

**Jaap Spronk (1949 – 2021)***Obituary*

Emeritus Professor Jaap Spronk passed away in Rotterdam on February 8, 2021. He was full professor of Finance and Investment since 1982 at Erasmus School of Economics, where he was also chairman of Department of Finance from 1984 to 2003, vice-dean of international new business development from 2003 to 2008, director of studies from 2003 to 2007, director division of accounting and finance from 1996 to 2003, academic dean of MBA programmes until 2014, full professor of Financial Management Science at Rotterdam School of Management (RSM), until his retirement in 2015, and main advisor and member of the jury of numerous graduate and doctoral studies all over the world.

He had professorships at all levels in Finance, Financial Management, Decision Theory and Management Science, teaching worldwide in Dutch, English and Italian, at numerous universities, including the Bocconi University in Milan, the University of Bergamo and the University of Catania in Italy, the Helsinki School of Economics in Finland, the State University of New York at Buffalo, USA.

He initiated several important programmes for RSM and Erasmus University Rotterdam, and was able to build an impressive international network, organizing seminars, conferences, scientific meetings, summer schools, master and Erasmus programmes and so on. He was also an active member of European Working Group on "Multiple Criteria Decision Aiding", and initiator of the First International Summer School on Multiple Criteria Decision Methods, Applications and Software (Catania, 1983). He was the founder (1986) and first chairman of the prestigious EURO Working Group on Financial Modelling.

He was the founder and director of the GEMFM Global Network, which began in 2015 under his leadership and vision. Premium institutions such as IESDE School of Management Mexico, ESA Business School Lebanon, University of Curaçao and UCC Business School Mexico affiliated. He also held a part-time professorship in Financial Management at the University of Curaçao.

He was one of prominent visiting professors at Master in Management, Faculty of Economics and Business, Universitas Gadjah Mada (MMUGM) in Indonesia. He successfully coordinated MMUGM International Risk Management Training Programs for Top Executives since 2014 and initiated cooperation between MMUGM and reputable institutions in many countries.

Author of several books and hundreds of scientific papers, he worked in a variety of problems. His main research interests

and contributions focus on Decision and Portfolio Theory, Financial Risk Management, Performance Evaluation, Financial Modelling, Financial and Macro-Economic Planning with Multiple Objectives, Multiple Objective Decision Making, developing in particular the Interactive Multiple Goal Programming. In the framework of the MCDA, he was too Member of the Executive Committee Special Interest Group on MCDM (1980-1992), and was awarded by the MCDM Gold Medal (International Society on Multiple Criteria Decision Making), 2002.

His international awards include also the EUROPIN Award from EURO, for merit services, 1993, the Umbra Erasmi Medal of Erasmus University, 1996, the Gold Medal of the University of Crete, Greece, 1996, and the President's Award (2012) of the Association of European Operational Research Societies (EURO), whose he was President-elect (1989-1990), president (1991-1992) and immediate past president (1993).

He was one of the three main editors of the VBA Journal (for Investment Analysts) until 1990 and he served as an editor of numerous journals, including managing editor of the *Springer Series in Financial Modelling*, associate editor of *Operations Research*, of the *Revue Belge de Statistique, d'Informatique et de Recherche Opérationnelle*, and of the *Journal of Multiple Criteria Decision Analysis*, Editor of Feature Issues on Financial Modelling in the *European Journal of Operational Research*, and editor of other various special issues.

He was a member of the Royal Netherlands Academy of Arts and Sciences since 1988, selected member of the Olivians, since 1991, member of Founding Board of the Tinbergen Institute, member of Program Committee European Doctoral Program in Quantitative Methods in Management, member of Advisory Board of the Merrill Lynch Center for the Study of International Financial Services and Markets, New York, member of Advisory Board of the Center for Banking and Financial Research, Cyprus. He was also in the board of various companies and non-profit organizations and was advisor to investors, corporates and governmental organizations, and was active in research and professional partnership until the last days of his life.

It is very difficult to find other professors who enjoy the same appreciation, esteem, and fame internationally as Jaap does. But in my opinion, all these prestigious scientific and professional gratifications, however important they may be, do not by themselves return a complete profile of Jaap. He always faced any kind of problems seriously, analytically, taking into account all their different aspects and nature, always with a great sense of responsibility, competence, and conscientiousness.

He was very well educated, with the loving heart of a child, and was able to transmit the love of his skill to his students, colleagues and friends, quite a special gift. Another of Jaap's asset was his non-stop imagination and creativity. He was able to come up with great new projects, not just at the planning stage but also on the operational level. His brain was in constant activity, just like Mount Etna's volcano that he loved so much, offering other people the chance to take advantage of them, with generosity, great modesty, availability and easy-goingness, never expecting anything for himself.

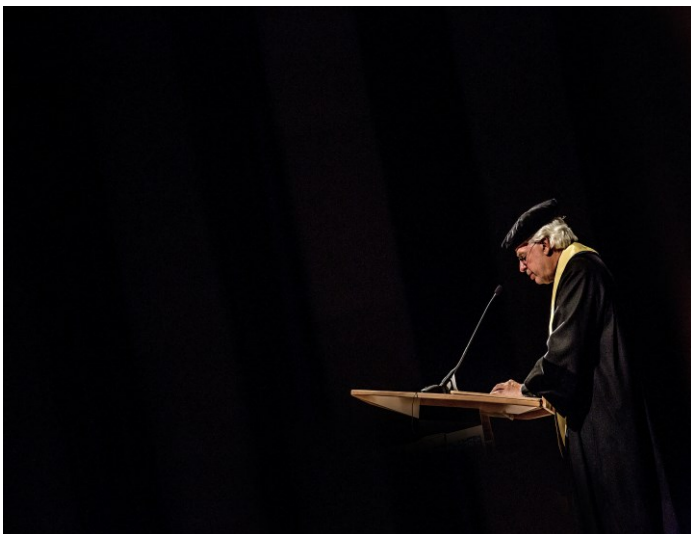
Always radiating enthusiasm and encouragement, endowed with great culture and many interests, all people appreciated his constructive and operational attitude, intuition, his mixture of competence, optimism, sense of humour: an excellent combination of Dutch rationalism and efficiency with Sicilian flexibility, friendship and love of life. He actually achieved an excellent balance between an intensively interesting working life and constantly growing social relationships all over the world, rejoicing in being in company of his friends.

His personality cannot be dissociated from his family. As people say, behind a great man there is always a great woman. His wife Yvonne's charm, unselfishness, diligence, kindness, commitment and culture perfectly complement her husband's character, understanding and supporting Jaap in his hard and sometimes stressful job.

However - of course - it is not all just hard work! Jaap liked to have some rest and holidays with his family, travel together around the world, sit and eat in beautiful, comfortable restaurants, enjoy some good wine with his friends in his house. What a perfect harmony in bringing up their wonderful family! How Jaap has been proud of his children Sarah and Thomas and how much his seven grandchildren were his pride and joy!

We always will keep a grateful memory and will be proud of Jaap friendship. He, that has always been one-step ahead of others, not to excel or to be proud, but to show everyone the best way, to pave it, to encourage all of us to follow him, to help us to reach new goals.

**Benedetto Matarazzo**



## Opinion Makers Section

**The workshop in decision making and techniques  
'Decision, decision, decision!' has been a success!**

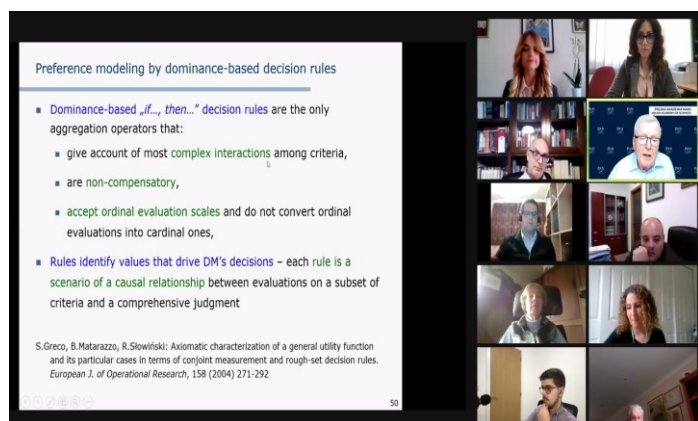
The university of Portsmouth in collaboration with the INFORMS Section on Multiple Criteria Decision Making, the EURO Working Group on Multicriteria Decision Aiding (EWG-MCDA) and the Decision Analysis SIG of the Operational Research Society has very successfully hosted the second edition of the workshop 'Decision, decision, decision!'. The event was designed last year with the aim of creating awareness of the usefulness of multicriteria decision making methods and techniques. This year the workshop generated massive interest across the academic and industry community and almost 200 participants from all over the world attended.

The plenary speaker was Professor Roman Slowiński who gave an inspiring speech on Evolutionary Multiobjective Optimization Guided by Human Choices where, thanks to interaction with stakeholders, a decision can be taken even in extremely complex situations.

The second part of the workshop was devoted to illustrating how such methodologies can be considered new and emerging technologies. Dr Sajid Siraj, introduced the topic with an engaging speech on how companies are adopting such methodologies - and even helping to control the spread of the pandemic.

Then, it was the turn of world leading experts in the field (Dr Salvatore Corrente, Professor Jose Figuiera and our own Professor Salvatore Greco) together with Professor Ashraf Labib and Professor Dylan Jones (of our own Centre for Operational Research and Logistics – CORL). They participated in a virtual round table to illustrate the latest applications and to explore the amazing potential of these techniques. A discussion followed about how best to promote the techniques and we concluded with what will become our mantra: *to sell our fish we need to prepare it in a way that people would appreciate it!* We really believe that this workshop helped to sell the multicriteria methodologies to the academic and industry communities. If you feel inspired you can watch the recording of the workshop at this [link](#) (Passcode 5\$jpY.2G)

**Maria Barbati**



## MCDA Research Groups

### ITAKA: Intelligent Technologies for Advanced Knowledge Acquisition

#### ITAKA presentation

Our research group was created in 2007 by Dr. Aida Valls and Dr. Antonio Moreno at University Rovira i Virgili, in the Department of Computer Science and Mathematics. The university is placed in Tarragona, a city created by the Romans in century III b.C. (Tarraco). The city is located in the coast of the Mediterranean Sea in Catalonia, a northern region of Spain.

