



Opinion Makers Section

About the 98th Meeting of the EWG on MCDA in Catania, Italy

From 26 to 28 September 2024, the two European Working Groups on Multiple Criteria Decision Aiding (EWG-MCDA) and Behavioural Operational Research (EWG-BOR) held a joint meeting at the Department of Economics and Business, University of Catania (Italy), organized by Salvatore Corrente, Salvatore Greco and Benedetto Matarazzo together with Sally Giuseppe Arcidiacono and Silvano Zappalà. The main theme was "*Behavioural Issues in Multicriteria Decision Aiding*", marking the 98th EWG-MCDA and the 5th EWG-BOR meetings. The event aimed to foster collaboration between researchers in the domains of BOR and MCDA, while also offering a platform for those exploring other topics in these fields to exchange knowledge and identify synergies.

The meeting brought together 55 researchers from various countries around the World, including Canada, China, England, Finland, France, Germany, Italy, Poland, Portugal, Serbia, Spain, and Switzerland.

The meeting began on Thursday morning with a welcome address from Prof. Roberto Cellini, Head of the Department of Economics and Business, followed by brief greetings from Salvatore Greco (Co-Coordinator of EWG-MCDA) and Raimo Hämmäläinen (Co-Coordinator of EWG-BOR). In particular, Salvatore Greco remembered that this was the third meeting of the EWG held in Catania, after the 28th meeting in October 1988 and the 78th meeting in October 2013. He also noted, quite remarkably, that Benedetto Matarazzo was once again among the organizers of this meeting. Additionally, some participants at the October 2024 meeting, like Maria Franca Norese and Roman Słowiński, had been present not only at the October 2013 meeting but even as far back as October 1988.

The scientific sessions opened with the Bernard Roy Award ceremony. The 2024 Award was presented to Mohammad Ghaderi from Pompeu Fabra University, who, due to bureaucratic issues, was unable to attend in person and delivered his lecture online, sharing insights from his ongoing research. The members of this year's award committee, chaired by Maria Franca Norese, were Yves De Smet, Salvatore Greco, Luis Martinez, and Constantin Zopounidis.

Following the first session and lunch, a lively roundtable discussion took place, chaired by Benedetto Matarazzo. Speakers included Irene Abi-Zeid and Maria Franca Norese for EWG-MCDA, and Alberto Franco and Raimo Hämmäläinen for EWG-BOR. The discussion, originally scheduled for one hour, extended to over an hour and a half as participants enthusiastically contributed to the discussion on the behavioural aspects of decision aiding.

On Thursday evening, participants gathered for a social dinner in Catania at Trattoria "Me Cumpari Turiddu," where they enjoyed a variety of traditional Sicilian dishes.

Friday featured regular sessions and a dynamic business meeting. In addition to various announcements, the next three EWG-MCDA meetings were introduced: the 99th meeting in April 2025 in Venice, presented by Maria Barbati, the 100th meeting in September 2025 in Poznan, presented by Miłosz Kadziński, and the 101st meeting in spring 2026 at the University of Leeds, which will host also the EURO conference of the next year (22-25 June 2025), presented by Sajid Siraj.



Figure 1 The usual group photo taken on Friday 27th at the Department of Economics and Business

Finally, on Saturday, in agreement with the EWG-MCDA's tradition, participants enjoyed a social excursion. They first visited "Cantine Tornatore," where they toured the cellar and the vineyard on the slopes of Etna, and savored a lunch

featuring delicious local dishes. The excursion concluded with a visit to Taormina, where participants strolled through the charming streets before returning to Catania around 8 p.m.

The detailed program of the meeting is attached. However, both the program and the Book of Abstracts are available at the Conference site: [link](#).

Looking forward for the Next Meeting of the EWG MCDA in Venice.

