



Opinion Makers Section

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Multi-Objective Optimization and Multi-Criteria Decision Analysis in the Energy Sector (part II – MCDA)

Multi-criteria decision analysis approaches

MCDA methods become increasingly popular in energy decision-making due to their capability to deal with complex decision processes, in face of multiple and conflicting evaluation criteria (of technical, economic, environmental and social nature), different stakeholders with different views and preferences, several sources of uncertainty and distinct time frames. Literature reviews with specific focuses on the use of MCDA in energy problems have been reported. Hobbs and Meier (2000) provide a wide review of MCDM methods and energy-environment applications. Greening and Bernow (2004) describe a modeling framework incorporating developments in integrated assessment of energy and environmental issues, and suggest a strategy for developing a set of coordinated policies from varying levels of information about policy attributes and DM's preferences. Pohekar and Ramachandran (2004) review the application of various MCDM methods in the framework of sustainable energy planning. Løken (2007) provide an overview of some of the most relevant MCDA methods

proposed in the literature. Mirakyan and Guio (2013) present a review of methods and tools for integrated energy planning in cities and territories, concluding that the purpose of MCDA methodologies is not just required to define the "right" energy plan but rather to support the understanding of the multi-criteria complex situation that supports interactive planning and learning, helping people to systematically consider, articulate and apply value judgments.

The problems most often dealt with with MCDA approaches are:

- Comparison of power generation technologies, involving the appraisal of available primary energy sources and technological options, considering conventional technologies and/or renewable energy technologies.
- Formulation and development of energy plans and policies, involving the choices faced by energy planners at the national, regional or local level seeking to identify the most desired one among alternative scenarios, taking into account the public debate on energy policy, energy conservation strategies and energy resource allocation issues.
- Selection of energy projects, namely concerning renewable energy investments for electricity generation.
- Location decisions, namely focussing on the siting of new wind farms and hydro and thermal power plants, also complemented with choices regarding operational parameters.
- Energy efficiency studies, mainly devoted to the evaluation of energy efficiency measures and programs either in technology replacement or building refurbishment.

3.1. Criteria

The main criteria used in energy decision-making studies may be broadly categorized as reflecting technical, economic, environmental and social axes of evaluation.

Technical criteria include adaptability (the technology's potential to be adapted to actual conditions for energy production), availability (which is often used to indicate the amount of time a unit can be used for electricity and/or steam production, and is relevant for assessing intermittent renewable energy sources), continuity and predictability (reflecting the technology's ability to maintain stable the energy generated without being affected by external factors), diversity (namely concerning energy production mix, technology or supply sources), efficiency (ratio of energy output vs. input), feasibility (as a surrogate for confidence on implementation technologies or policies), local technical know-how (qualitative assessment of the complexity of the technology and the capacity of local actors to ensure an appropriate support for its installation and maintenance), maturity of the technology (the technology's maturity rate and its penetration in international markets, perceived as technological advantage), peak load response (technology's ability to respond promptly to large variations in demand), generation capacity, reliability (technology's capacity to perform as designed, resistance to failure, ability to perform a required function under stated conditions for a specified period of time, ability of failure without catastrophic consequences), risk (of a major disaster or safety of the implementation of a policy), security (of the supply system, reduction of energy dependence or fuel imports), technical spin-off (development of analogous technologies).

Economic criteria include cost and economic performance criteria. Cost criteria are modeled through externality costs (imposed on society and environment but not accounted for by the producers and consumers of energy, and therefore generally not included in market prices), fuel costs (provision of raw materials, e.g. coal or natural gas for conventional thermal plants or uranium for nuclear power plants, for the operation of the energy supply system, also including extraction or mining, transportation and possible fuel processing), infrastructure costs (investments in transmission network required by each scenario, in grid connections, etc.), investment cost (purchase of mechanical equipment, technological installations, construction of roads and connections to the national grid, engineering services, drilling and other incidental construction work), operation and maintenance costs (wages and the funds spent for energy, products and services, and preventive and corrective maintenance works), production costs (assessing how commercially competitive the system is compared with other production technologies).

Economic performance criteria include economic impacts (capacity of the energy project or policy of promoting local/regional/national economic development, or the impact on the dynamics of the national industry and local income, or even the impact on GDP or GNP), economic viability (evaluates the energy policy/project using typical indicators, such as net present value, internal rate of return,

cost-benefit analysis, payback period, useful life). Other economic criteria may consider political, fiscal, legal, and commercial criteria, e.g. availability of funds, compatibility with the national energy policy objectives, political acceptance, geopolitical issues, legal framework, commercial aspects, market size, energy price stability, duration of preparation and implementation phases for the evaluation of different energy policy implementations.

Environmental criteria may be broadly devoted to appraise local and global impacts. Local impacts include acidification and eutrophication, different types of emissions (CH₄, CO₂, NO_x, SO₂, SO_x, etc.), effects on natural environment, land use, local pollutants, noise, particulate matters, photochemical ozone creation, potential radioactivity, visual impact, and wastes. Global impacts account for climate change, namely using global warming potential and greenhouse gas emissions as surrogates, resource depletion, sustainability of energy resources.

Social criteria include health impacts (in general compared using the concept of expected years-of-life lost), risks (e.g., of fatal accidents or injuries, food safety), development (job creation, regional development, and social impacts), and acceptability (social or to the users) issues.

3.2. Methods

MCDA methods to tackle problems in the energy sector mainly include: value and utility theory approaches, outranking approaches, AHP/ANP approaches and other approaches. Simple Additive Weighting is mainly considered in power generation technology comparisons and in developing sustainability indices. MAUT is mostly used to capture the uncertainty relating to the outcomes of alternatives rather than the uncertainty relating to attribute values, namely in energy efficiency studies. MAVT is mainly used in power generation technology comparisons, in particular to rank power expansion alternatives or to prioritize investment portfolios in capacity expansion and energy security problems. The Simple Multi-Attribute Rated Technique (SMART) is mostly used for renewable energy planning. The Ordered Weighted Average (OWA), which combines non-weighted and weighted linguistic information, is used in the formulation of sustainable technological energy priorities, the assessment of renewable energy producers' operational environment, and to derive suitability indices to install power.

