakawa. 5. Interactive Nonlinear Multiobjective Procedures; K. Miettinen. 6. Evolutionary Algorithms and Multiple Objective Optimization; C.A. Coello, C.E.M. Romero. 7. Data Envelopment Analysis in Multicriteria Decision Making; H. Nakayama, et al. 8. Multiobjective Combinatorial Optimization; M. Ehrgott, X. Gandibleux. 9. Multicriteria Scheduling Problems; V. T'Kindt, J.-C. Billaut. Index.

Kluwer Academic Publishers. INTERNATIONAL SERIES IN OPERATIONS RESEARCH AND MANAGEMENT SCIENCE Volume: 52. Hardbound, ISBN 1-4020-7128-0, June 2002, 520 pp. EUR 175.00 / USD 160.00 / GBP 110.00. URL of this book: http://www.wkap.nl/book.htm/1-4020-7128-0

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Multiple Criteria Decision Analysis – State of the Art (Surveys)
(Volume 2, Forthcoming)

edited by

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CONTENTS: Introduction José Figueira, University of Coimbra (P), Salvatore Greco, University of Catania (I) and Matthias Ehrgott, Auckland University (NZ). ELEMENTARY NOTATION (SYMBOL LIST). PART 0: AN OVERALL OVERVIEW ON MCDA TECHNIQUES TODAY. Chapter 1. Paradigms and Challenges. Bernard Roy, LAMSADE, Université Paris-Dauphine (F). PART I: FOUNDATIONS OF MCDA. Chapter 2. Preference Modelling, Meltem Öztürk, Alexis Tsoukiàs, LAMSADE, Université Paris-Dauphine (F) and Philippe Vincke, Université Libre de Brussels (B). Chapter 3. An Introduction to Conjoint Measurement, Denis Bouyssou, LAMSADE, Université Paris-Dauphine (F) and Marc Pirlot, Faculté Polytechnique de Mons (B). PART II: OUTRANKING METHODS. Chapter 4. ELECTRE Methods, José Figueira, University of Coimbra

(P), Vincent Mousseau, LAMSADE, Université Paris-Dauphine (F) and Bernard Roy, LAMSADE, Université Paris-Dauphine (F). Chapter 5. PROMETHEE Methods, Jean-Pierre Brans and Bertrand Mareschal, Free University of Brussels (B). Chapter 6. Other Outranking Approaches, Benedetto Matarazzo, University of Catania (I) and Jean-Marc Martel, Université Laval (C). PART III: MULTIATTRIBUTE UTILITY AND VALUE THEORIES, Chapter 7. MAUT-Multiattribute Utility Theory, James Dyer, University of Texas (USA). Chapter 8. UTA Methods, Yannis Siskos, University of Pireus,Vangelis Grigoroudis and Nikolaos Matsatsinis, Technical University of Crete (GR). Chapter 9. The Analytic Hierarchy & Analytic Network Processes, Thomas Saaty, University of Pittsburgh, Katz Graduate School of Business (USA). Chapter 10. MACBETH Carlos Bana e Costa, Technical University of Lisbon (P) and London School of Economics (GB), Jean-Claude Vansnick and Jean-Marie de Corte Université de Mons-Hainaut (B). PART IV: NON-CLASSICAL MCDA APPROACHES. Chapter 11. Dealing with Uncertainties in MCDA, Theo Stewart, University of Cape Town (SA). Chapter 12. Choice, ranking and sorting in fuzzy multiple criteria decision aid, Marc Roubens, University of Liège (B). Chapter 13. Decision Rule Approach, Salvatore Greco, Benedetto Matarazzo, University of Catania (I) and Roman Slowinski, Poznan University (PL). Chapter 14. Fuzzy Measures and Integrals in MCDA, Michel Grabisch, Université Paris VI (F) and Christophe Labreuche, Thales Research & Technology (F). Chapter 15. Verbal Methods of MCDA, Helen Moshkovich, Alexander Mechitov, University of Montevallo (USA) and David Olson, University of Nebraska (USA). PART V: MULTIOBJECTIVE MATHEMATICAL PROGRAMMING. Chapter 16. Interactive Methods, Pekka Korhonen, Helsinki School of Economics (Finland). Chapter 17. Multiobjective Programming, Matthias Ehrgott, Auckland University (NZ) and Margaret Wiecek, Clemson University (USA). Chapter 18. Multiple Objective Programming with Fuzzy Data, Masahiro Inuiguchi, Osaka University (J). Chapter 19. MCDM Location Problems, Stefan Nickel, University of Kaiserslautern (G) , Justo Puerto, University of Sevilla (SP) and Antonio Rodríguez-Chía, Cádiz University (SP). PART VI: APPLICATIONS. Chapter 20. MCDA Applied to Finance, Constantin Zopounidis, University of Chania (GR), Jaap Spronk, Erasmus University Rotterdam (H) and Ralph Steuer, University of Georgia (USA). Chapter 21. MCDA and Energy Planning, Carlos Henggeler Antunes, António Martins, University of Coimbra (P) and Danae Diakoulaki National Technical University (GR). Chapter 22, Multicriteria Analysis in Telecommunication Network Planning and Design-problems and issues, João Clímaco and José Craveirinha, University of Coimbra (P). Chapter 23, MCDA and Environmental Decisions, Giuseppe Munda, Universitat Autonoma de Barcelona (SP). PART VI: MCDM SOFTWARE. Chapter 24. MCDM Software, Heinz Roland Weistroffer, Subhash Narula and Charles H. Smith, Virginia Commonwealth University (USA).