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98th EWG-MCDA and 5th EWG-BOR meeting:
PROGRAM

Thursday 26th September 2024	
8:00 -	Registration
9:00 – 9:30	Opening Ceremony
9:30 – 10:30 Session 1: Bernard Roy	Chair: Maria Franca Norese
10:30 – 11:00 Coffee Break	
11:00 – 12:30 Session 2	Chair: Mladen Stamenkovic
11:00 – 11:30	MultiCriteria Decision Aid and complex decision problems Maria Franca Norese
11:30 – 12:00	A Multiple Criteria Approach for a Sustainable Urban Logistics Policies Ranking Problem Franco Corti; Chiara D'Alpaos; José Rui Figueira
12:00 – 12:30	Exploring the boundaries of Behavioural OR Alberto Franco, Raimo Härmäläinen
Submitted to Discussion Multi-Objective Workflow Scheduling Algorithms in Cloud Computing José Rui Figueira; Tomas Zaki, Yannik Zeitrag; Rui Neves The optimal manipulation of a pairwise comparisons matrix equating the weights of two alternatives Jacek Szybowski; Konrad Kulakowski; Sebastian Ernst Construction of alternatives for stochastic choice models reflections from choice experiments on diabetic markets Christine C Huttin	
12:30 – 13:45 Lunch	

13:45 – 15:00 Session 3: Round Table	Chair: Benedetto Matarazzo
Behavioural Issues in Multicriteria Decision Aiding Irene Abi-Zeid, Alberto Franco, Raimo Härmäläinen, Maria Franca Norese	
15:00 – 15:30 Coffee break	
15:30 – 17:30 Session 4	Chair: Alberto Franco
15:30 – 16:00	Using MCDA to Communicate Commander’s Intent in Air Combat Kai Virtanen; Heikki Mansikka; Mikko Kankaisto; Raimo P. Härmäläinen
16:00 – 16:30	C40 Reinventing Cities: Integrating Assessment, Planning, and Design for the Urban Regeneration of Bologna's Prati-Ravone District Isabella Giovanetti; Vanessa Assumma; Elisa Conticelli; Annarita Ferrante; Angela Santangelo
16:30 – 17:00	How can existing MCDA software support sustainability assessment? Laura Mesa Estrada; Martina Haase; Manuel Baumann; Marco Cinelli
17:00 – 17:30	"Voters' behavior to sort alternatives, elicitation of preferences and how to aggregate them" José Luis García-Lapresta; Miguel Martínez-Panero
Submitted to Discussion Navigating Human Behavior Complexities in Complex Business Environments: The Role of AI and MCDA Georgios Tsaples; Dimitrios Zopounidis; Constantin Zopounidis A nonparametric approach to capture compromise effect Moha Ghaderi	
20:00 – 23:00 Social Dinner at “Me Cumpari Turiddu”, Piazza Turi Ferro, 36/38, Catania	
Friday 27th September 2024	
9:00 – 10:45 Session 5	Chair: Matteo Brunelli
9:00 – 9:30	In search for consensus among peers Konrad Kulakowski; Jacek Szybowski
9:30 – 10:00	How do you generate the set of decision alternatives? Alexis Tsoukiàs, Irene Pluchinotta
10:00 – 10:30	How the ELECTRE methods can facilitate experiments in research ambits: the case of the potential impact of Italian quarries on water resources Antonino Scarelli; Maria Franca Norese
10:30 – 10:45	Dynamic Attribute Prioritization in Multiple Attribute Decision Making: Bridging the Gap between Shortlisting and Final Decision-Making Sarfaraz Hashemkhani Zolfani

<p>Submitted to Discussion</p> <p>Deep aggregation of incomplete rankings in Multiple Criteria Group Decision Making <i>Grzegorz Miebs; Adam Mielniczuk; Miłosz Kadziński</i></p> <p>Combining behavioural decision science and multi-criteria decision aids for climate services: A need for research <i>Andrea Taylor</i></p>
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10:45 – 11:15 Coffee break

11:15 – 12:45 Session 6	Chair: Miłosz Kadziński
11:15 – 11:45 Decision Theory, Design Theory and Innovative Policy Design for Conflict Transformation and Management <i>H. Berkay Tosunlu, Alexis Tsoukias, Joseph Guillaume, Irene Pluchinotta</i>	
11:45 – 12:15 Process Tracing and Attention in Multi-Attribute Choice <i>Ilkka Leppänen</i>	
12:15 – 12:45 Modeling Criteria and Project Interactions in Portfolio Decision Analysis with the Choquet Integral <i>Matteo Brunelli; Salvatore Corrente</i>	
<p>Submitted to Discussion</p> <p>Replacing standard confusion matrix with overestimates and underestimates for ordinal classification problems <i>Sajid Siraj; Edward Abel</i></p> <p>A Data-Driven Approach to Digital Requirements Prioritization in Automotive Service Operations: Addressing Subjectivity and Improving Decision-Making <i>Pietro Fronte; Núria Agell; Marc Torrens; Jordi Nin; Tamara Garcia</i></p> <p>Developing a knowledge base for the Sustainability Assessment of urban projects: the GLOSSA project <i>Francesca Abastante; Beatrice Mecca</i></p>	