The ITAKA group was recognized with the label "Consolidated research group" in 2010 and 2014 by the Catalan Government Agency on Quality. The group started with two main lines of research: (1) decision support systems and (2) knowledge learning and analysis, mainly with linguistic data. In 2010, we included a third research line with the fusion with another research group focused on computer vision, called RIVI (Robotics and Vision group). The group is currently led by Dr. Aida Valls. The group is formed by 2 full professors, 3 associate professors, 4 post-docs and several PhD students. The official website of the group is the following:

<https://www.urv.cat/html/grupsrecerca/reconegets/general-G756.php>

In addition, we keep two separate webpages for the original ITAKA group and the RIVI group, with the following links: <https://deim.urv.cat/~itaka> and <https://deim.urv.cat/~rivi/>

#### ITAKA work on MCDA

Our research on MCDA covered different approaches, including aggregation operations (MAUT), outranking methods and systems based on rules. We do both theoretical and applied research. Now we will highlight some of our recent work.

Regarding aggregation operators, we defined a new operator for unbalanced linguistic sets of terms, using fuzzy logics [1].

Recently we have focused on aggregation using Choquet integral and we have developed some new methods for learning from data the capacity measure that is used in this operator [2][3].

In the outranking-based approach, we have worked with Polish researchers in the ELECTRE methodology. Some works have been done on the use of hierarchies of criteria in ELECTRE ranking and sorting methods [4][5]. We have also defined concordance and discordance indices for linguistic data using the semantics provided by ontologies [6].

We are currently focused on the learning and use of rule-based systems for classification, using fuzzy logic [7]. In this line, we have proposed the use of fuzzy integrals for the aggregation of the outputs given by the rules in Fuzzy Random Forests (which are models with thousands of rules) [2][3].

From the practical perspective, we mainly work on three domains. In Tourism, with the design of a recommender system that uses MCDA to filter and rank activities according to the user profile [8][9], as well as some tools for tourist management, like website evaluation [10]. In Environmental Analysis, we have participated in some projects, the most recent are related to sustainability in energy production [11][12]. The last area is Health Care, where since 2013 we are working on the development of a clinical diagnosis aid system aimed at assisting in the diagnosis of Diabetic Retinopathy, which is an ocular disease that can cause blindness if not detected on time. We are constructing a clinical decision support system based on fuzzy random forests that analyzes the values of a set of risk factors and indicates which is the patient risk of developing diabetic retinopathy, allowing an optimal screening time [13]. Together with the use of data analysis tools and decision-making methods, we also make an automated analysis of the images taken from the eye fundus using both pattern recognition methods and deep learning. This is an ambitious project in which we're still involved together with a regional hospital.

#### We are busy organizing...

Currently we're organizing the CCIA 2021, the *international conference of the Catalan Association for Artificial Intelligence*. Topics like Decision Support Systems, Aggregation Operators, Preference Learning are welcome, among others. Find more information at <https://ccia2021.udl.cat/en/english/>

The proceedings of the CCIA conference are published in a book in IOSPress, in the series Artificial Intelligence Research and Development. Moreover, extended versions of the papers can be submitted to two special issues in ISI-JCR indexed journals, which may be also interesting for you:

- [International Journal of Computational Intelligence Systems \(IJCIS\)](#): Special issue on: New reasoning models: improving optimization and decision support with the management of uncertainty and constraints. Guest Editors: Dr. César Fernández, Dr. Aida Valls, Dr. Mateu Villaret
- [International Journal on Artificial Intelligence Tools \(IJAIT\)](#): Special issue on: Data mining, machine learning and decision support systems in Health Care.

Guest Editors: Dr. Aida Valls, Dr. Teresa Alsinet, Dr. Antonio Moreno

### Selected papers

1. Induced Unbalanced Linguistic Ordered Weighted Average and its application in multi-person decision making. L. Marin, A. Valls, D. Isern, A. Moreno, J.M. Merigó. *The Scientific World Journal*, Vol. 2014, Article ID 642165, 2014.
2. Learning fuzzy measures for aggregation in fuzzy rule-based models. Saleh, E., Valls, A., Moreno, A., Romero-Aroca, P., Torra, V., Bustince, H. *Modeling Decisions for Artificial Intelligence, Lecture notes in Artificial Intelligence*, vol. 11144, pp. 114-127, Springer, 2018.
3. A Hierarchically 1-Decomposable Fuzzy Measure-Based Approach for Fuzzy Rules Aggregation. E. Saleh, A. Valls, A. Moreno, P. Romero, H. Bustince, V. Torra. *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, Vol. 27, pp. 59-76, 2019.
4. The ELECTRE-III-H method for making decisions based on outranking relations with hierarchically structured criteria. L. del Vasto, A. Valls, R. Slowinski, P. Zielniewicz. *Expert Systems with Applications*, vol. 42(11), pp. 4910-4926, 2015.
5. A hierarchical multi-criteria sorting approach for recommender systems. L. del Vasto, A. Valls, P. Zielniewicz, J. Borràs. *Journal of Intelligent Information Systems*, 46, 313-346, 2016.
6. Inferring preferences in ontology-based recommender systems using WOWA. M. Martínez-García, A. Valls, A. Moreno. *Journal of Intelligent Information Systems*, Vol. 52(2), 393-423, 2019.
7. Learning ensemble classifiers for diabetic retinopathy assessment. E. Saleh, J. Blaszczynsky, A. Moreno, A. Valls, P. Romero-Aroca, S. de la Riva, R. Slowinsky. *Artificial Intelligence in Medicine*, 85, pp. 50-63, 2018.
8. Recommender systems in tourism. A. Moreno, L. Sebastià, P. Vansteenwegen. *IEEE Intelligent informatics bulletin*, Vol. 16, N°1, pp. 1-2, 2015.
9. SigTur/E-Destination: Ontology-based personalized recommendation of tourism and leisure activities. A. Moreno, A. Valls, D. Isern, L. Marin, J. Borràs. *Engineering applications of artificial intelligence*, Vol. 26(1), pp. 633-651, 2013.
10. Official tourist destination websites: Hierarchical analysis and assessment with ELECTRE-III-H. L. Del Vasto, J. Fernández Cavia, A. Huertas, A. Moreno, A. Valls. *Tourism management perspectives*, Vol. 15, pp. 16-28, 2015.
11. A semantic multi-criteria approach to evaluate different types of energy generation technologies. Martínez-García, M., Valls, A., Moreno, A., Aldea, A. *Environmental Modelling and Software*, Special Issue: Environmental Data Science, Elsevier, 2018.
12. Finding the most sustainable wind farm sites with a hierarchical outranking decision aiding method.

Afsordegan, A., Vasto-Terrientes, L., Valls, A., Agell, N., Sánchez, M. *Annals of Operations Research*. Springer. pp. 1-29, 2017.

13. A Clinical Decision Support System for diabetic retinopathy screening: Creating a clinical support application, Romero-Aroca, P., Valls, A., Moreno, A., Sagarra-Alamo, R., Basora-Gallisa, J., Saleh, E., Baget-Bernaldiz, M., Puig, D. *Telemedicine and E-Health*, 25(1), 2019.

*Aida Valls*

### About the 91<sup>st</sup> online meeting of the EWG-MCDA

The 91<sup>st</sup> online meeting of the EURO Working Group on Multicriteria Decision Aiding (EWG-MCDA) was held from April 29 to 30, 2021 in Zoom, jointly organized by Corvinus University of Budapest and the Institute for Computer Science and Control (SZTAKI).

Gyula Vastag, vice-rector for research, Corvinus University of Budapest, welcomed the participants in the opening session. The main theme of the meeting was Multiple Criteria Decisions under Uncertainty. The first keynote talk was given by Giuseppe Munda (European Commission, Joint Research Centre) with title '*Dealing with uncertainties in a social multi-criteria framework*'. The second keynote talk was given by Marie-Paule Kieny (Inserm) with title '*Decision making on purchase of COVID-19 vaccines in the context of incomplete information*'. Not only the keynote presentations but also the majority of the 18 regular talks induced a remarkable number of questions and remarks. Following the traditions of the EWG-MCDA meeting series, discourses were not limited, even at the price of possible delays in the schedule. Opening breakout rooms, a feature of Zoom, supported the private communication between interested participants and the authors of the 14 discussion proposals.

195 participants from 29 countries (according to affiliation) registered for the meeting. Most (almost fifty) registrations arrived from Italy. The large number of registered students was welcome news. The online setting made it simpler to have participants not only from Europe, but also from India, Japan, Morocco, USA, Brazil and Canada. Inevitably, not all the participants could join the whole meeting. The number of concurrent participants varied between 50 and 110.

Based on the feedbacks during and after the meeting we can conclude that the online mode did not reduce the scientific value. However, from several other points of view, personal presence has no substitute.

*Sándor Bozóki*

## Program

Time	Event	Author(s)	Title
13:30-13:45	Connecting in Zoom		
13:45-14:00	Opening		
14:00-14:45	Keynote lecture	Giuseppe Munda	Dealing with uncertainties in a social multi-criteria framework
14:45-16:15	Session 1 – Ecosystems		
14:45	Scharpenberg C Geldermann J		Decision support for sustainable regional food distribution of small farmers
15:15	Bottero M Caprioli C Dell'Ovo M Oppio A		Assessing ecosystem services through multi-criteria decision analysis: a case study in Turin
15:45	Henriques CO Gouveia CM Tenente M da Silva PP		Eco-efficiency of the electricity sector across the EU 28 – A Value-Based approach
	Submitted to Discussion		
	Barbati M Bottero M Corrente S Datola G Dell’Anna F Greco S		A space-time model to plan new developments in Yanzhou Island (China)
	Lemos Martins H Figueira JR Henriques CO		A multiple criteria classification approach for assessing policy interventions to stimulate transition of electric vehicle technology in Europe

	Bottero G D'Alpaos C	Policy prioritization to enhance the sustainability of water management in river basins
	Bagheri N	Evaluation of the Efficiency of UAE Sectors based on Sustainable Development Objectives and Circular Economy Using DEA
	Kelemen A Bozóki S	On the interaction of weights of criteria and assessment functions in composite indices of well-being and sustainable development
16:15-16:30	Break	
16:30-18:30	<b>Session 2 – Outranking methods and applications</b>	
16:30	Pappalardo MR Angilella S	Assessment of a failure prediction model in the Energy sector: A Multi-criteria discrimination approach with Promethee based classification
17:00	Pohl E Geldermann J	PROMETHEE-Cloud: A Web-based implementation of the outranking method PROMETHEE offering a wide range of sensitivity analysis and reporting options
17:30	Pereira M	Using ELECTRE TRI-NC to model a sunshine



		regulatory framework for the public hospitals in Portugal: A proposal
18:00	Norese MF Rolando D Curto R	A multi-criteria decision aid perspective that guides an incremental development of knowledge and fosters relationships and decisions