The outranking approaches (ELECTRE - elimination and choice translating reality - family of methods), are used in ranking of renewable energy resources and recommending future energy sources, assessment of agricultural biogas plants, definition of national priorities for GHG emissions, selection of wind energy projects, evaluation of energy-

efficiency initiatives, and the assessment of risk in natural gas pipelines. The several versions of PROMETHEE (preference ranking organization method for enrichment evaluation) are used in energy plans and policies concerning the design of renewable energy projects and policies, sustainable energy planning, comparison of power generation technologies, and ranking the performance of different biomass feedstock.

ANP is applied on power generation technology studies, in particular in the evaluation of alternative fuels for electricity generation and energy sources for a country. Several applications of AHP in combination with other methods have been reported, including the evaluation of conventional and renewable energy sources for space heating in the household sector, selection of renewable energy alternatives and energy policy options, environmental performance of urban energy use plans, and selection of energy policies and production sites, renewable energy projects, and optimal locations for thermal power plants.

TOPSIS (technique for order preference by similarity to ideal solution) applications are mostly focused on the evaluation and selection of energy generation processes and technologies as well as energy systems performance, including determining the best compromise alternative fuel mode for public transportation, selection of the best energy technology alternative, ranking the alternative locations of thermal power plants, selection of the most sustainable electricity production technologies.

NAIADE (novel approach to imprecise assessment and decision environment) applications to energy decision-making studies are focused on the assessment of scenarios, including the feasibility of installing wind energy turbines on an island site, assess sustainability of bioenergy systems, assess policy measures or scenarios relating to residential heating energy and domestic electricity consumption.

VIKOR is used in applications ranging from the assessment of energy sources to energy projects and siting decision evaluations, including assessing fuel modes for public transportation, selection of renewable energy options and production sites, selection of renewable energy projects, and site selection and plant technical and operational parameters decisions of hydro power plants.

MACBETH (measuring attractiveness by a categorical based evaluation technique) is used to assess whether small scale or large scale approaches to renewable energy provision are best placed to help meet the targets set in the Energy White Paper for the UK at the lowest social, economic and environmental costs.

Participatory multi-criteria analysis is used to overcome the problems of monetary valuation and account for the multiple dimensions and long-term nature of sustainable

development, in a participatory process for appraising future energy systems.

3.3. Uncertainty

Due to the lack, inconsistency or imprecision of data and the subjectivity or vagueness of human judgments, the different types and sources of uncertainty should be explicitly taken into account to provide results in which the DM can have confidence. The difficulty of providing exact numerical values for the criteria, making precise evaluations and translating human reasoning into a qualitative/quantitative scale has been largely recognized (Doukas, 2014). Therefore, most of the input data and parameters required by the methods cannot be given precisely. Data associated with the performance of the alternatives according to multiple criteria, namely those of a more subjective nature, and parameters, such as weights whether or not understood as criterion importance coefficients, may be expressed in some methods by linguistic terms. Human judgments on qualitative attributes are always subjective and thus inherently imprecise.

Sensitivity analysis is the most popular uncertainty handling technique. Sensitivity analysis investigates the model response to different types of variation in the input information, including raw data, technical parameters conveying preferences, and additional assumptions. Several flavors of sensitivity analysis are combined with the MCDA methods mentioned above. In most applications sensitivity analysis considers changes in the results due to variations in a single parameter. Sensitivity analysis may be conducted for assessing whether there are other preferences or weights affecting the overall ordering of the options, computing the variation between optimistic and pessimistic scores, determining the range of weights within which the dominant alternative remains stable, evaluating the assignment of various criterion weighting schemes to accommodate a range of perspectives combined with different methods, studying changes of the (indifference, preference) thresholds as well as the degree of robustness for each outranking situation in ELECTRE methods. In methods based on value and utility theory approaches, the treatment of uncertainty is mainly done by using sensitivity analysis and/or stochastic distributions.

Fuzzy sets and fuzzy logic are also used to address uncertainty in MCDA. The use of fuzzy logic techniques has allowed developing a quantitative approach using a qualitative representation, so it has been capable of simultaneously handling numerical data and linguistic knowledge expression. Scenario based analysis is also a frequent uncertainty handling technique, in which a limited number of scenarios is constructed to analyze likely or relevant projections of the future. Robustness analysis, which is generally defined as the determination

of the degree to which a solution is affected, in terms of any attribute, by unknown parameters or changing assumptions, has gained an increased attention in MCDA.

4. Conclusions

The energy sector is of outstanding importance for the satisfaction of societal needs, providing directly or indirectly the fundamental requirements for almost all activities in modern societies. The application of models and methods of operational research has contributed to effective decision support in several problems arising in the energy sector. Until mid 1970s models for energy planning were mainly based on an overall cost minimization perspective subject to demand satisfaction and technology constraints. Nowadays, energy planning models, from strategic long-term to operational short-term ones, are mostly based on multi-objective optimization and multi-criteria decision analysis approaches, thus recognizing the need to encompass multiple, conflicting and incommensurate aspects of evaluation of the merits of distinct courses of action pertaining to economy, environment, reliability, quality of service, etc. These models not just capture in a more realistic manner the complexity of these problems, but also provide a value-added in exploring a variety of possible decisions representing different trade-offs between the competing objectives/criteria thus enabling a more comprehensive analysis of potential solutions also including in the decision process the preferences and interests of stakeholders.

The quest for sustainability, namely concerning renewable energy resources, technological advancements, new market designs, the significance of investments, etc., make problems in the energy sector important challenges, for which MOO and MCDA possess the right tools to be offered to planners and decision makers (governments, regulators, utilities, consumers, interest groups) for a thorough analysis and balanced recommendations. Therefore, it is expected that the energy sector will remain one of the most active and exciting areas of application of MOO/MCDA models and methods, with an enriching cross-fertilization between challenging problems and innovative models and methods.

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MCDA Research Groups

Centre for Operational Research and Logistics (CORL)

Alessio Ishizaka
Founding Deputy Director of the CORL

The new Centre for Operational Research and Logistics (CORL) at the University of Portsmouth (UK) is gathering members of several departments: Department of Mathematics, Faculty of Technology, Operations and Systems Management Group, Portsmouth Business School and the Institute of Industrial Research, Faculty of Creative and Cultural Industries.