12:45 – 14:00 Lunch

14:00 – 14:30 Group Activities	Chair: Roman Słowiński
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14:30 – 16:00 Session 7	Chair: Raimo Härmäläinen
14:30 – 15:00 Addressing Behavioral Issues in Multicriteria Decision Aiding for Fine Wine Pricing: A Machine Learning Approach <i>Edward W. Sun; Claire Y. T. Chen</i>	
15:00 – 15:30 The SOCRATES software for policy impact assessment <i>Giuseppe Munda</i>	
15:30 – 16:00 Does starting below or above the Pareto Front in interactive MCDM result in different anchoring behavior? Results from a behavioral experiment <i>Maura Halstead; Manuel López-Ibáñez, George Farmer, and Paul Warren</i>	

Submitted to Discussion

<p>An enhanced simulation-based approach for multicriteria evaluation problems of SME's performance <i>Maria Rosaria Pappalardo; Silvia Angilella; Michalis Doumpos; Constantin Zopounidis</i></p> <p>A Behavioural Investigation of Feasibility and Demand Uncertainty in Production Planning Systems <i>Maryam Azani; Lijia Tan; Rob Basten; Ton de Kok</i></p>

16:00 – 16:30 Coffee break

16:30 – 18:00 Session 8	Chair: Giuseppe Munda
16:30 – 17:00 A collaborative dashboard-building approach combining business intelligence and socio-technical multicriteria decision analysis: a tool to assist decision-makers in health settings <i>Rafael Miranda; Filipa Baptista; Isabel Albuquerque; Monica Oliveira</i>	
17:00 – 17:30 Evaluation of agro-sylvicultural systems, using the ELECTRE TRI-nC and ELECTRE III methods, including stakeholder behaviour <i>Odile Phelpin; Francis Macary</i>	
17:30 – 18:00 "Participatory modelling and multicriteria decision aiding for marine ecosystem management" <i>Irène Abi-Zeid; Maud Thermes; Maud Thermes; Franck Taillandier, Arnaud Sentis</i>	
<p>Submitted to Discussion</p> <p>Hierarchical DRSA-approach for the multiple channel retailing <i>Mladen Stamenković; Aleksa Dokić</i></p> <p>Explainable Interactive Evolutionary Multiobjective Optimization with Dominance-based Rough Set Pairwise Comparisons <i>Salvatore Corrente, Salvatore Greco, Benedetto Matarazzo, Roman Słowiński</i></p>	

18:00 Closing session	Chair: Salvatore Greco
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Saturday 28th September 2024
10:00 - 19:00: Social excursion at Tornatore wineries www.tornatorewine.com/?lang=en

Report on the 2024 Elections for the Executive Committee of the International Society on Multiple Criteria Decision Making

The 2024 elections for the renewal of the Executive Committee of the International Society on Multiple Criteria Decision Making (MCDM) (<https://www.mcdmsociety.org/>) took place last month. A total of 529 members participated by casting their votes and expressing their preferences in the election.

The results of the election are as follows:

- President-elect (2024-2028): *Serpil Sayin*, Koç University, Turkey. She will now join the Executive Committee and serve as President for the 2028-2032 term.
- MCDM Vice-President for Finance (2024-2028): *Birsen Karpak*, Distinguished Professor Emeritus, Youngstown State University, USA.
- Elected MCDM Executive Committee Members (in alphabetical order):
 - *Carlos Coello Coello*, CINVESTAV-IPN, Department of Computer Science, Mexico
 - *Andrea Raith*, University of Auckland, New Zealand
 - *Francisco Ruiz*, University of Malaga, Spain
 - *Johannes Siebert*, Department of Business and Management, Management Center Innsbruck, Austria.

We would like to remind you that the MCDM society has also a LinkedIn group titled "*International Society on Multiple Criteria Decision Making*" [link](#). All members of the International Society on MCDM can become members of the LinkedIn group. Analogously, to become a member of the International Society on MCDM, please, follow the instructions on the following page: [membership](#).