**April 30, Friday**

	Event	Author(s)	Title
8:45-9:00	Connecting in Zoom		
9:00-9:45	Keynote lecture	Marie-Paule Kieny	Decision making on purchase of COVID-19 vaccines in the context of incomplete information
9:45-10:00	Break		
10:00-12:00	<b>Session 3 – Analytic Hierarchy Process</b>		
10:00	Inuiguchi M Torisu I	The usefulness of interval weight estimation in ranking alternatives under a crisp pairwise comparison matrix	
10:30	Lakićević M Marques M Martó M	The AHP method in optimizing pollution from pulp production	

11:00	Kazibudzki P	On the affinity of the selected AHP prioritization methods
11:30	Szádoczki Zs Duleba Sz	Distance-based aggregation methods in group AHP
	<b>Submitted to Discussion</b>	
	Kuřakowski K Talaga D	Inconsistency indicators for incomplete pairwise comparisons
	Fattoruso G Barbati M Ishizaka A Squillante M	Improving classification methods through MCDA methods in the automotive sector
	Matulova M Kolacek M	A decision-making framework for event management based on a hybrid fuzzy mcdm method
	Oliva G Faramondi L Setola R Bozóki S	Characterizing robustness to rank reversal in Analytic Hierarchy Process
	Juhász P Szádoczki Zs Bozóki S	A comparison of weight vectors calculated from incomplete pairwise comparison matrices associated to specific graphs
12:00-13:00	Lunch Break	

13:00-14:30	Session 4 – Decision support in health care			16:15	Skulimowski AMJ	Multicriteria multimodel-based social impact optimization
13:00	Huttin CC	New development for cost sharing influence in health care - Identification of cost cues and consistency issues		16:45	Kurek KA Heijman W van Ophem J Gedek S Strojny J	Measuring local competitiveness: comparing and integrating two methods PCA and AHP
13:30	Costa AS Rocha A Figueira JR Ferreira DC Marques RC	Quality assessment of the Portuguese public hospitals using a multiple criteria sorting method			Submitted to Discussion	
14:00	Csiszár O Diaz Ochoa JG Csiszár G	Neural network-based medical recommender system using preference modeling			Szüle B	The relationship between bank asset structure and solvency probability
14:30-14:45	Break				Stamenkovic M	Dominance-based rough set approach for multiple-channel strategy selection
14:45-15:15	Preparations for the next EWG-MCDA meetings				Manthoulis G Doumpos M Zopounidis C Galariotis E	An ordinal classification framework for bank failure prediction: methodology and empirical evidence for US banks
15:15-17:15	Session 5: Ranking and optimization				Sziklai BR Baranyi M Héberger K	Testing cross-validation variants in ranking environments
15:15	Orbán-Mihálykó É Mihálykó Cs Gyarmati L	The evaluation of sports tournaments' results by Thurstone methods		17:15-17:30	Closing	
15:45	Spyridakos A Tsotsolas N Vryzides I	A methodological approach to measure and handle the impacts on the ranking of the alternative actions in extrapolation phase of the MCDA UTA methods in cases of low robustness				



## Software

### Spatial Sustainability Assessment Model (SSAM)

Boggia A., Massei G., Paolotti L., Rocchi L.  
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- Bioeconomics Research Unit, University of Perugia, Italy  
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SSAM is a calculation procedure developed in a geographic environment, aimed to develop spatial sustainability analysis, using multiple criteria that cover environmental, economic and social aspects. Essentially, it consists of a plugin working in the open-source GIS software QGIS [1], freely downloadable in the QGIS repository (<http://plugins.qgis.org/plugins>). It represents an evolution of the GeoUmbriaSUIT [2] plugin, of which it has maintained the theoretical approach, but with significant changes in the work environment and in the generated outputs. The multi-criteria method used within SSAM is the algorithm TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) [3, 4], which defines a ranking based on the distance from the worst point and the closeness to an ideal point, for each of the criteria used. For the sustainability assessment procedure, SSAM needs a geographic vector file, which has a graphic and an alphanumeric part (attribute table). The graphic data represents the alternatives: the study area and the single evaluation units within it (e.g.: the regions of a country, or the municipalities of a region); the alphanumeric part describes the criteria: the environmental, economic and social aspects relating to the evaluation units by means of a set of indicators (Fig. 1). The vector file must be provided as a GeoPackage Encoding Standard, a standards-based open format based on the SQLite database. If vector data are coded in a different format (i.e.: shapefile) they have to be converted.

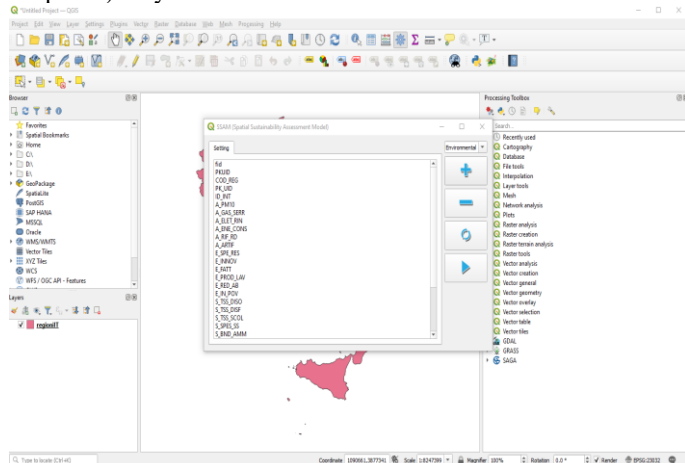


Fig. 1: Criteria setting

The use of the algorithm available in the plugin allows to treat individually the indicators representing the three pillars of sustainability, by assigning each of them to one dimension, and to compute three different indices: EnvIdeal (environmental index), EcoIdeal (economic index) and SocIdeal (social index) (Fig. 2).

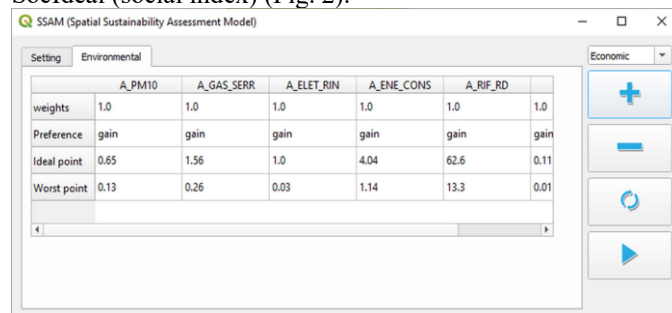


Fig. 2: Environmental card, as an example of the three dimensions.

After adding the indicators in the proper dimension, a card specific for the dimension will be added. In the card it is possible to: change the weights, indicate if the criterion has to be maximized or minimized, change the Ideal and Worst points. Weights can be directly insert, in the range 0-1. In case of weights in other ranges, they will be rescaled when the model is launched. All criteria are considered to be minimized by default. To change it, just click on the cell relating to the criterion to be maximized and the cost will turn into gain, along with the change of the ideal and worst points. The ideal and worst points are taken by default as the maximum and minimum value in the distribution of the criterion values, but it is possible to change them beyond the boundaries of the distribution. Each dimension and the relative card can be removed any time, just clicking on the button 'Remove dimension'.

When one or more dimensions are ready, the computation can be run using the button 'Process'. The computation generates a new card (Analysis) and the Geographical output. For each index calculated a map is generated, while the indices are added to the attribute table (Fig. 3).

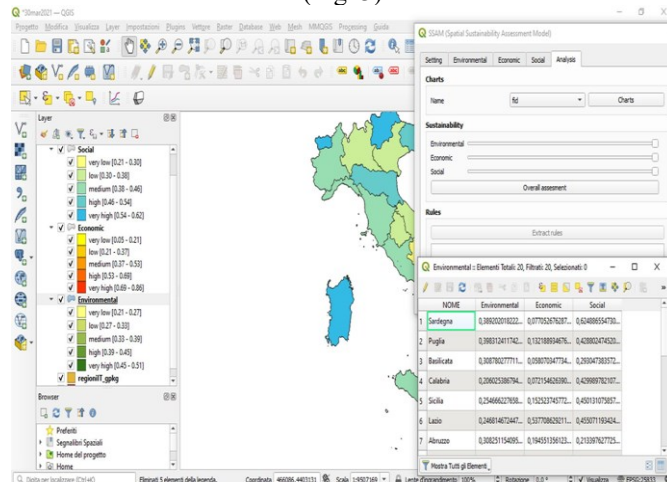


Fig. 3: SSAM output.



The three indexes can be computed singularly or up to all the three, giving information on one or more dimensions of sustainability. If at least two indexes are computed it is also possible to combine them together, using an additive weighted summation, for creating a global sustainability index (SustIdeal). The higher the value of this index, the better the performance of the unit in terms of global sustainability. To compute the SustIdeal, the user has to slide the point on the Sustainability section in the 'Analysis' card, to determine the weight of each dimension in the final index, and to click on 'Overall assessment' (Fig. 4). It generates an additional index and map, automatically added in QGIS.

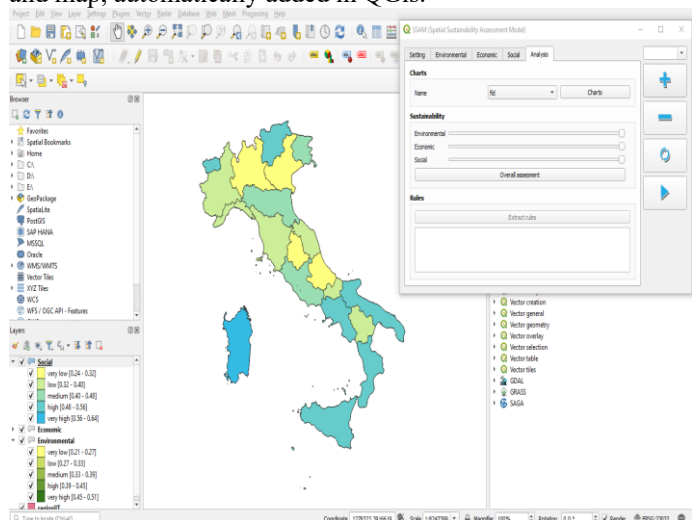


Fig. 4: SustIdeal overall assessment.