CORL has staff members covering many areas of the field of Operational Research and the quantitative aspects of the logistics field. There are particular strengths in the sub-fields, hereafter labelled themes, of:

1. Multiple criteria decision analysis
2. Exact methods, heuristic and metaheuristics
3. Optimisation modelling
4. Soft OR and integrated methodologies

The expertise within CORL can also be mapped onto the following target application areas:

1. Logistics, transportation, and supply chain management
2. Healthcare
3. Marine and maritime
4. Renewable energy and sustainability

These are the application areas that the Centre concentrates on building Knowledge Transfer links and applied research outputs.

In the past three years there have been a number of significant Research and KT achievements of the centre:

- Over 40 peer-reviewed ISI journal articles, the majority of which are at the ABS 3* or 4* level.
- Plenary seminars given at the International Conference on Multiple Criteria Decision Making, XV Summer School Francesco Turco "Sustainable Development: Industrial Practice, Education & Research and the Brazilian CMAC conference.
- The award of 4 PhDs including sponsored students from the Malaysian and Thai governments.
- The award of 2 major EU grants (2OM, Leanwind) and the completion of a third (SEABILLA).
- The award of a Charitable Aims project from the Operational Research Society
- The hosting of the 76th Workshop of the Euro Working Group of Multi-Criteria Decision Aid.
- Involvement in four Technology Strategy Board Projects
- Collaboration with a range of academic, research or industrial institutions worldwide

Members of CORL specialise in both discrete and continuous MCDA/M techniques. The theory and application of the distance-based MCDA/M techniques is a significant area of expertise. This involves techniques such as goal programming where the distance between a solution that can be achieved and a set of decision maker

set goals is minimised. Theoretical and computational advances in the technique of goal programming have been achieved by group members, details of most of which are available in Jones and Tamiz (2010). Distance-based MCDM/A techniques have been applied by CORL members to a wide range of applications including healthcare logistics and optimisation, analysis of cinema-going behaviour, fisheries economics management, selecting financial portfolios, and location of offshore wind-farms.

The second major area of expertise of CORL members is that of discrete decision aiding methods (Ishizaka and Nemery 2013), where we are active on the whole spectrum of the discrete MCDA methodologies, including aggregation methods (AHP, ANP, MacBeth, UTA), outranking methods (ELECTRE, PROMETHEE, GAIA), performance evaluation (DEA), case-based decision analysis (IRIS), decision rule methods (DRSA), robust ordinal regression and non-additive integrals to represent interaction between criteria (e.g. Choquet integral), interactive multiobjective optimization methods. We apply all these MCDA methodologies for choice, ranking, sorting decision problems, both in case of a single decision maker or group of decision makers.

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Jones, DF and Tamiz, M (2010) Practical Goal Programming, Springer Books, New York.

The current members of the CORL are:

- Professor Dylan Jones (Director)
- Dr Alessio Ishizaka (Deputy Director)
- Dr Maria Barbatti
- Dr Philip Brabazon
- Professor David Brown
- Dr Huijing Chen
- Professor Salvatore Greco
- Professor Ashraf Labib
- Dr Xiaodong Li
- Dr Zhening Li
- Dr Djamila Ouelhadj (KT and Application Areas Co-ordinator)
- Dr Martin Read
- Dr Jana Ries (Events Co-ordinator)
- Dr Edward Smart
- Dr Xiang Song (Themes Co-ordinator)
- Dr Graham Wall
- Dr Christine Welch
- Dr Salem Chakhar
- Dr Saijd Siraj

More information on the CORL can be found on <http://www.port.ac.uk/corl>

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ESTECO is known as a pioneer in numerical optimization solutions, specialized in the research and development of engineering software for all stages of the simulation-driven design process. ESTECO caters to engineers and researchers across a wide range of sectors including the automotive, aerospace, manufacturing, pharmaceutical, petrochemical and life sciences industries. ESTECO S.p.A. headquarters have been located at the AREA Science Park of Trieste (Italy) since the very beginning, and along the way, the initial group of experts in optimization techniques, numerical analysis and information technology has grown and acquired new skills, positioning ESTECO as the ideal partner for engineering companies interested in optimizing the industrial design process. Today ESTECO has more than 50 employees – most of them engineers and IT specialists – in Italy, USA (an ESTECO subsidiary) and India, and is distributed throughout Europe, South America and Asia via a qualified network of partners.



modeFRONTIER®, the company's key product, is an integration platform for multi-objective and multi-disciplinary optimization. It provides seamless coupling with third party engineering tools, enables the automation of the design simulation process, and facilitates analytic decision making. With modeFRONTIER®, the design process is streamlined, combining the different design objectives of individual engineering disciplines. Powerful workflows enable the execution of complex chains of design optimization, innovative algorithms determine the set of best possible solutions combining opposing objectives, and post-processing tools allow users to perform sophisticated statistical analysis and data visualization, actively supporting the decision making process.

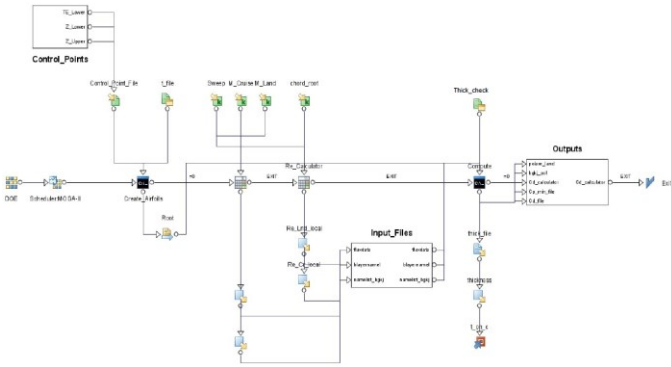
Advanced Optimization and Numerical Tools

ESTECO expertise in numerical solutions equips designers with a complete array of optimization algorithms covering deterministic, stochastic and heuristic methods for both single and multi-objective problems. Alongside traditional methods, modeFRONTIER provides fine-tuned multi-strategy optimization algorithms able to multiply the capabilities of single approaches: the FAST algorithm (using Response Surface Methodology to accelerate the number of iterations to achieve the optimum), the Hybrid method (combining global search and local refinement) and SAnGeA (adding an automatic screening phase to manage high-dimension, unconstrained problems). For post processing purposes, modeFRONTIER® provides a comprehensive environment for data analysis and visualization, enabling the statistical assessment of complex datasets. These sophisticated tools, ranging from Sensitivity Analysis to Multi-Variate and Visual Analysis, help visualize results from multiple simulations and identify key problems.