*Josè Rui Figueira (MCDM Society President) and
Salvatore Corrente (MCDM Society Secretary)*
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27TH INTERNATIONAL CONFERENCE ON MULTIPLE CRITERIA DECISION MAKING (MCDM2024) 2 to 7 June 2024, Hammamet, Tunisia

The 27th international conference on multiple criteria decision making (MCDM 2024), organized by the Multiple Criteria Decision Making (MCDM) Society, served as a premier interdisciplinary platform for showcasing recent advancements and applications within the realm of decision aid sciences. This conference was designed to facilitate the exchange of cutting-edge models and techniques pertaining to multiple criteria decision making among a diverse array of global researchers and practitioners. Following a rigorous evaluation process by both national and international reviewers, MCDM 2024 curated a program featuring 102 accepted manuscripts out of the 185 submissions received. The conference boasted a rich international presence, with participants hailing from 31 countries, including Algeria, Bahrain, Belgium, Brazil, Canada, China, Colombia, Czech Republic, Finland, France, Germany, India, Ireland, Italy, Lebanon, Mexico, Morocco, Poland, Portugal, Russia, Saudi Arabia, Serbia, Spain, Sweden, Switzerland, Thailand, the Netherlands, Tunisia, Turkey, United Kingdom, and USA.

Plenary Speeches

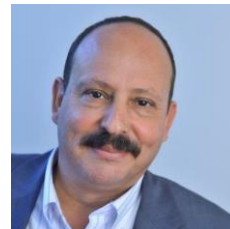
During MCMD 2024 conference, the four plenary speakers delivered insightful talks on diverse topics related to advanced areas in multiple criteria decision making.



Professor Ralph Steuer from the University of Georgia, USA, presented an inspiring speech reflecting on the historical development of the field. He discussed the challenges faced in the early days of MCDM research, highlighting the formation of the Society of the conference as a pivotal moment that fostered international collaboration. Despite the evolution and wide application of multiple criteria models, the quest to identify the most preferred solution remains a challenging task, especially in larger problem sets. Professor Steuer illustrated this using an example from tri-criterion portfolio selection, emphasizing the need for cognitive assistance in decision-making processes.



Professor José Rui Figueira from the University of Lisboa, Portugal, introduced a multiple criteria approach for constructing composite indicators to assess the impact of pandemics. His talk showcased the applicability of an additive multi-attribute value theory aggregation model in real-world scenarios, using Portugal as a case study. The interactive socio-technical process employed in eliciting preference parameters and determining criteria weights, including the deck of cards method, provided valuable insights for practitioners and researchers.



Professor Fouad Ben Abdelaziz from NEOMA Business School, France, delivered a comprehensive overview of metaheuristics for multi-objective optimization. He discussed the significance of specialized optimization techniques in managing conflicting objectives and presented various categories of metaheuristic algorithms such as genetic algorithms, particle swarm optimization, and ant colony optimization. The efficacy of these algorithms was evaluated through benchmark problems and real-world applications across different domains.

Lastly, Professor Hatem Masri from Applied Science University in Bahrain shared findings from a controversial scientometric study comparing global and African research trends in MCDM and MO. The analysis spanning from 1999 to 2024 revealed similar growth patterns in publications and citations globally and in Africa, highlighting the significant impact of African research despite its smaller volume. The study emphasized the interdisciplinary nature of MCDM/MO research globally and the importance of collaboration in addressing scientific challenges and fostering innovation within the field.

Tutorials

During the MCMD 2024 conference, two tutorials were presented, offering valuable insights into innovative methodologies and applications in the field.

- *Tutorial on MCDM Based Methodology to Big Data Analysis and Applications*: Conducted by Yong Shi from the University

of Chinese Academy of Sciences, China, this tutorial provided insights into the methodologies of Multiple Criteria Linear Programming and Multiple Objective Support Vector Machine in the context of Big Data Analysis. Over the past 15 years, the author and their colleagues have contributed significantly to this field. The tutorial covered various aspects, including multi-criteria linear programming for supervised learning, incorporating expert and rule-based knowledge, and leveraging multi-criteria decision-making in data analytics. It also explored research findings in Twin Support Vector Machine in Classification, Nonparallel Support Vector Machine Classifiers, Laplacian Support Vector Machine Classifiers, and Loss Functions of Support Vector Machine Classification. Additionally, the tutorial highlighted applications in designing China's National Credit Scoring System and supporting large-scale engineering projects that enhance computing resources across regions, playing a crucial role in advancing the Chinese digital economy.