If SustIdeal is run, the plugin has the possibility to perform a Back analysis, thanks to the possibility to implement the DOMLEM algorithm, based on the Dominance Based Rough Sets Approach (DRSA) [5]. In this case, the exemplary cases are the best alternatives found after the analysis according to the SustIdeal. DRSA is not used to get ranking but to extract the decision rules that can explain the positions obtained by the alternatives in the ranking, based on the criteria used. Using it, transparency, traceability and back analysis capability are increased. Traceability means that from the score it is possible to go back to the rules and from the rules back to the input data. By clicking on the singular rule, the units which satisfy it will be highlighted in the map (Fig. 5).

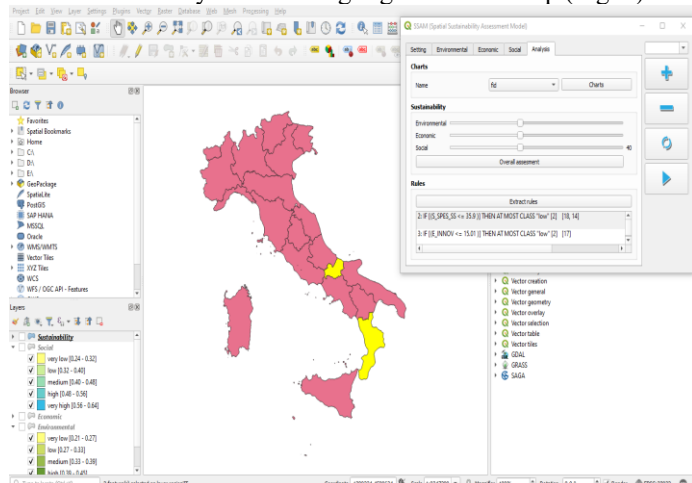


Fig. 5: Back Analysis.

When all the three indices are computed, along with the geographical output, it is possible to produce also additional graphic outputs, as graphs. By selecting the name of the dimension to categorize the units and clicking on the button *Charts* it is possible to create two different graphs. The first type of graph is a stacked histogram, in which the overall height is proportional to the sustainability value as the linear combination of the three indices (environmental, economic and social) (Fig. 6), while in the second the three dimensions are flanked one next to the others (Fig. 7). The three dimensions are always clearly identifiable, as they remain separated. The graphs are shown on the default browser.

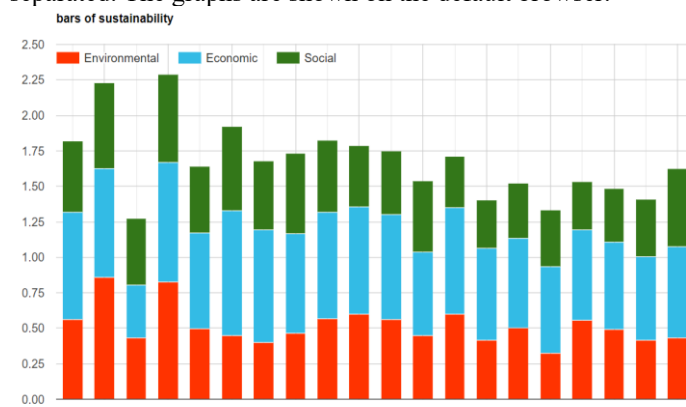


Fig. 6: Bars of sustainability

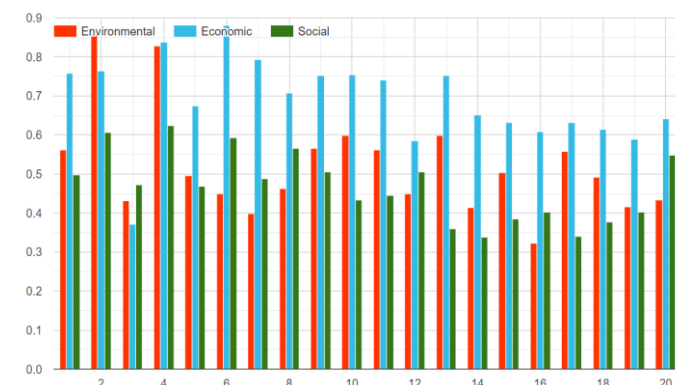


Fig. 7: Chart of sustainability

Furthermore, SSAM always saves the last simulation run in a file located in the same folder where the input Geopackage file is located. Therefore, in this way it is always possible to recall the parameters used, both to repeat and verify individual evaluations, and to introduce changes in the parameters and perform analyzes in different scenarios starting from a common basis.

Although SSAM suggests the use of three dimensions of sustainability assessment (environmental, economic and social), it is always possible to choose different dimensions (e.g. sanitary, cultural, etc.) or to choose a smaller number, even just one, or add more. This allows to make assessment in different decision-making process than sustainability one.

## References

- [1] QGIS Development Team 2013. QGIS Geographic Information System. Open Source Geospatial
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## Forthcoming meetings

(This section is prepared by Carlos Henggeler Antunes, [ch@decc.uc.pt](mailto:ch@decc.uc.pt))

19-21/5/2021

Conference on Integer Programming and Combinatorial Optimization - IPCO XXII  
ONLINE  
[Link](#)

26-28/5/2021

7th International Conference on Decision Support System Technology (ICDSST 2021)  
ONLINE  
[Link](#)

2/6/2021

2nd Online Doctoral Workshop on Supply Chain Analytics  
ONLINE  
[Link](#)

7-10/6/2021

CORS 2021  
ONLINE  
[Link](#)

8-11/6/2021

SEIO 2022: 39th Spanish Conference on Statistics and Operational Research and 13th Conference on Public Statistics  
Granada, Spain  
[Link](#)

10-11/6/2021

ECCO XXXIV 2021 - The 34th annual conference of the EURO Working Group European Chapter on Combinatorial Optimization  
ONLINE  
[Link](#)

15-18/6/2021

MESS 2020+1 - Metaheuristics Summer School  
ONLINE/Catania, Italy  
[Link](#)

21-23/6/2021

OLA'2021 - International Conference on Optimization and Learning: Challenges and Applications  
ONLINE/Catania (Sicilia) Italy  
[Link](#)

5-7/7/2021

IWOCA 2021 - 32nd International Workshop on Combinatorial Algorithms  
ONLINE  
[Link](#)

5-10/7/2021

International Conference on the Mathematical Optimization Theory and Operations Research (MOTOR 2021)  
Irkutsk-Baikal, Russia  
[Link](#)

7-9/7/2021

18th EUROPT Workshop on Advances in Continuous Optimization - EUROPT 2021  
ONLINE/Toulouse, France  
[Link](#)

10-14/7/2021

2021 Genetic and Evolutionary Computation Conference (GECCO 2021)  
ONLINE  
[Link](#)

11-14/7/2021

EURO 2021  
ONLINE/Athens, Greece  
[Link](#)

19-23/7/2021

ACDL 2021, 4th Advanced Online & Onsite Course on Data Science & Machine Learning  
ONLINE/Certosa di Pontignano, Siena – Tuscany, Italy  
[Link](#)

19-22/7/2021

Online PhD Course Choice-Based Optimization

ONLINE

[Link](#)

19-21/7/2021

EURO PhD School on Sustainable Supply Chains

ONLINE

[Link](#)

22-23/7/2021

3rd Conference on Sustainable Supply Chains (SustSC 2021)

ONLINE

[Link](#)

2-4/8/2021

Modeling and Optimization: Theory and Applications (MOPTA 2020)

Pennsylvania, USA

[Link](#)

9/8/2021

First International Workshop on Parallel and Distributed Algorithms for Decision Sciences (PDADS)

Chicago, Illinois, USA

[Link](#)

**22-27/8/2021**

**IFORS**

ONLINE

[Link](#)

30/8-3/9/2021

29th edition of the IFIP TC7 Conference: System Modelling and Optimization

Quito, Ecuador

[Link](#)

31/8-3/9/2021

OR 2021 – International Conference on Operations Research

ONLINE

[Link](#)

1-3/9/2021

2nd International Conference on Applied Mathematics in Engineering (ICAME21)

Burhaniye, Balıkesir, Turkey

[Link](#)

2-5/9/2021

14th International Workshop on Computational Optimization (WCO21)

ONLINE

[Link](#)

5-9/9/2021

APMS 2021 conference

ONLINE/Nantes, France

[Link](#)

24th edition of the EURO Working Group on Transportation Annual Meeting (EWGT2021)

Aveiro, Portugal

[Link](#)

**September 2021**

**92nd Meeting of EURO Working Group on MCDA Cracow, Poland**

[Link](#)

14-17/9/2021

50th Annual Conference of the Italian Operations Research Society. ODS2021: The International

Conference on Optimization and Decision Science.