MCDM in modeFRONTIER

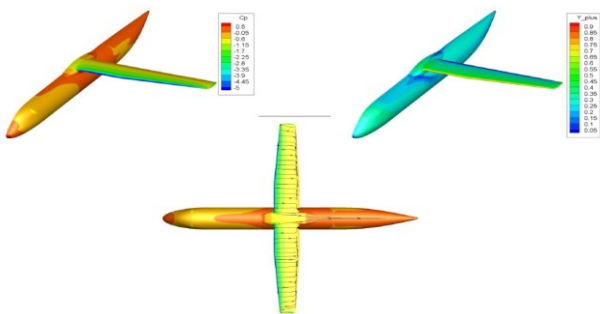
When design problems reach a certain level of complexity, a visual classification of the options becomes unfeasible. When many competing objectives apply, modeFRONTIER® users can automate the ranking of alternatives when intuition alone cannot provide a rational order.

Example of modeFRONTIER workflow



ESTECO customer, Alenia Aermacchi, used modeFRONTIER to optimize the wing of an aircraft and, with the help of the MCDM tool, successfully identified the most environmentally-friendly wing configuration.

Aircraft view



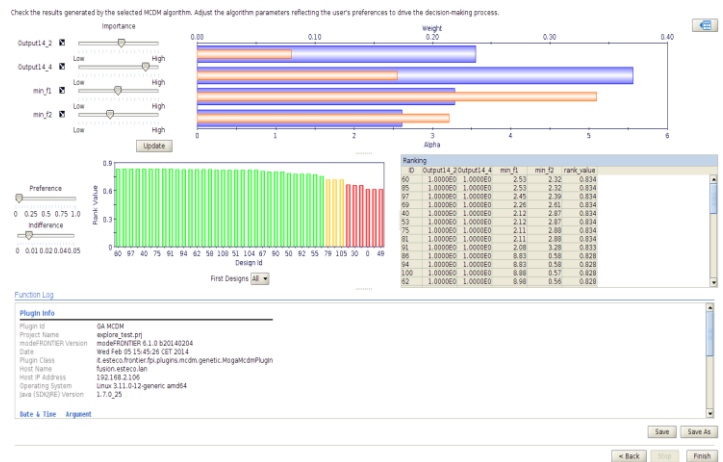
Starting from a reference configuration, designers followed a two-step approach:
1. Increment the aerodynamic performance

2. Reduce the wing weight while maintaining the optimal aerodynamic settings among those identified.

The modeFRONTIER® optimization process starts from the creation of the workflow where users define all input variables, objectives and parameters. The optimization algorithm selected was the genetic method MOGA-II which generated 20k possible designs; 3k Pareto designs were then extracted from this design dataset. But which design was effectively the best given the constraint and objectives?

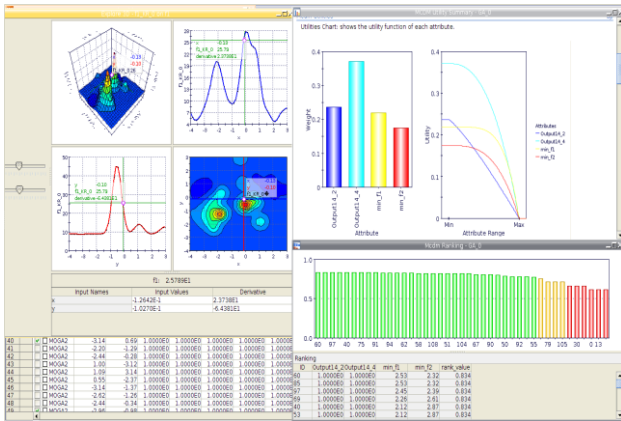
Alenia Aermacchi performed a Multiple Criteria Decision Making (MCDM) process, using the modeFRONTIER MDM tool. After evaluating the available modeFRONTIER algorithm sets, Alenia Aermacchi engineers used the GA-MCDM. Since it was hard to define the weights of the utility function precisely, this algorithm provided a full ranking without specifying the function parameters, indicating the importance of one criterion with respect to others. As a result of this guided decision-making process, the aerodynamic performance of the wing design was enhanced by 2.5%, with a 4% wing weight reduction.

modeFRONTIER GA-MCDM Panel



The main benefit of using the modeFRONTIER MCDM tool consists in the capability of investigating a series of possible rankings simply by changing a few parameters and, in doing so, find the most reliable solution. When engineers deal with a large set of possible solutions, it becomes very important to have a fast tool which is able to rank a large number of designs almost instantaneously without having a constrained tool and allows users to explore all ranking solutions quickly and efficiently.

Example of Design Space results



Software

Smart-Picker Pro Software

The Promethee and FlowSort methods to address choice, ranking, sorting and description problems.

Ph. Nemery

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Smart-Picker Pro is a decision support software that enables a decision maker to address several types of decision problems within one framework. Smart-Picker Pro helps the user when facing a choice, a ranking, a sorting and/or a description problem involving several criteria. Smart-Picker Pro implements therefore the PROMETHEE and GAIA [1] and FlowSort [2] methods along with weight elicitation methods. The decision maker or practitioner needs in fact to get used to only one method to solve all type of problems within the user-friendly software, described in this article. Introduction

1. Introduction

On any one day, people face a plethora of different decisions and people face no longer one specific type of decision problem. A manager in a company for example may have to evaluate projects and regroup them in priority-based categories along with the required resources (human, financial, equipment ...). Besides, he might have to hire new workforce and choose the best candidate(s) amongst a group of potential persons. The manager will regularly evaluate suppliers and develop partnerships with the best ones. Understanding the weaknesses and strengths of each team member will help the manger to develop the team's skills with a personal development plan and assigning adequately corresponding tasks.

People and companies consider multiple (often conflicting) criteria in their decision process to build long-term relationships, make sustainable and environmentally friendly decisions. Furthermore, decision problems arise frequently; they are diverse and have to be addressed in a minimum of time. In order to support the practitioner, Smart-Picker has developed a software package which integrates several methods within a unified framework [3] (to reduce the learning curve and increase its use).

Visualization [4] and user-friendliness have been one of the major focuses of the software. In what follows, a particular attention will be paid to visualizations within the sorting context although similar visualizations exist for ranking problem.

The reader can find more information in our co-written book 'Multi-Criteria Decision Analysis: Methods and Software' [5] as well as in the manual [6]. Let us mention that there is a trial version and license fees can be negotiated for academic and business users.