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Basis Concepts of Multiset Theory

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There is a sufficiently wide range of problems where the objects under analysis are characterized by many diverse features (attributes), which may be quantitative and qualitative. Furthermore, the same objects may exist in several copies with different values of attributes, and their convolution is either impossible or mathematically incorrect. Examples of such problems are the classification of multicriteria alternatives estimated by several experts, the recognition of graphic symbols, text document processing, and so on. A convenient mathematical model for representing multiattribute objects is a multiset or a set with repeating elements. The multiplicity of elements is the most essential property of multiset that allows us to distinguish a multiset from a set and to consider multiset as a qualitatively new mathematical concept.

Foundations of multiset theory are stated systematically and consequently for the first time in this book. Principal characteristics of multiset are introduced. Various types of multisets and ways for comparing multisets are considered. The operations with an arbitrary number of multisets are determined, and their properties are investigated. The calculation rules for multiset cardinalities and dimensionalities, which are results of different operations with multisets, are found. Different forms for representing multisets are suggested.

Contents. Introduction. **1.** Notion of multiset. 1.1. Definition of multiset. 1.2. Possible forms for a multiset notation. 1.3. Characteristics of multiset. 1.4. Equality of multisets. 1.5. Inclusion of multisets. 1.6. *S*-equivalency of multisets. 1.7. *D*-equivalency of multisets. 1.8. Special types of multisets. 1.9. Special families of multisets. 1.10. Passage from multisets to sets. **2.** Operations with multisets. 2.1. Union. 2.2. Intersection. 2.3. Addition. 2.4. Subtraction. 2.5. Symmetric difference. 2.6. Complement. 2.7. Multiplication. 2.8. Multiplication by a scalar. 2.9. Direct product. 2.10. Linear combinations of operations. 2.11. Comparison with operations with sets. **3.** Properties of the operations with multisets. 3.1. General properties of the operations. 3.2. Presence of the operation properties. 3.3. Dualities of the operations. 3.4. Absence of the

operation properties. 3.5. Relations between the operations. 3.6. Calculation rules for multisets. **4.** Calculation of multiset cardinalities and dimensionalities. 4.1. Sum of two multisets. 4.2. Arithmetic difference and symmetric difference of two multisets. 4.3. Arithmetic multiplication and direct multiplication of two multisets. 4.4. Sum, union, and intersection of several multisets. 4.5 Reproduction, arithmetic multiplication, and raising to an arithmetic power of several multisets. 4.6. Direct multiplication, and raising to a direct power of several multisets. **5.** Forms for representing multisets. 5.1. Diagrams. 5.2.Vectors and matrices. 5.3.Graphs. 5.4. Lattices. 5.5. Algorithms. Conclusions. References.

Editorial URSS, Moscow, 2002. ISBN 5-354-00166-8 (in Russian).

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Negotiation Analysis: The Science and Art of Collaborative Decision Making

by

Howard Raiffa
(with John Richardson and David Metcalfe)

This masterly book substantially extends Howard Raiffa's earlier classic, The Art and Science of Negotiation. It does so by incorporating three additional supporting strands of inquiry: individual decision analysis, judgmental decision making, and game theory. Each strand is introduced and used in analyzing negotiations. The book starts by considering how analytically minded parties can generate joint gains and distribute them equitably by negotiating with full, open, truthful exchanges. The book then examines models that disengage step by step from that ideal. It also shows how a neutral outsider (intervenor) can help all negotiators by providing joint, neutral analysis of their problem. Although analytical in its approach--building from simple hypothetical examples--the book can be understood by those with only a high school background in mathematics. It therefore will have a broad relevance for both the theory and practice of negotiation analysis as it is applied to disputes that range from those between family members, business partners, and business competitors to those involving labor and management, environmentalists and developers, and nations.