Sapienza University Campus, Rome, Italy

[Link](#)

14-16/9/2021

OR63 Annual Conference

ONLINE

[Link](#)

20-23/9/2021

XLVIII Symposium on Operational Research - SYM-OP-IS 2021

Banja Koviljača, Serbia

[Link](#)

22-24/9/2021

16th International Symposium on Operations Research (SOR '21)

Bled, Slovenia

[Link](#)

5-8/10/2021

LOD 2021: The 7th Online & Onsite International Conference on Machine Learning, Optimization, and Data Science

ONLINE/Lake District, UK

[Link](#)

14-15/10/2021

EURO HOPE Mini Conference 2021

Helsinki, Finland

[Link](#)

18-22/10/2021  
IEC 61850 Week 2021  
Sweden

[Link](#)

21-22/10/2021  
19th International Logistics and Supply Chain Congress  
(LMSCM2021)  
Gaziantep, Turkey

[Link](#)

**24-27/10/2021**  
**INFORMS Annual meeting**  
**Anaheim, USA & ONLINE**

[Link](#)

25-29/10/2021  
CP2021 - 27th International Conference on Principles  
and Practice of Constraint Programming  
ONLINE

[Link](#)

27-30/10/2021  
META'2021 International Conference on  
Metaheuristics and Nature Inspired Computing  
ONLINE/Marrakech, Morocco

[Link](#)

3-5/11/2021  
The 7th International Conference on Algorithmic  
Decision Theory - ADT 2021  
Toulouse, France

[Link](#)

25-27/11/2021  
22nd International Conference on Intelligent Data  
Engineering and Automated Learning (IDEAL)  
Manchester, UK

[Link](#)

29/11-1/12/2021  
Joint ALIO/EURO International Conference 2021 on  
Applied Combinatorial Optimization  
Viña del Mar, Chile

[Link](#)

10-17/12/2021  
EURO PhD School - Reinforcement Learning Applied  
to Operations Research  
Marienheide, Germany

[Link](#)

13-16/12/2021  
IEEM 2021  
Marina Bay Sands, Singapore (mixed mode)

[Link](#)

13-14/12/2021  
[MCO2021] The 4th International Conference on  
Modelling, Computation and Optimization in  
Information Systems and Management Sciences  
Hanoi, Vietnam

[Link](#)

1-4/3/2022  
International Network Optimization Conference 2022  
(INOC)  
Aachen, Germany

[Link](#)

**April 2022**  
**93rd Meeting of EURO Working Group on MCDA**  
**Belgrade, Serbia**

[Link](#)

**3-6/7/2022**  
**EURO 2022**  
Espoo, Finland

[Link](#)

25-29/7/2022  
XVI International Conference on Stochastic  
Programming (ICSP2022)  
California, USA

[Link](#)

12-16/9/2022  
paraoptXII: 12th International Conference on  
Parametric Optimization and Related Topics  
Augsburg, Germany

[Link](#)

**September 2022**  
**94th Meeting of EURO Working Group on MCDA**  
**Agios Nikolaos, Greece**

[Link](#)

**April 2023**  
**95th Meeting of EURO Working Group on MCDA**  
**Jaén, Spain**

[Link](#)



## Books

2nd Edition

### **Multi-Criteria Decision Analysis: Case Studies in Engineering and the Environment**

By Igor Linkov, Emily Moberg, Benjamin D. Trump, Boris Yatsalo, Jeffrey M. Keisler

Copyright Year 2021  
ISBN 9780367345334  
CRC Press, 420 Pages

#### **Book Description**

Decision analysis has become widely recognized as an important process for translating science into management actions. With climate change and other systemic threats as driving forces in creating environmental and engineering problems, there is a great need for understanding decision making frameworks through a case-study based approach. Management of environmental and engineering projects is often complicated and multidisciplinary in scope and nature, thus issues that arise can be difficult to solve analytically. *Multi-Criteria Decision Analysis: Case Studies in Engineering and the Environment* provides detailed description of MCDA methods and tools with particular focus on illustrating their applications through case studies on sustainability and system engineering applications.

The Book:

- Addresses current and emerging environmental and engineering problems
- Analyzes trends in MCDA within the environmental field and in government agencies
- Includes seven new case studies to illustrate different management situations applicable at the international level
- Builds on real case studies from recent and relevant environmental and engineering management experience in various realms including water resources, land use, and industry
- Describes advanced MCDA techniques such as MAUT, Outranking and AHP, as well as extensions such as value of information, portfolio analysis, GIS and optimization
- Provides corresponding decision models and worked examples implemented using the DECERNS software package
- Gives a more holistic approach to teaching MCDA methodology with a focus on sustainable solutions and adoption of new technologies, including nanotechnology and synthetic biology
- Given the novelty and inherent applicability of this decision-making framework to the environmental and engineering fields, a greater number of teaching tools for this topic need to be made available. This

book provides those teaching tools, covering the breadth of the applications of MCDA methodologies with clear explanations of the MCDA process. The case studies are implemented in the DECERNS software package, allowing readers to experiment and explore and to understand the full process by which environmental managers assess these problems.

This book is a highly useful resource for professionals and students alike, seeking to both learn and understand current multi-criteria decision analysis techniques and apply similar frameworks to environmental and engineering projects.



## **Announcements and Call for Papers**

### **Call for the "Bernard Roy Award of the EURO Working Group on Multiple Criteria Decision Aiding" (Bernard Roy Award of EWG MCDA)**

#### **Policy**

-The Bernard Roy Award of EWG MCDA is a recognition conferred to a researcher under 40 years old for an outstanding contribution to the methodology and/or applications of Multiple Criteria Decision Aiding (MCDA).

-The award will be officially bestowed at the opening session of the 92nd EWG MCDA meeting, september 2021, Cracow, Poland, if there is a suitable candidate. In this case, following a presentation of the competition by the chair of the Jury, the laureate will be invited to give a talk.

#### **Award**

The laureate then will receive the financial award (1000 EUR) and the diploma.

#### **Eligibility**

-The Bernard Roy Award of EWG MCDA shall be awarded for a body of work in MCDA, preferably published over the last decade. Although recent work will not be excluded, care shall be taken to allow the contribution to stand the test of time.

-The potential award recipient shall have a recognized stature in the MCDA community. Significance, innovation, depth, and scientific excellence shall be emphasized.

#### **Nominations**

-Candidates can be nominated by any three members of the EWG MCDA.

-A candidature for the Bernard Roy Award of EWG MCDA is composed of the nomination letter along with a recent and detailed CV, up to 5 best publications, as well as a self-description of the achievements up to 3 page long in a standard manuscript format. The nominations must be sent to the Jury chair by the due date of June 30, 2021.

#### **Selection process**

-Only one award may be assigned on each occasion.

-One person may receive the award at most once in her/his lifetime.

-The jury evaluates the nominees essentially on the basis of their scientific activities (papers in top journals, editorials, relevance of methodological proposals and/or applications...).

#### **Jury**

-The jury for the current edition is composed of Professors Irène Abi-Zeid (chair), Maria Franca Norese, Yannis Siskos, Roman Słowiński, and Daniel Vanderpooten.

#### **Timing**

-Deadline for nominations: June 30, 2021.

-The Jury chair informs the EWG coordinators who invite the laureate to the meeting: July 31, 2021.

-Preparation of the diploma by the EWG coordinators. Presentation of the laureate and her/his talk during the EWG MCDA Autumn meeting. An electronic copy of the laureate's presentation handed over to the EWG coordinators will be made available on the EWG on MCDA Web Site.

Applications should be sent to Irène Abi-Zeid at [irene.abi-zeid@osd.ulaval.ca](mailto:irene.abi-zeid@osd.ulaval.ca)

## **Call for Papers**

### ***Annals of Operations Research***

**Special Issue: Classification, Sorting and Clustering Methods Based on Multiple Criteria: Recent Trends**

The *Annals of Operations Research* seeks submissions for a special issue on **Classification, Sorting and Clustering Methods Based on Multiple Criteria: Recent Trends**. The deadline for submission is May 31, 2021.

#### **The main topics of interest are:**

- New multicriteria methods for classification, sorting, and clustering problems
- Problem structuring and preference modeling
- Behavioral issues and decision analytics
- Preference elicitation and the inference of multicriteria models from data
- Knowledge-based methods and computational intelligence for multicriteria classification/sorting/clustering problems
- Robustness analysis
- Multicriteria decision support systems
- Computational and experimental analyses
- Applications in engineering and management

**Instructions for authors can be found at:**  
<http://www.springer.com/business/operations+research/journal/10479>

Authors should submit a cover letter and a manuscript by **May 31, 2021**, via the Journal's online submission site. Please see the Author Instructions on the web site if you have not yet submitted a paper through Springer's web-based system, Editorial Manager. When prompted for the article type, please select **Original Research**. You will then be asked if the

manuscript belongs to a special issue, please choose the special issue's title, **Classification, Sorting and Clustering Methods Based on Multiple Criteria: Recent Trends**, to ensure that it will be reviewed for this special issue.

Manuscripts submitted after the deadline may not be considered for the special issue and may be transferred, if accepted, to a regular issue.

Papers will be subject to a strict review process under the supervision of the Guest Editors, and accepted papers will be published online individually, before print publication.

#### **Guest Editors:**

Salvatore Corrente, Yves De Smet, Michalis Doumpos, Salvatore Greco, Constantin Zopounidis

### ***Energies***

**Special Issue: Energy Security within the Nexus of Risk, Resilience and Sustainability: Antinomy or Panacea?**

We are pleased to inform you that we are guest-editing for a Special Issue entitled **"Energy Security within the Nexus of Risk, Resilience and Sustainability: Antinomy or Panacea?"**, which will be published in *Energies* (<https://www.mdpi.com/journal/energies>). Details can be found at the following link:

[https://www.mdpi.com/journal/energies/special\\_issues/Energy\\_Security\\_within\\_the\\_Nexus\\_of\\_Risk](https://www.mdpi.com/journal/energies/special_issues/Energy_Security_within_the_Nexus_of_Risk)

The submission deadline is 31 January 2022.

For further details on the submission process, please see the instructions for authors at the journal website (<https://www.mdpi.com/journal/energies/instructions>). Thank you in advance for your consideration of this request.

*Energies* is a fully open access journal. Manuscripts are peer-reviewed, and a first decision is given to authors approximately 17 days after submission. An Article Processing Charge (APC) of CHF 1800 currently applies to all accepted papers.

If you wish to check the fit of your manuscript for this Issue prior to submission, you are welcome to send a tentative title and abstract to the editorial office (Ms. Estelle Chen, [estelle.chen@mdpi.com](mailto:estelle.chen@mdpi.com)) and you will receive feedback shortly.

We look forward to collaborating with you and to hearing back from you soon.

#### **Guest Editors:**

Eleftherios Siskos, Peter Burgherr



## Socio-Economic Planning Sciences

### Methods and techniques for assessment of health care performance

Socio-Economic Planning Sciences invites submissions that focus on theoretical contributions and innovative application frameworks to assess efficiency, quality, and access to health care systems (HCS) worldwide. For this Special Issue, we are seeking papers that address innovative methods and application frameworks to measure the performance in the health sector in terms of efficiency, quality, and access dimensions, including but not limited to the following topics:

- Measuring the impact of public policies or social programs related to health care systems' performance;
- Health care systems' performance in a variety of scenarios, such as in wealthy and developed nations, or impoverished and social excluded regions;
- Theoretical and methodological challenges in understanding the determinants of health care systems' performance;
- Patterns and trends in health care systems' performance, across time, contexts, and demographic groups;
- Social determinants of health care systems' performance as they relate to demographic changes;
- Contextual determinants of health care systems' performance and health disparities;
- Cross-national perspectives in the examination of health care systems' performance.

The deadline for submissions is **December 31, 2021**. Authors should submit their papers online at <https://www.editorialmanager.com/SSM/default.aspx>.