2. Sorting: FlowSort

Smart-Picker Pro supports the sorting method FlowSort [2] and its associated visualization tools [4]. Examples of sorting problems include regrouping of customers into 'high-value', 'medium-value' and 'low-value' customers ; the assessment of innovation capabilities of enterprises [4,7] (classified into 4 categories: proactive, pre-active, reactive and passive enterprises); assignment of projects into priority-based categories ...

The FlowSort method allows assigning a set of actions to one of K predefined categories. In the sorting context, there is a complete order on these categories such that the decision maker has ordered these categories from the best (noted C1) to the worst (CK).

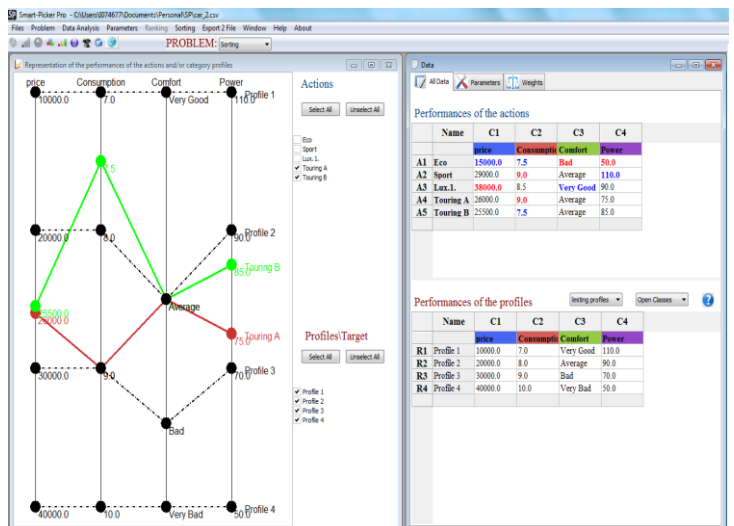


Figure 1 Representation of a sorting problem with 5 actions to be assigned to 3 categories defined by limiting profiles.

The categories are predefined since the decision maker knows their exact meaning. Therefore, he defines the categories by means of either limiting (boundary) profiles or central (representative) profiles. Figure 1 represents the problem definition phase: the sorting of 5 cars ('Eco', 'Touring A', 'Touring B', 'Lux.1' and 'Sport'), evaluated on 4 criteria (price, consumption, comfort and power), into 3 categories (the most preferred cars, the cars to be further investigated and the least preferred cars) defined by limiting profiles.

The FlowSort method is a direct extension of the PROMETHEE method and is based on the following idea: in order to assign an action to a category, it compares the action to the profiles by means of the PROMETHEE ranking method and then deduces its category based on its rank. All the actions, which belong to the same category, will receive the same recommendation. It is important to remark that the assignment of one action into one of the categories is independent from the assignment of the other actions.

Figure 3 represents therefore the comparison (in terms of net flows) of the car 'Sport' with the reference profiles (based on the net flows). Once the action assigned to its category, the decision maker is willing to understand the (reason of) assignment: the user can directly notice that 'Sport' is assigned to the second category due to a high score on 'Power' but with comparatively weaker scores on 'Consumption'.

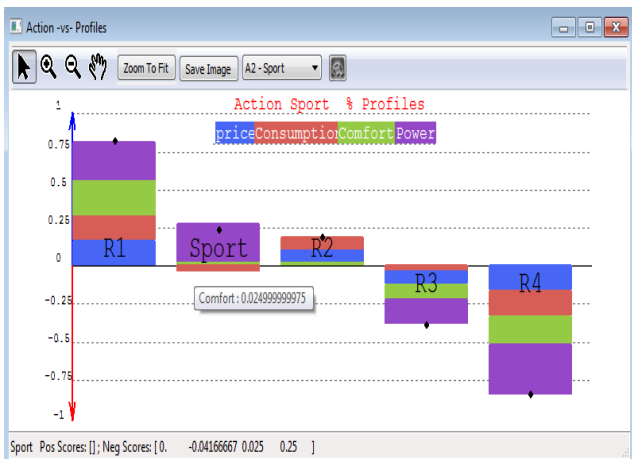


Figure 2 Comparison of an action (Sport car) to the reference profiles R1-R4.

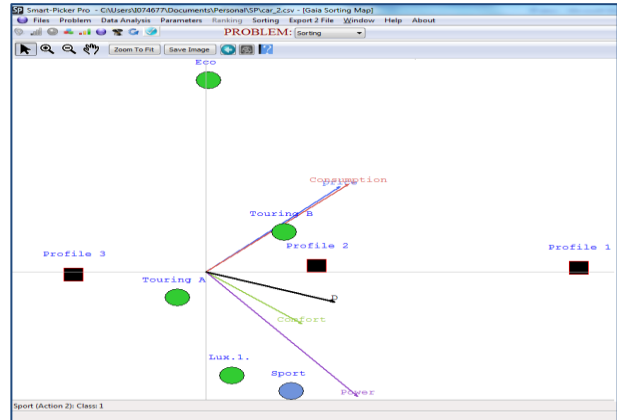


Figure 3 Assignment of all actions.

Furthermore, although the assignment of an action is independent of the other actions, the decision maker is usually interested in analyzing the similarities and differences between assigned actions. Figure 3 and Figure 4 (the so-called FS-Gaia plane [4]) permit to answer the following questions very easily:

- Why are some actions assigned to different classes (e.g. 'Lux.1' and 'Sport'?)
- Do the actions, assigned to the same category, have similar or different evaluations (e.g. 'Eco' and 'Touring A')?

Let us finally remark that all the parameters of the sorting methods such as the weights (that can be defined by means of an elicitation process), the thresholds, etc. can easily be varied in order to perform a sensitivity analysis.

Finally, as shown in Figure 5, the user can increase/decrease the evaluation of an action on one criterion in order to investigate when a change in assignment will occur. If the 'power' of 'Eco' becomes 90.8 instead of 50, 'Eco' will be assigned to class 1 instead of the 2nd class.