Preface. **Part I. Fundamentals**.1. Decision Perspectives On four approaches to decision making. 2. Decision Analysis On how individuals should and could decide. 3. Behavioral Decision Theory On the psychology of decisions; on how real people do decide. 4. Game Theory On how rational beings should decide separately in interactive situations. 5. Negotiation Analysis On how you should and could collaborate with others. **Part II. Two-Party Distributive (Win-Lose) Negotiations**. 6. Elmtree House On setting the stage for adversarial bargaining. 7. Distributive Negotiations: The Basic Problem On the essence of noncooperative, win-lose negotiations. 8. Introducing Complexities: Uncertainty On deciding to settle out of court and other problems of choice under uncertainty. 9. Introducing Complexities: Time On entrapments and downward escalation; on real and virtual strikes.10. Auctions and Bids On comparing different auction and competitive bidding procedures. **Part III. Two-Party Integrative (Win-Win) Negotiations**. 11. Template Design On brainstorming alone and together; on deciding what must be decided.12. Template Evaluation On deciding what you need and want. 13. Template Analysis (I) On finding a joint compromise for a special simple case.14. Template Analysis (II) On finding a joint compromise for the general case.15. Behavioral Realities On learning how people do negotiate in the laboratory and the real world.16. Noncooperative Others On how to tackle noncooperative adversaries. **Part IV. External Help**. 17. Mostly Facilitation and Mediation On helping with people problems. 18. Arbitration: Conventional and Nonconventional On how a neutral joint analyst might help. 19. What Is Fair? On principles for deciding joint outcomes 20. Parallel Negotiations On negotiating without Negotiating. **Part V. Many Parties**. 21. Group Decisions On organizing and managing groups. 22. Consensus On how to achieve a shared agreement for all. 23. Coalitions On the dynamics of splitting and joining subgroups. 24. Voting On anomalies of collective action based on voting schemes. 25. Pluralistic Parties On dealing with parties fractured by internal conflict. 26. Multiparty Interventions On the role of external helpers in multiparty negotiations. 27. Social Dilemmas On the conflict between self-interest and group interest. References. Note on Sources. Index.

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Editor – in – chief
Prof. Edmundas K. Zavadskas

(On the occasion of the 15 th anniversary of cooperation between the Department of Construction Engineering and Management of Poznan University of Technology and the

Department of Building Technology and Management of Vilnius Gediminas Technical University).

CONTENS: 1. Kapliński. Changes and achievements in *CM* research and *CM* education at the Poznań University of Technology. 2. E.K.Zavadskas, A.Kakalauskas Efficiency increase in research and studies while applying up-to-date information technologies. 3. Pasławski, Methods for risk management in concerting at low temperatures. 4. T.Theil, Application of multicriteria decision-aid methodology in building production engineering. 5. A. Fojud, Multidimensional data analysis in construction industry. 6. T. Wiatr, Capital expenditure and receipts analysis in construction project management (description of the model). 7. S.Mitkus, T.Dėjus, Multiple criteria evaluation of construction tenders in accordance with the law on public procurement of the Republic of Lithuania. 8. N.Kvederytė, Analysis of efficiency of single-family house life cycle. 9. A.Banaitis, Model of rational housing in Lithuania. 10. V.Malienė, Valuation of commercial premises by the method of multiple criteria analysis. 11. V.Šarka, A decision support system applying multicriteria synthesis methods in construction. 12. S.Jakučionis, L.Ustinovičius, Multicriteria analysis of the variants of the old town building renovation in the marketing aspect.

Articles Harvest

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

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Séminaires du LAMSADE

“MODÉLISATION DES PRÉFÉRENCES ET AIDE MULTICRITÈRE À LA DÉCISION”
Responsables: Bernard ROY et Daniel VANDERPOOTEN
(le mardi, de 14:00 à 17:00, en salle P510)

4 mars 2003	Conférence de **Michel Grabisch** (LIP6 Université de Paris VI) : Bi-capacités pour la décision multicritère.
6 mai 2003	Discussion des travaux de **Mohamed Farah** (LAMSADE) Apport de l'aide multicritère à la décision pour la recherche de documents sur le Web.