When asked to choose article type, authors should stipulate 'Special Issue: Methods and techniques for assessing hospital performance.' In the 'Enter Comments' box, the Special Issue title should be inserted along with any further comments to the editors. All submissions should meet the Socio-Economic Planning Sciences Journal author guidelines.

Early submission is encouraged. The referee process will start upon submission of the paper. Accepted papers will be published individually online as they are accepted before print publication. All inquiries concerning the submission to the special issue will be addressed directly by the Guest Editors. For any query, please contact the Key Guest Editor Diogo Ferreira.

The Guest Editors of this Special Issue are:

Diogo Ferreira ([diogo.cunha.ferreira@tecnico.ulisboa.pt](mailto:diogo.cunha.ferreira@tecnico.ulisboa.pt)),

Ana Camanho ([acamanho@fe.up.pt](mailto:acamanho@fe.up.pt)),

José Rui Figueira ([figueira@tecnico.ulisboa.pt](mailto:figueira@tecnico.ulisboa.pt)).

#### Important dates

Submission deadline December 31, 2021

Editorial and publication September 30, 2022

Detailed information available at the following

URL: <https://www.journals.elsevier.com/socio-economic-planning-sciences/call-for-papers/methods-techniques-assessment-of-health-care-performance>

#### Guest Editors:

Diogo Cunha Ferreira\*, Ana Camanho, and José Rui Figueira

\* Key Guest Editor

## Virtual workshop

### Multiple Criteria Decision Analysis Methods Selection Software (MCDA-MSS) 1 June 2021, 8-11am EDT, 2-5pm CEST

#### Knowledge gap

Over the last few decades, the number of Multiple Criteria Decision Analysis (MCDA) methods has grown steadily (hundreds are available nowadays), and an analyst can find it difficult to select the relevant MCDA method(s) for the problem under consideration. The main issue that decision analysts have to deal with is summarized by the following question:

*"Which is the most suitable MCDA method (or subset of methods) that should be used for a given decision-making problem?"*

#### The solution: MCDA-MSS

We have developed the first MCDA-Methods Selection Software (MCDA-MSS) that allows decision analysts to find the most relevant MCDA methods (among > 200 of them) for many decision-making problems, from relatively simple to very complex. This software has two aims:

1. Allow analysts to learn our sequential and dynamic framework to describe complex decision-making;
2. Guide an analyst assisting a Decision Maker (DM) in choosing the most appropriate MCDA method(s) for a given decision-making problem.

MCDA-MSS is a main outcome of the Marie Skłodowska-Curie Global Fellowship at Poznań University of Technology ([Sustainability Assessment based on Decision Aiding](#), grant agreement No 743553, September 2018 – September 2021) of Dr. Marco Cinelli and his scientific exchanges at CESER at the U.S. EPA (September 2018 – July 2020) and Paul Scherrer Institute (September 2020 – February 2021).

#### Format of the workshop

(only for those who will attend all the workshop, see program below) → Before the workshop (material to be sent to the organizers by 16 May 2021)

The attendees can prepare their own background material by compiling two Excel sheets: (1) **Sheet 1 (necessary)**: Summary of features that the analysts think should be used to select an MCDA method for a certain decision-making problem; (2) **Sheet 2 (optional)**: Examples of case studies developed by the MCDA analysts showing the "activated" features justifying the selection of the MCDA.

#### During the workshop

The workshop will be held virtually, and it will include four sessions. Session 1 will provide an overview of MCDA-MSS and its sections, while the remaining three sessions will be interactive with MCDA-MSS training and hands-on use of the software to:

1. Explore its (i) intelligibility, (ii) comprehensiveness, (iii) easiness of use, (iv) suitability for learning, and (v) interactive efficiency;

- Compare the features listed by the attendees with those reported in MCDA-MSS and study if they match and/or if any is missing in the lists of the attendees, as well as in MCDA-MSS.

Here below is the workshop program.

EDT (am)	CEST (pm)	Virtual MCDA-MSS workshop program, 1 June 2021
8.00 – 8.05	2.00 – 2.05	Welcome
		Introduction to MCDA-MSS
Session 1: 8.05 – 9.00 (55 min)	Session 1: 2.05 – 3.00 (55 min)	Description of MCDA-MSS & its sections Problem typology, preference model, elicitation of preferences, exploitation of the preference model
		Co-Constructing MCDA methods selection
Session 2: 9.00 – 9.40 (40 min)	Session 2: 3.00 – 3.40 (40 min)	Discussion of features from the attendees & their case studies Missing features in the attendees' lists; missing features in MCDA-MSS; case studies analysis
9.40 – 9.50	3.40 – 3.50	Coffee break
Session 3 A: 9.50 – 10.30 (40 min)	Session 3 A: 3.50 – 4.30 (40 min)	Application of MCDA-MSS by the attendees 20 min guided exercise led by the moderator, 20 min use of MCDA-MSS individually or in small groups
10.30 – 10.35	4.30 – 4.35	Coffee break
Session 3 B: 10.35 – 10.55 (20 min)	Session 3 B: 4.35 – 4.55 (20 min)	Application of MCDA-MSS by the attendees 20 min discussion with all the attendees to identify trends/discuss issues
Session 4: 10.55 – 11.00 (5 min)	Session 4: 4.55 – 5.00 (5 min)	Summary & next steps Summary of the event & planning of deliverables

### Interested to attend the workshop?

You can sign up [here](#) and choose between attending:

- Session 1 only (presentation of MCDA-MSS): no limit to the number of attendees
- Sessions 1-4 (the whole workshop): **this option is limited to ~20 people (first-come, first-served)** to guarantee a manageable and constructive experience for all the attendees. So, sign up early! Please note that if you choose this option you agree to prepare by 16 May 2021 the background material as described in the workshop presentation (available here too: <https://www.dropbox.com/s/ihz1mgvgboo89uf/MCDA-MSS%20workshop%20presentation.pdf?dl=0>)

**Web site for Announcements and Call for Papers:**  
[www.cs.put.poznan.pl/ewgmcda](http://www.cs.put.poznan.pl/ewgmcda)



## MCDM consultancy companies

MCDA Consulting LLC  
[www.MCDAconsulting.com](http://www.MCDAconsulting.com)  
[Gina.Beim@MCDAconsulting.com](mailto:Gina.Beim@MCDAconsulting.com)  
Based in Cleveland, Ohio, USA

MCDA Consulting helps organizations in the public, private and not-for-profit sectors prioritize competing alternatives and navigate complex decision-making problems. The company specializes in Multi Criteria Decision Analysis, the methodology for which it is named, primarily employing Multi Attribute Value or Utility Theory. Its clients are encouraged

to learn that whenever decisions are complicated, tradeoffs between alternatives exist, subjectivity is present, and accountability is necessary, MCDA can help in the ranking and alternative selection process.

Gina Beim, a registered professional engineer in the State of Ohio, USA, is the founder and president of MCDA Consulting. She first explored the science of Decision Making while a civil engineering student in her native Brazil, as a research assistant on the application of Electre to a road configuration project. Gina's interest in applying Multi Criteria Decision Making to real world situations continued as she earned MS degrees in Systems Engineering and Operations Research, and an MBA from CWRU. Her research included using MAVT for the selection of countries for business expansions and for projects for venture capital funding. Gina also attended the International Summer School on Multiple Criteria Decision Aid in Montreal, Canada.

A sample of MCDA Consulting projects includes the evaluation of alternatives for the replacement of a decaying bridge in Cleveland, Ohio; the multi criteria screening of college education programs for refugees; the ranking potential local election candidates independent of partisan affiliation; the evaluation of watershed preservation initiatives and development of the optimal portfolio of projects that meets an organization's budget.

## MCDA Consulting LLC



### Recent contributions in brief

J.L. García-Lapresta, P. Moreno-Albadalejo, D. Pérez-Román and V. Temprano-García (2021). A multi-criteria procedure in new product development using different qualitative scales. *Applied Soft Computing* 106, 107279.

This paper is the last one included in our project "Qualitative Scales"

(see <https://www.researchgate.net/project/Qualitative-scales>).

In our seminal paper "Ordinal proximity measures in the context of unbalanced qualitative scales and some applications to consensus and clustering", by J.L. García-Lapresta and D. Pérez-Román, published in *Applied Soft Computing* 35, pp. 864-872, 2015, we introduced the notion of ordinal proximity measure (OPM) in order to manage the perceptions between the linguistic terms of non-uniform ordered qualitative scales in a purely ordinal way.

Now, in this paper, a new multi-criteria procedure is devised for new product development decision-making made from survey data. Groups of panelists evaluate several product

categories regarding different criteria, each one through a specific ordered qualitative scale (OQS). These OQSs are equipped with OPMs that collect the perceptions about the proximities between the terms of the scales by means of ordinal degrees of proximity. The weights assigned to the criteria are managed in an ordinal way by replicating the linguistic assessments obtained for each alternative in each criterion as many times as necessary until these replications reflect the proportions among weights. The linguistic assessments provided by panelists are compared with the highest terms of the corresponding OQSs. In order to aggregate the obtained ordinal degrees of proximity, a homogenization process is provided. It avoids any cardinalization procedure in the OPMs associated with the OQSs used for assessing the alternatives regarding the corresponding criteria. Products categories are ranked taking into account the medians of the homogenized ordinal degrees of proximity.

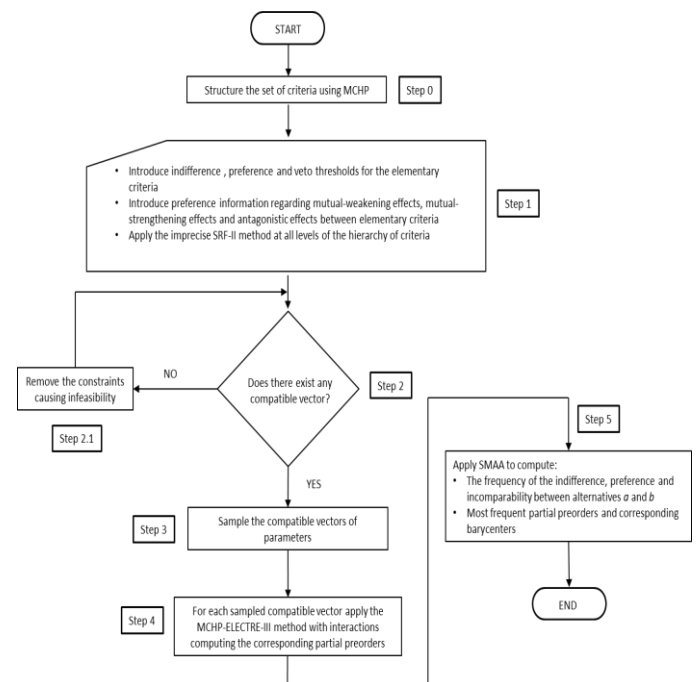
Contact: [lapresta@eco.uva.es](mailto:lapresta@eco.uva.es)

**Abastante, F., Corrente, S., Greco, S., Lami, I.L., Mecca, B. (2020). The introduction of the SRF-II method to compare hypothesis of adaptive reuse for an iconic historical building. *Operational Research - An International Journal* <https://doi.org/10.1007/s12351-020-00611-4>**

The paper proposes a new assessment framework based on Multi-Criteria Decision Aiding aiming at verifying its applicability in the architectural field.