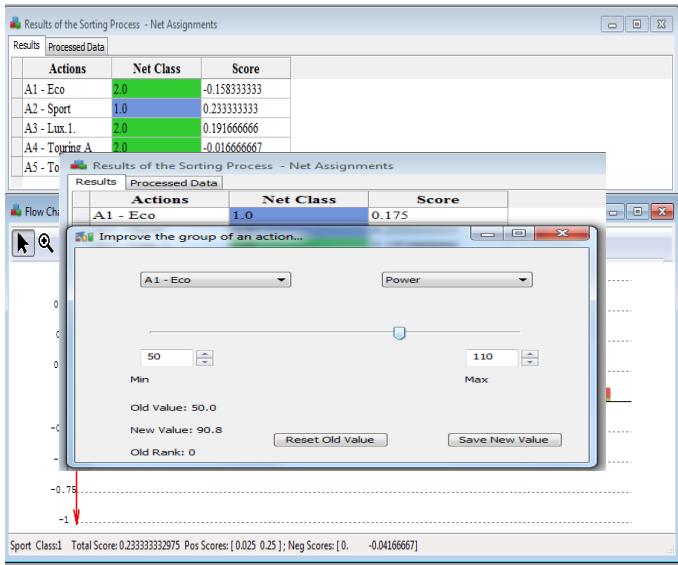


Figure 5 Improvement of the assignment of an action

3. Ranking: Promethee

Smart-Picker Pro implements the Promethee-GAIA Method to address the ranking, choice and description problem. Figure 6 shows the usual steps involved in the Promethee method: defining the preference parameters such as the preference function, the thresholds and the weights.

On the right, the user will see the final ranking of the actions along with the classic Gaia map. Let us remark that the user has indeed access to all the intermediate scores (net, positive, negative flows and all unit-criterion scores) and can perform a sensitivity analysis by changing the values of each parameter and seeing the impact visually. Figure 6 Implementation of the Promethee method

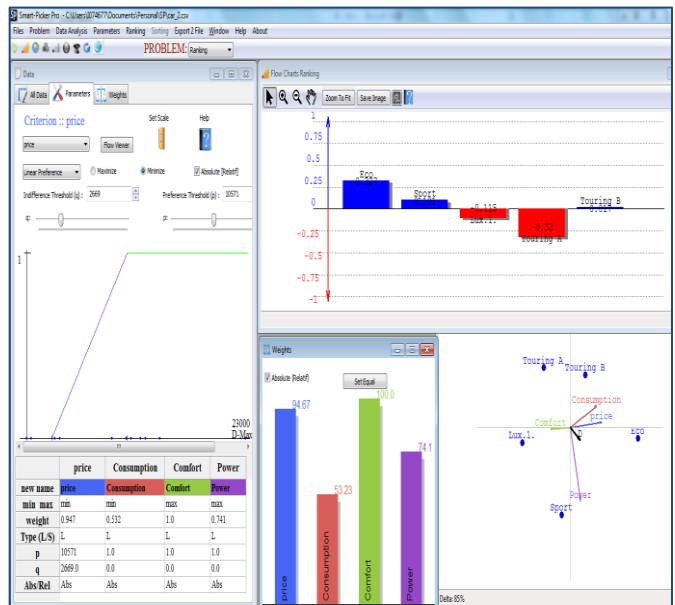


Figure 6 Implementation of the Promethee Method

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About the 79th Meeting

National Centre for Scientific Research "DEMOKRITOS", Athens, GREECE, 3rd to 5th April 2014

The 79th meeting of the European Working Group on Multicriteria Decision Aiding has taken place at the National Centre for Scientific Research "DEMOKRITOS", in Athens, GREECE, from the 3rd to the 5th April 2014. The 79th MCDA Meeting has specially focused on the "Multicriteria decision support in emergency and land use planning", as Risk management, i.e. the lowering of the individual risk created by a hazardous installation, constitutes a central factor affecting the acceptability of the latter by the nearby communities. It has been widely recognized that people accept technology mainly because of the benefits they can derive, while in the siting procedure of a potentially noxious facility or in the routing selection of hazardous materials transportation, the "not-in-my-back-yard" (NIMBY) syndrome is very difficult to ignore in wealthy western societies.

MCDA is more related to the risk perception by the general public caused by both natural and technological hazards; namely the former will aid in the decision making among various alternatives." In this perspective, the 79th meeting of the European Working Group on Multicriteria decision aiding has hosted contributions that gave some illuminating answers to these questions.

Articles presented

In total, 22 abstracts have been submitted, with 15 of them presented as short (20') presentations and 2 as long (40') ones; the rest have been announced as "discussion papers" and all abstracts have been included in the relevant book of Abstracts. The themes of the sessions included "Land Use Planning", "Resources Planning", "Robustness & multi-objective optimization", "Hierarchy process", "Finance" and "Ranking methods". There has also been a) a special session dedicated to the 80th anniversary of Bernard Roy, the founder of the MCDA group, and b) a round table session dedicated to "Ordinal Regression".

Participants

Around 50 participants have been registered to the workshop (and almost all of them came to the meeting), participating vividly in the discussion after each presentation. Additionally, a group of 20 students in informatics joined the workshop to follow the concluding remarks of it on the second day. A number of 30 regular

members of the group send their registration without participating in this workshop so as to continue to be members of the group.

Social program

On the first day of the meeting a common dinner has been organized in a typical Greek tavern. On the second day a common supper has been also organized for most of the participants, while on the 3rd day an excursion to the archaeological site of Sounion (near Athens) has taken place, followed by a lunch by the seaside.

79e Journées du Groupe de Travail Européen «Aide Multicritère à la Décision» 79th Meeting of the European Working Group «Multiple Criteria Decision Aiding» (Athens, Greece 3-5 avril/April, 2014)

SCIENTIFIC PROGRAM / PROGRAMME SCIENTIFIQUE

Program

Day 1: Thursday 3th April 2014

11:30 – 12:45 Registration of participants

12:45 – 13:15 Welcome

13:15 – 14:30 Session 1 – Land Use Planning

Chair: Zoe Nivolianitou

13:15 – 13:40 Assessment of vulnerability of land-use types with respect to major accident hazards

Ioannis Sebos, Athena Progiou, Ioannis Ziomas

13:40 – 14:05 Sustainability assessment in rural urban fringe areas: A proposed methodology

Ottomano Palmisano G., De Boni A., Roma R.