• **Tutorial on Multi-Objective Retail Store Layout:** Presented by Bacel Maddah from the American University of Beirut, Lebanon, this tutorial delved into the realm of modern "store-wide" retail space planning. The session highlighted the potential benefits of integrating customer interests through demand-side objectives, fostering mutually beneficial solutions for both shoppers and retailers. Beyond immediate business applications, the tutorial underscored the significant modeling and computational challenges inherent in this area, with implications that extend to other domains. The tutorial motivated further research into spatial demand models and the streamlining of computational processes such as quadratic assignment and bin packing. It emphasized the importance of identifying and modeling objectives crucial to retailers, including considerations of customer welfare and health. Despite the highly multi-objective nature of retail space planning, the tutorial noted the relative lack of exploration of Multiple Criteria Decision Making (MCDM) in this domain within existing literature.

Doctoral Dissertation Session

During the MCMD 2024 conference, three Doctoral Dissertations were presented, offering innovative approaches and methodologies in the fields of project portfolio management, combinatorial optimization with ordinal costs, and interactive multiobjective optimization.

• **A Novel Hyper Project Portfolio Approach to Select and Balance a Sustainable Project Portfolio:** Presented by Ercan Emin Cihan from Global Proje Doktoru & Yıldız Technical University, Turkey, this dissertation explored a trajectory towards a sustainable and balanced project portfolio. It presented a roadmap for decision-makers, offering seven major contributions including a novel portfolio space, an original front-end evaluation approach, and a debiasing strategy. The research employed a multi-method approach, providing instructive insights for decision-makers in project portfolio organizations.

• **Ordinal Costs in Multi-Objective Combinatorial Optimization:** Julia Sudhoff Santos from the University of Wuppertal, Germany, presented a modeling framework for combinatorial optimization problems with ordinal costs. The talk reviewed different optimality concepts for ordinal costs,

showcasing their equivalence to Pareto-optimality in corresponding multi-objective optimization problems. Results were extended to multi-objective optimization problems combining ordinal and real-valued objective functions.

• **Pioneering Techniques to Tackle Challenges of Interactive Multiobjective Optimization:** Bhupinder Singh Saini from the University of Jyväskylä, Finland, addressed the challenges of interactive multiobjective optimization. The dissertation proposed techniques to tackle these challenges, such as the SMTS algorithm for selecting suitable machine learning models and the IOPIS algorithm for interactive multiobjective optimization. The research also introduced the O-NAUTILUS algorithm for handling MOPs with expensive evaluations and the SCORE bands visualization technique for comprehensively displaying solutions from MOPs with multiple objectives. The DESDEO framework was implemented to provide open access to these algorithms and facilitate their combination for new applications.



Figure 2 Bhupinder Singh Saini wins the Doctoral Dissertation Award

Conference Parallel Sessions

During the conference, 102 papers were presented and discussed in the following special sessions:

- Advances in MCDM Theory
- AHP and ANP
- Artificial Intelligence
- Climate Change and Sustainable Development
- Computing and Software for MCDM
- Data Envelopment Analysis
- Decision Support Systems
- Evolutionary multi-objective optimization
- Finance and Investment
- Group Decision Making and Best Worst Method
- Healthcare Management
- Industry Applications and Logistics
- Multi-Criteria Decision models
- Multi-objective Combinatorial Optimization
- Multi-objective Optimization
- Multiple Criteria Decision Aiding
- Multiple Criteria Ranking or Sorting
- Practical Applications of MCDM
- Registered participants only
- Risk, Fuzziness and Uncertainty
- The Creative Decisions Foundation
- Transportation and Traffic

MCDM Awards Ceremony 2024

The MCDM Gold Medal: This is the highest honor that the International Society on Multiple Criteria Decision Making bestows upon a scholar who, over a distinguished career, has markedly contributed to the theory, methodology, practice and professional development of MCDM.



Figure 3 Serpil Sayin: MCDM Gold Medal 2024

The MCDM Edgeworth-Pareto Award: This is the highest distinction that the International Society on Multiple Criteria Decision Making bestows upon a researcher or practitioner of MCDM who has demonstrated a high level of creativity in developing novel areas of application of MCDM and associated methodology, markedly influencing the form of MCDM practice.