The new proposal is an improvement of the decision support procedure introduced by [1] and it is applied with the aim of investigating the best design solution for the adaptive reuse of an iconic historical building.

Specifically, the framework combines four methods: 1) Multiple Criteria Hierarchy Process allows the management of a large number of criteria structured in a hierarchical way and used to evaluate the alternatives; 2) ELECTRE III outranking method enables considering uncertainty and imprecision in the definition of the criteria through discrimination thresholds, and permits to consider interactions between criteria; 3) SRF-II imprecise method constitutes the innovation proposal of the framework supporting the management of the preferential information of the Decision Makers (DMs); 4) Stochastic Multicriteria Acceptability Analysis provides robust recommendations by considering a plurality of parameters in a way that is compatible with the preferences of DMs. The flow-chart in **Fig. 1** summarises the steps of the framework.



**Fig. 1.** Flow-chart of the applied framework

The innovation of SRF-II lies in the definition process of the criteria weights, aiming at making the elicitation procedure of the  $z$  value (ratio between the weights of the most important and least important criteria) more comfortable for DMs maintaining the consistency and solidity of the imprecise SRF method [2]. In SRF-II method, the  $z$  value is replaced with information more similar in kind to the other information required in the elicitation procedure: the number of blank cards between the least important criterion and a fictitious “zero criterion” having a null weight. Our case study, the reuse of the former Stock Exchange in Turin (Italy), proved that the DM is comfortable in providing this information, finding it clear and understandable.

#### Reference:

1. Corrente, S., Figueira, J. R., Greco, S., & Słowiński, R., A robust ranking method extending ELECTRE III to hierarchy of interacting criteria, imprecise weights and stochastic analysis. *Omega*, 73, 1-17, (2017).
2. Figueira, J., Roy, B., Determining the weights of criteria in the ELECTRE type methods with a revised Simos' procedure. *European journal of operational research*, 139(2), 317-326 (2002).

Contact: [beatrice.mecca@gmail.com](mailto:beatrice.mecca@gmail.com)

**Babashahi, S., Hansen, P., Sullivan, T. (2021). Creating a priority list of non-communicable diseases to support health research funding decision-making. *Health Policy*, 125(2), 221-228.**

Non-communicable diseases (NCDs) are the leading causes of mortality and morbidity globally. A MCDA-based framework for prioritising NCDs to support health research funding decision-making was developed and implemented in New Zealand. Given limited research funding available, it is important that valid and reliable prioritisation methods are used.

Nineteen NCDs were prioritised based on five criteria related to their overall burden to society. Weights for the criteria were determined from a survey of 476 stakeholders using the PAPRIKA method implemented by 1000minds software. The criteria, in decreasing order of importance (mean weights in parentheses), are: deaths (27.7%) and loss of quality-of-life (23.0%) across the population, cost to patients and families (18.6%), cost to the health system (17.2%), and whether vulnerable groups are disproportionately affected (13.4%).

For ease of communication to researchers and policy-makers, the 19 ranked NCDs were stratified into four priority tiers: 'Very critical' priority: coronary heart disease, back and neck pain, diabetes mellitus; 'Critical' priority: dementia and Alzheimer's disease, stroke; 'High' priority: colon and rectum cancer, depressive disorders, chronic obstructive pulmonary disease, chronic kidney disease, breast cancer, prostate cancer, arthritis, lung cancer; and 'Medium' priority: asthma, hearing loss, melanoma skin cancer, addictive disorders, non-melanoma skin cancer, headaches.

When NCD research projects are being assessed and research funds allocated, additional considerations such as the cost of the research and its likelihood of success would also need to be included.

This is the first study to have used MCDA to prioritise NCDs for research funding. The framework could also be used for other health conditions.

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Schär, S., & Geldermann, J. (2021). Adopting Multiactor Multicriteria Analysis for the Evaluation of Energy Scenarios. *Sustainability*, 13(5), 2594. DOI: [10.3390/su13052594](https://doi.org/10.3390/su13052594)

The assessment of future options and pathways for sustainable energy systems requires considering multiple techno-economic, ecological and social issues. Application of Multicriteria analysis methods could support the comprehensive analysis of such issues. Regarding energy policies, the key actors and stakeholders' acceptance of emerging and innovative technologies for generating, converting and storing electricity, heat and fuels is crucial for their future implementation. Previous studies on the assessment of pathways towards sustainable energy systems addressed the issue of path dependencies, which arises when evaluating transition processes in energy systems, but they explicitly did not involve stakeholders in the assessment.

Therefore, we presented and applied the MAMCA methodology, developed by Macharis et al. (2009), for stakeholders' explicit and more participatory involvement in energy scenario assessment. By explicitly including a separate set of criteria for each stakeholder, the MAMCA method adds an additional layer to the available MCA methods. We extended the MAMCA methodology to include the outranking approach PROMETHEE and applied the extended methodology to a case study of four different transition pathways of providing electricity to a bioenergy village in Germany. The detailed sensitivity analysis provided by the extension of MAMCA with PROMETHEE reveals the stakeholders' crucial trade-offs when allowing each stakeholder group to develop its own set of criteria and weights

and indicates compromise options. This may facilitate the process of reaching consensus between stakeholders and foster a decision's acceptance.

The methodology could be of great value in future energy system projects or contexts requiring extensive stakeholder involvement and where qualitative and quantitative criteria are to be considered simultaneously.

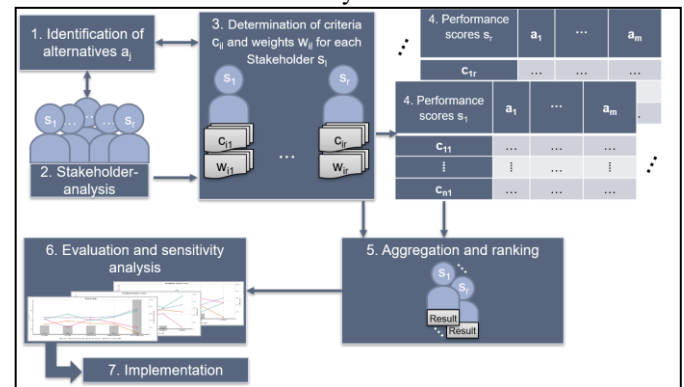


Figure 1: Framework of the MAMCA methodology [Macharis et al., 2009] with PROMETHEE as the aggregation method [Schär/Geldermann, 2021].

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Arandarenko, M., Corrente, S., Jandrić, M., & Stamenković, M. (2020). Multiple criteria decision aiding as a prediction tool for migration potential of regions. *European Journal of Operational Research*, 284(3), 1154-1166.

We introduce a new prediction model for the determination of internal migration potential of regions within a country. The model facilitates a comprehensive analysis of the regional net migration potential, aims to predict future regional migration trends and provides insights into the reasons behind them by creating a classification of regions, based on their internal migration potential.

Our model is the combination of four known methods in MCDA. For classification we use the ELECTRE Tri-C and the MCHP. The imprecise SRF method and the SMAA come as a natural solution to build upon such a specific preferences modelling. The SRF method infers the importance of drivers by considering their preference ranking and other information regarding possible interactions or antagonistic effects. Such an indirect preference elicitation procedure creates more than one value that can be assigned to the level of importance of the drivers. To take into account all of them, representing preferences of a multitude of individuals, we apply SMAA.

MCDA deals with problems where analyst tries to elicit DM's preferences via direct or indirect preference elicitation using well-known methods in the field. Our paper intends to move this philosophy to the economic-related phenomena in which there is no formal decision-maker, but we are facing numerous, so-called, economic agents whose future actions we want to predict, in this case, whether to stay or move to other municipality. In our setting, a panel of experts elicited the parameters of the model based on known drivers of migration serving as criteria. Applying the model to 2010 we show good and robust predictions about future migration potential confirmed by the net migration rate in this period.



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**Rocchi L., Cortina C., Paolotti L., Boggia A. (2020). Recreation vs conservation in Natura 2000 sites: a spatial multicriteria approach analysis. *Land Use Policy*, 99: 105094.**

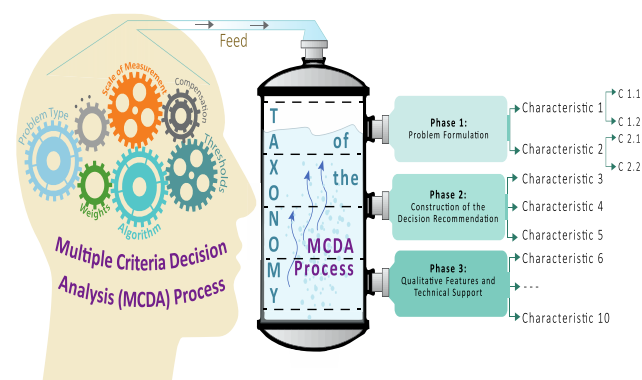
Natura 2000 network (N2K) is becoming increasingly important for recreational opportunity, in particular in relation to the Nature-based tourism (NBT), which is based on the natural attractions of an area, as N2K is not a system of strict nature reserves. The approach to conservation and sustainable use of N2K is much wider, largely centered on people working with nature rather than against it. To do this, a balance between nature-based tourism development and ecological protection should be reached.