14:05 – 14:30 Exploring the role of artificial neural networks for the multidimensional evaluation of territorial vulnerability and local conflicts

Alessandra Oppio, Stefano Corsi, Andrea Tosini

14:30 – 15:20 Session 2 – Resources Planning

Chair: José Rui Figueira

14:30 – 14:55 Multi-sensor Fusion - An application to the Food Industry

Loukas, D., & Nychas, G-J

14:55 – 15:20 Interactive Multiobjective Optimization using Dominance-based Rough Set Approach

Salvatore Greco, Benedetto Matarazzo, Roman Słowiński
Discussion papers

1. Multicriteria Assessment of Agricultural Resources for Energy and Material Use

Meike Schmebla, Jutta Geldermann

15:20 – 16:00 Coffee break

16:00 – 17:30 Session 3 - Session dédiée à Bernard Roy/Session dedicated to Bernard Roy

Chair: Yannis Siskos

16:00 – 16:30 ELECTRE: A comprehensive literature review on methodologies and applications

Kannan Govindan, Martin Brandt Jepsen

16:30 – 17:30 Présentation de Bernard Roy à l'occasion de ses 80 ans (album photos + vidéos)
Yannis Siskos, Nikolaos Matsatsinis
17:30 End of day 1

20:00 – 23:00 Official Dinner in Athens

Day 2: Friday 4th April 2014

9:15 – 10:30 Session 4 – Robustness and multiobjective optimization

Chair: Constantin Zopounidis

9:15 – 9:40 Inducing probability distributions on the set of value functions

Salvatore Corrente, Salvatore Greco, Milosz Kadziński, Roman Słowiński

9:40 – 10:05 Generalizing the core concept for multi-objective multi-dimensional knapsack problems and comparison to evolutionary algorithms

George Mavrotas, José Rui Figueira, Kostas Florios

10:05 – 10:30 Measuring the robustness of Pareto sets in multi-objective integer programming problems

George Mavrotas, José Rui Figueira, Eleftherios Siskos

Discussion papers

1. Aide à la décision robuste dans une démarche de développement durable

Bastien Rizzon, Vincent Clivillé, Sylvie Galichet

2. Applying stochastic MUSA for the evaluation of hotel service quality

E. Grigoroudis

10:30 – 11:00 Coffee break

11:00 – 11:30 Presentation of next meetings

Irène Abi-Zeid, Vincent Clivillé

11:30 – 12:20 Session 5 – Hierarchy process

Chair: Michael Doumpos

11:30 – 12:00 Applying Multiple Criteria Hierarchy Process to UTADIS and UTADISGMS

Salvatore Corrente, Michael Doumpos, Salvatore Greco, Roman Słowiński, Constantin Zopounidis

11:00 – 12:20 Multiple Criteria Hierarchy Process applied to decision about the re-use of historical buildings

Bottero M., Corrente S., Ferretti V., Greco S., Słowiński R.

Discussion papers

1) ELECTRE-TRI-B-H for solving hierarchically structured sorting problems

Luis Del Vasto-Terrientes, Aida Valls, Piotr Zielniewicz

12:20 – 12:50 Round table – Ordinal Regression

12:50 – 14:00 Lunch break

14:00 – 15:15 Session 6 – Finance

Chair: Salvatore Greco

14:00 – 14:45 Project portfolio selection for group decision making using multi-criteria analysis and mathematical programming through an iterative approach

Olena Pechak, George Mavrotas, Danae Diakoulaki, John Psarras

14:45 – 15:15 Towards a robust multiple criteria aggregation procedure for mixed evaluations

Sarah Ben Amor

Discussion papers

1. How to evaluate social innovation. A multicriteria approach

Maria A. de Vicente, María Alvarado, Ricardo García Vegas, Jaime Manera

2. Was the Construction Sector in 20 European Countries Anti-Cyclical during the Recession Years 2008-2009 as measured by MOO?

Willem K. M. Brauers and Edmundas K. Zavadskas

15:15 – 15:45 Coffee break

15:45 – 17:30 Session 7 – Ranking methods

Chair: Roman Słowiński

15:45 – 16:10 Parametric evaluation of research units with respect to reference profiles

Milosz Kadziński, Roman Słowiński

16:10 – 16:35 Proposition d'un cadre de prise de décision pour la conservation de rang d'une classe:

Examen de quelques méthodes multicritères

Amine Affes, Abdelwaheb Rebai

Discussion papers

1. Data-driven robustness analysis for MCDA preference disaggregation approaches

Michael Doumpos, Constantin Zopounidis

2. The Chance Constrained Recourse Approach for Portfolio Selection

Fouad Ben Abdelaziz and Meryem Masmoudi

16:35 – 17:30 Concluding remarks

17:30 End of day 2

20:00 – 23:00 Optional Dinner in Athens

Day 3: Saturday 5th April 2014

9:30 – 17:00 Excursion to Sounion

Official Dinner, Thursday: CHRISOMILO, 12, Agatharchou str. & Lepeniotou, Psiri, MONASTIRAKI metro station (on the map signed with "A")

Optional Dinner, Friday: YRIA, 6, Herakleidon str., close to the pedestrian road (Apostolou Pavlou) to Acropolis (on the map signed "STAVLOS")

Forthcoming meetings

IFORS 2014 - 20th Conference of the International Federation of Operational Research Societies
Barcelona, Spain
<http://www.ifors2014.org>

19/7/2014-1/8/2015
EURO Summer Institute 2014. OR in Agriculture and Agrifood Industry
Lleida, Spain
http://orafm.udl.cat/?page_id=233

20-25/7/2014
WCCM 2014 - 11th World Congress on Computational Mechanics
Barcelona, Spain
<http://www.wccm-eccm-ecfd2014.org>

20-25/7/2014
ORAHS 2014 - Operational Research Applied to Health Services
Lisbon, Portugal
<http://www.orahs2014.fc.ul.pt>

28-30/7/2014
Optimization 2014
Guimarães, Portugal
<http://optimization2014.dps.uminho.pt>

29-31/7/2014
6th International Conference on Applied Operational Research - ICAOR 2014
Vancouver, Canada
<http://www.tadbir.ca>

24-29/8/2014
19th IFAC World Congress IFAC 2014
Cape Town, South Africa
<http://www.ifac2014.org/>

26-29/8/2014
PATAT 2014 - 10th International Conference on the Practice and Theory of Automated Timetabling
York, United Kingdom
<http://www.patatconference.org/patat2014/>

2-5/9/2014
International Conference on Operations Research, OR2014
Aachen, Germany
<http://www.or2014.de>