Other Works

(Communicated by the authors)

Collections du LAMSADE

(Université Paris-Dauphine)

J.-M. MARTEL, B. ROY, Analyse de signifiance de diverses procédures d'agrégation multicritère. Cahier nº 199, LAMSADE (décembre 2002).

V. MOUSSEAU, L. DIAS, J. FIGUEIRA. On the Notion of Category Size in Multiple Criteria Sorting Models. Cahier nº 199, LAMSADE (mars 2003).

Research Reports of INESC Coimbra

RR Nº 1/2003 - "On the notion of category size in multiple criteria sorting models", Vincent Mousseau, Luís C. Dias and José Figueira

RR Nº 2/2003 - "Labeling algorithms for multiple criteria knapsack problems", José Figueira and Margaret Wiecek

RR Nº 3/2003 - " Report on a comparative Study of simulation Models for Self - Similar Traffic", Rita Girão and José Craveirinha

RR Nº 4/2003 - "An interactive method for bicriteria knapasck problems" (in portuguese), Carlos Gomes Silva, José Figueira and João Clímaco.

Dissertations

MONTANO-GUZMAN, Linett. "Fuzzy measures and integrals, MCDA sorting problematic". Ph.D Dissertation, ULB, Brussels. December 2002. Jury: Supervisor : Philippe Vincke (SMG - ULB), Martine Labbé (SMG - ULB), Michel Grabisch (LIP6 – UPMC), Jean Claude Vansnick (University of Mons – Hainaut), Bertrand Mareschal (SMG – ULB).

ABSTRACT: The additivity property of the ``*measure*", one of the most important concepts in mathematics, is often inflexible or too rigid to represent the many facets of human reasoning. In order to be able to express human subjectivity, recent researches proposed to replace this property by a weaker one, the ``*monotonicity*" and called these non-additive monotonic measures ``*fuzzy measures*".

"*Fuzzy integral*" is a generic term for integrals with respect to fuzzy measures. In this thesis we will mainly concentrate on the Choquet integral. This integral provides an alternative scheme to aggregate the information. Indeed, this aggregation operator, in the evaluation process, takes into account, not only the importance of each criterion but also the importance of all subsets of criteria.

Most multicriteria decision aid methods are based on an aggregation procedure. The most commonly used aggregation operators must satisfy the *independence* assumption. Nevertheless, there are few cases where this supposition is verified, and in this case, we talk about the interactions between criteria. The originality of our research is based on the introduction of these concepts of fuzzy measures and integrals into the multicriteria sorting methods. Indeed, the Choquet integral allows to take into account the importance of each criterion as well as the interactions of synergy and redundancy between them.

The proposed methods are implemented and tested on the Diagnostic of Firms Problem: The financial information, widely used in the assessment of a firm presents a high degree of dependences and these interactions have an influence on the financial position of the firm. The methodology proposed in this thesis allows to take into account these relations of synergy and redundancy between the analysed criteria in the evaluation process.

*** *** ***

VALLS-MATEU, Aïda. "ClusDM: A multiple criteria decision making method for heterogeneous data sets". Ph.D Dissertation, Universitat Politècnica de Catalunya (Barcelona, Spain). Jury: Advisor: Dr. Vicenç Torra (Research Institute on Artificial Intelligence, CSIC, Spain), Supervisor: Dr. Ulises Cortés (Universitat Politècnica de Catalunya, Spain), Dr. Joan Jacas (Universitat Politècnica de Catalunya, Spain), Dr. Miquel Sánchez (Universitat Politècnica de Catalunya, Spain), Dr. Yasuo Narukawa (Toho Gakuen, Tokyo, Japan), Dr. Josep Domingo (Universitat Rovira i Virgili, Spain), Dr. Enrique Herrera (Universidad de Granada, Spain).

ABSTRACT: We propose a new multi-criteria decision method for dealing with data described with different types of criteria. ClusDM (*Clustering for Decision Making*) is based on the utility theory approach and uses the classical artificial intelligence clustering techniques to perform the aggregation of these heterogeneous values. After the ranking, we have introduced two new stages for decision aid: (i) the Explanation Stage, in which we select the most appropriate term to describe the global value of each alternative, and (ii) the Quality Stage, in which we measure the trustworthiness of the final result. Moreover, ClusDM is able to extract knowledge about the decision problem, which is given to the user to let him/her know any special properties of the data set.

Announcement:

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

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

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

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

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

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

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

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

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

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

ldias@inescc.pt

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