In this work, we propose the application of spatial multicriteria analysis, in order to analyze multiple conflicting dimensions interacting over time, considering in particular both criteria related to NBT development and ecological protection. In particular, the aim of the application was to analyze the opportunities of Nature-based tourism development in N2K in Umbria, one of the Regions of central Italy, which consists of 102 sites. There still are few works applying MCDA in the context of the N2K network and this paper was a first attempt to evaluate the N2K through spatial multicriteria analysis, in the context of NBT development. In particular, the geographic plugin VectorMCDA was applied, the GeoTopsis module in particular. Spatial MCDA resulted to be a useful tool for mapping a multidimensional thematic, considering aspects that could often result in contrast between each other, and finally visualizing which are the N2K sites on Umbria region more suitable for an increase of NBT development. The proposed methodology and the results of the work could be of support for Public Decision Making, when addressing European and National funds for developing NBT, and deciding which sites must be prioritized in terms of concrete actions on territory, and which sites need more protection.

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**Cinelli M., Kadziński M., Gonzalez M., Słowiński R. (2020) How to Support the Application of Multiple Criteria Decision Analysis? Let Us Start with a Comprehensive Taxonomy. *Omega*, 96, 102261.**

<https://doi.org/10.1016/j.omega.2020.102261>



The paper delivers a framework founded on a thorough taxonomy needed to conduct a Multiple Criteria Decision

Analysis (MCDA). This framework will then select the most relevant MCDA method(s), allowing the user to reach a comprehensive evaluation of the alternatives under consideration. The conceptual structure is based on the MCDA process, characterized in the form of decision characteristics typical of Alternatives Assessment (AA).

The taxonomy is based on the analysis of 47 selected papers, meeting the inclusion criteria, out of a total of 930 that were studied. These selected papers included available approaches that have been proposed to conduct the MCDA process and select an MCDA method, with and without a specific application area in mind.

*Contribution to the state of the art*

Key contributions of this research are:

1. A unified and comprehensive high-level representation of the MCDA process characteristics (i.e., features), grouped into three main phases: (i) problem formulation, (ii) construction of the decision recommendation, and (iii) qualitative features and technical support;
2. Demonstration of how decision-making can be split into manageable and justifiable steps, which can reduce the risk of overwhelming the analyst, as well as the Decision Makers (DMs)/stakeholders during the entire MCDA process;
3. Advancing of a questioning strategy to demonstrate application of the taxonomy to map MCDA methods and select the most relevant using real-world case studies;
4. Presentation of the Decision Support Systems (DSSs) for MCDA method recommendation and how they can be grouped into three main clusters and proposal of a strategy for traceable and categorizable development of such systems.

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**Costa, A. S., Corrente, S., Greco, S., Figueira, J. R., & Borbinha, J. (2020). A robust hierarchical nominal multicriteria classification method based on similarity and dissimilarity. *European Journal of Operational Research*, 286(3), 986–1001.**

The wide range of classification problems in decision situations has motivated us to develop MCDA methods for solving multiple criteria nominal classification problems. This kind of problems involves a set of criteria for assessing the actions (or alternatives) and assigning them to predefined nominal categories (not preferentially ordered). Hence, CAT-SD (CATegorization by Similarity-Dissimilarity) was designed and published in 2018. This method innovates by considering subjective similarity-dissimilarity between two actions and the potential interaction effects in criteria pairs. A set of preference parameters can be defined per category (e.g., weights and interaction coefficients). However, the method does not consider a hierarchical structure of criteria and robustness analysis of the assignments for different vectors of parameter sets. Our paper contributes to overcome these gaps. We apply Multiple Criteria Hierarchy Process to CAT-SD and use the imprecise SRF for each category considering the criteria hierarchy and the possible interactions between criteria. The method has a general interest, since it can be

applied to any outranking method considering criteria interactions. Then, we apply Stochastic Multicriteria Acceptability Analysis (SMAA) to the hierarchical CAT-SD method by sampling several sets of parameters compatible with the preference information provided by the Decision Maker (DM). We also propose a procedure that, starting from the probabilistic assignments obtained through the SMAA, provides a final classification that fulfills requirements given by the DM. It can be applied to nominal and ordinal classification methods. Thus, we introduce SMAA-hCAT-SD. An example illustrates the application of our proposal.

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**Kadziński M., Tomczyk M., Słowiński R. (2020) Preference based cone contraction algorithms for interactive evolutionary multiple objective optimization. *Swarm and Evolutionary Computation*, 52, 100602.**

<https://doi.org/10.1016/j.swevo.2019.100602>

This study introduces a novel family of preference-based evolutionary algorithms for multiple objective optimization. These approaches implement different postulates favorable from the Multiple Criteria Decision Analysis (MCDA) perspective: interactivity, robustness concern, and acceptance of intuitive holistic preference statements – pairwise comparisons of solutions.

The key novelty of the proposed methods lies in using preference cones to drive the evolutionary search. These emerge from all preference model instances being compatible with the Decision Maker's (DM's) pairwise comparisons and highlight relevant regions in the objective space. The cones are contracted with every newly received pairwise comparison, successively narrowing the explored area.

Key contributions of our study are:

1. Introducing a new preference-based cone contraction family of highly competitive evolutionary methods that are founded on state-of-the-art MCDA paradigms;
2. Investigating the impact of the (i) selected preference model, (ii) employed ranking procedure, (iii) and incorporated evolutionary base on the method's performance;
3. Proposing new static and dynamic preference elicitation schemes and analyzing how the interactions with the DM should be distributed throughout the evolutionary search to improve the method's efficiency;
4. Presenting a novel technique for visualizing the progress of an evolutionary search that can be deemed robust and credible due to aggregating many independent runs of the algorithm.

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**Manthoulis, G., Doumpos, M., Zopounidis, C., & Galariotis, E. (2020). An ordinal classification framework for bank failure prediction: Methodology and empirical evidence for US banks. *European Journal of Operational Research*, 282(2), 786–801.**

Classification (sorting) problems arise in various decision aiding contexts that require the assignment of a set of alternatives into predefined categories. In this study a multicriteria approach is employed to construct decision models for classifying banks according to their risk of failure. Bank failure prediction models usually combine financial and non-financial attributes through binary (i.e., dichotomic) classification approaches. This study extends this standard framework by examining the risk of failure in a multi-period context to distinguish between banks that face short-term risks (one year) from those that are likely to fail in a mid-term period (up to three years).

To this end, an ordinal classification framework is introduced, and various ordinal models are constructed using both standalone approaches as well as ensembles based on error-correcting output codes. The construction of the models is performed based the preference disaggregation paradigm of MCDA. The proposed ordinal classification scheme extends the UTADIS method, by constructing ordinal multi-class models through the combination of multiple binary models. The approach is tested on a large sample of US banks and the obtained results confirm the strong performance of the proposed scheme for constructing multi-class ordinal models compared to standard multi-class MCDA approaches.

Except for its practical implications for the area of business failure, the study also has implications about the development of decision models for multi-group classification problems that have a hierarchical ordinal structure regarding the definition of the categories. The proposed approach provides increased flexibility for handling hierarchical category structures of different forms and it is a general scheme that can be used for constructing different types of MCDA models, such as value functions, outranking relations, fuzzy integrals, and decision rules, among others.

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**Gaganis, C., Pasiouras, F., Tasiou, M., & Zopounidis, C. (2021). CISEF: A composite index of social, environmental and financial performance. *European Journal of Operational Research*, 291(1), 394-409.**

The evaluation framework banks use to evaluate corporate clients is crucial and naturally affects their risk-return portfolio and reputation. What often goes unnoticed is it also concerns several stakeholders, who inherently affect its evaluation perspective. According to the literature, different stakeholders may focus on different aspects, often extending to attributes related to responsibility. What is more, recent initiatives in line with the Sustainable Development Goals that large financial conglomerates sign up to, as well as regulatory initiatives aiming to introduce stress-tests to assess climate risks, all reinforce the need for banks to strengthen their responsible character. To this end, two issues arise: which objectives should a bank include in its framework, and at what trade-off?

Our study presents an innovative solution of OR that addresses this twofold question, introducing a holistic evaluation framework via means of a composite index. Its hierarchical structure is in line with ISO standards, drawing upon international consensus from the broadest view of stakeholder



groups. To address the issue of stakeholder representation, we adopt a recently proposed method in the field of MCDA known as  $\sigma$ - $\mu$  efficiency analysis. This permits us to incorporate a plethora of preferences, each proxying an alternative view from the stakeholder groups. Additionally, the proposed method penalises firms for imbalances that unfavourably treat a large proportion of its stakeholders, in line with the balanced growth doctrine known as 'circular interrelationship'. Finally, we decompose the overall index into its elementary components, assessing the impact of changes to the overall performance, aiding executives of evaluated entities and their stakeholders understand policy trade-offs.

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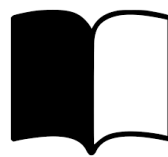
**Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2021). The ordinal input for cardinal output approach of non-compensatory composite indicators: the PROMETHEE scoring method. *European Journal of Operational Research*, 288(1), 225-246.**

The paper proposes PROMETHEE scoring, an extension of PROMETHEE methods permitting to assign a score to each action. The new PROMETHEE method takes into consideration robustness concerns with a specific attention to a range of variation of the weight vector adopted. Graphical outputs in terms of GAIA plan and a  $\sigma$ - $\mu$  efficiency plan representing standard deviation and average value of PROMETHEE flows are widely used to present the results of the multicriteria aggregation procedure. The new method proves to be very useful in constructing composite indicator (CI). In this context, the PROMETHEE net flow can be considered as an extension of the Borda aggregation procedure tackling the issue of (non-)compensation between different performances in each of the dimensions of the CI by a procedure that somewhat *translates* ordinal inputs into a cardinal output.

Taking into account that the weighting and the aggregation phases of any multicriteria procedure rather unavoidably encapsulate researchers' beliefs and value judgment, one can say that PROMETHEE scoring, rather than sweeping the underlying methodological issues under the carpet, somewhat attempts to put them in the foreground while not shirking the challenge of proposing a tentative solution.

Coming back to CIs, in consideration of both the increasing theoretical interest and the widening of their use, indeed, we hope that PROMETHEE scoring could convey the message that CIs rather than sending *misleading, non-robust policy messages*, can make a sound contribution in the policy arena. This is especially impactful in the current times of increased complexity where any relevant decision-making exercise involves a multitude of aspects belonging to substantially different spheres (e.g. health and economics) very often highly conflicting with each other.

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



**Web site for the EURO Working  
Group on "Multicriteria  
Decision Aiding"**

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

<http://www.cs.put.poznan.pl/ewgmcda/>

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