8-11/9/2014
EngOpt 2014 - 4th International Conference on Engineering Optimization
Lisbon, Portugal

<http://www.dem.ist.utl.pt/engopt2014>

10-12/9/2014
ANTS 2014 - Ninth International Conference on Swarm Intelligence
Brussels, Belgium
<http://iridia.ulb.ac.be/ants2014>

24-26/9/2014
The 15th International Conference on Operational Research KOI 2014
Osijek, Croatia
<http://www.hdoi.hr/en/call-for-papers>

Autumn 2014
80th EWG on MCDA
Québec (Canada)

27-31/10/2014
META'2014 - International Conference on Metaheuristics and Nature Inspired Computing
Marrakech, Morocco
<http://meta2014.sciencesconf.org/>

9-12/11/2014
INFORMS Annual Meeting 2014
San Francisco, USA
<http://meetings2.informs.org/sanfrancisco2014/>

3-7/8/2015
23rd International Conference on Multiple Criteria Decision Making MCDM 2015
Hamburg, Germany
<http://www2.hsu-hh.de/logistik/MCDM-2015/>

October 6-9, 2013
INFORMS Annual Meeting 2013 Minneapolis
Minneapolis Convention Center & Hilton Minneapolis, USA
<http://www.informs.org>

The 36th Annual Meeting of the Society for Medical Decision Making
October 19-24, 2014
Doral Golf Resort and Spa, USA
http://smdm.org/smdm_annual_meetings.shtml

INFORMS Annual Meeting 2014 San Francisco
November 16-19, 2014
Hilton San Francisco, USA
<http://www.informs.org>

Announcements and Call for Papers

Below you can find the link for the new issue of our IJMCDM.

<http://www.inderscience.com/info/inarticletoc.php?jcode=jmcdm&year=2014&vol=4&issue=2>

EURO Mini Conference on
Improving Healthcare: new challenges, new approaches
Coimbra, Portugal
30 March – 1 April 2015
www.minieuro2015.com

Streams

If you are interested in organizing a stream please let us know (info@minieuro2015.com).

Confirmed streams:

- Health Informatics
- Radiotherapy Optimization
- Biomedicine
- Health Logistics and Scheduling
- Health Economics

Important Dates:

Submission of Abstracts/ Papers: 17 October 2014
Notification of acceptance: 15 December 2014
Final abstract/paper due: 09 February 2015
Early Registration Deadline: 02 March 2015

Master «Modeling, Optimization, Decision, Organization (MODO)»

Université Paris-Dauphine, Ecole des Mines de Paris

This one-year Master Programme (level M2), which has been existing and evolving for about 40 years, is devoted to Decision Aiding and Operational Research.

Starting next academic year (2014-2015), courses will be taught in the English language and the programme will be organized around three main streams. In particular, the « Decision » stream includes courses such as Decision Theory and Game Theory, Multiobjective Optimization, Robustness in Operational Research and Decision Aiding, Algorithmic Decision Theory and Computational Social Choice.

Tuition fees are around 500 euros per year.

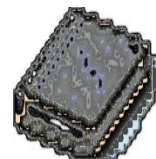
More information about the programme including the application procedure can be found at

<http://modo.dauphine.fr/en/master-program.html>

Any inquiries about the master can be addressed at master-modo@dauphine.fr

Web site for Announcements and Call for Papers:

www.cs.put.poznan.pl/ewgmcdm



Books

Multicriteria Analysis in Finance

By Doumpos, Michael, Zopounidis, Constantin, Springer 2014.

This book provides a concise introduction into the fundamentals and applied techniques of multiple criteria decision making in the finance sector. Based on an analysis of the nature of financial decisions and the general methods of financial modelling, risk management and financial engineering, the book introduces into portfolio management, banking management and credit scoring. Finally the book presents an overview of further applications of multi criteria analysis in finance and gives an outlook on future perspectives for the application of MCDA in finance.

<http://www.springer.com/business+%26+management/operations+research/book/978-3-319-05863-4>



Articles Harvest

(This section is prepared by Salvatore CORRENTE, salvatore.corrente@unict.it)

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Seminars

SEMINAIRE « MODELISATION DES PREFERENCES ET AIDE MULTICRITERE A LA DECISION »

Responsables : Bernard ROY, Daniel VANDERPOOTEN (le mardi à 14h00 – salles à préciser)

Prochaines réunions

28 janvier 2014 Conférence de Eyke Hüllermeier (Université de Marburg, Allemagne)

Preference-based Racing Algorithms for PAC Rank Elicitation (résumé voir pièce jointe)

18 février 2014 Présentation des travaux de Julien Roland (Université Exceptionnellement Libre de Bruxelles, Belgique) à 15h au lieu de 14h Optimisation inverse multi-objectifs : théorie, algorithmes et applications

(résumé voir pièce jointe)

11 mars 2014 Conférence de Tina Comes (University of Agder, Norway)

Decision Support in Emergency Management: Confronting Complexity and Uncertainty

(résumé voir pièce jointe)

8 avril 2014 Conférence de Vincent Mousseau 1, Marc Pirlot 2 et Olivier Sobrie 1;2 (1 Ecole Centrale de Paris, 2 Université de Mons)

Comment apprendre un modèle MR-Sort à partir d'un grand ensemble d'exemple d'affectation

(résumé voir pièce jointe)

20 mai 2014 Conférence de Jean-Luc Marichal (Université de Luxembourg)

Fonctions d'agrégation associatives et préassociatives

(résumé voir pièce jointe)

10 juin 2014 Conférence de Margaret Wiecek (Clemson University, South Carolina)

Robust Multiobjective Optimization

(résumé voir pièce jointe)

Persons and Facts

Subhush Narula
Virginia Common Wealth University
(1944-2013)

It's an honour for me to speak about a great man who contributed a lot in Multicriteria Decision Making Theory. Subhush was also a friendly person. He has many friends all over the world and has always supported them. He is humble and when someone compliments him about his wisdom and great sense of judgment, he smiles and says "I'm your mirror". Rest in peace my dear friend!!

Hella Ben Brahim Neji

Announcement:

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

(www.cs.put.poznan.pl/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 Rui Figueira (figueira@ist.utl.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.cs.put.poznan.pl/ewgmcda/>

Web site Editor: Milosz Kadzinski
(Milosz.Kadzinski@cs.put.poznan.pl)

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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