Figure 4 Carlos Coello Coello: MCDM Edgeworth-Pareto Award 2024

The Georg Cantor Award 2024: This is the highest form of recognition that the International Society on Multiple Criteria Decision Making bestows upon a researcher who has personified the spirit of independent inquiry in developing innovative ideas in the theory and methodology of MCDM, significantly expanding the tools available to MCDM practice.



Figure 5 Francisco Ruiz: Georg Cantor Award 2024

Closing Ceremony

The closing ceremony of MCDM 2024 was a resounding success, made possible by the dedicated efforts of all involved. Gratitude was extended to the individuals who played pivotal roles in ensuring the conference's triumph. Led by General Chair Fouad Ben Abdelaziz from NEOMA Business School, France, the event saw collaboration from esteemed Conference Co-Chairs Ralph Steuer, Hatem Masri, and José Rui Figueira, along with Organizing Committee Chair Salah Ben Abdallah and Local Arrangements Chair Rimeh El Fayedh from the University of Carthage. The Organizing Committee, comprising members from across the globe, including Thailand, Tunisia, Bahrain, and France, contributed their expertise to the event's success. Noteworthy mention was given to Sponsorship Committee Chair Karim Ben Abdelaziz from INSTEAD, Tunisia, for their crucial support. The ceremony marked the culmination of a collaborative and enriching conference experience, announcing that the next edition will be held in Marrakech, Morocco, chaired by Talbi El-Ghazali from the University of Lille 1, France.



Figure 6 Group picture taken in Hammamet

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MCDA Research Groups

DECISION ANALYSIS LAB (D.A. Lab)

https://knowledge4policy.ec.europa.eu/projects-activities/social-multi-criteria-evaluation-policy-options_en

https://knowledge4policy.ec.europa.eu/projects-activities/socrates-social-multi-criteria-assessment-european-policies_en

Decision Analysis Lab at the Joint Research Centre (European Commission) mainly focuses on innovative decision and

policy frameworks and tools useful throughout the policy cycle, in particular for impact assessments (IAs). Currently, the D.A. Lab conducts methodological and applied research, producing scientific publications, technical reports, guidelines, and software tools to advance Social Multi-Criteria Evaluation (SMCE). The D.A. Lab team also helps implementing SMCE in various policy areas, by supporting the European Commission, national governments (e.g. Germany) and international organizations (such as the United Nations International Atomic Energy Agency).

SMCE has been explicitly designed for supporting public policy and is a part of the latest version of the European Commission Better Regulation Toolbox (TOOL #62). The SMCE framework has demonstrated its usefulness for policy assessment and conflict management in many real-world problems in various geographical and cultural contexts. In the European Commission, we help to implement SMCE in different policy areas, such as health, energy and environment. In particular, we support impact assessments by helping to identify the best policy options in a structured and transparent way, while at same time allowing to consider a plurality of technical impact dimensions and social perspectives.

To ensure efficient capacity and community building in this field in high demand, the D.A. Lab team delivers training courses that are part of the EU learning package on Better Regulation. The primary audience is policy DGs but other audiences are also often included, such as European Parliament Research Services, international organisations (UN and OECD), and Member States. The team also manages an EC community of practice on SMCE.

Recent policy support activities of the D.A. Lab team:

- On request by DG SANTE, the D.A. Lab team accompanied the impact assessment process of the proposal for a "Regulation on Standards of Quality and Safety for Substances of Human Origin, intended for human application". We worked closely with DG SANTE to design a sound and transparent multi-criteria model to compare policy options. The criteria covered social, economic and fundamental rights' impacts relevant for reaching the objectives of the policy under revision.
- On request by DG ENER, we contributed to the impact assessment on "Eco-Design Measures for Local Space Heaters". The SMCE approach provided a useful framework for structuring and presenting a very technical impact assessment study.
- In collaboration with JRC experts in water modelling, the D.A. Lab is supporting two DG ENV impact assessments: the review of the "Marine Strategy Framework Directive" and the "Bathing Water Directive". The overall modelling framework forms the core of an ambitious approach pursued by DG ENV in collaboration with JRC to establish an integrated policy assessment capacity in the freshwater and marine environment fields. This collaboration aims to further extend the capacities of the BLUE2 water-modelling framework, and integrate the different relevant dimensions of the impact assessments through multi-criteria modelling.

- The D.A. Lab is Participating in the Coordinating Committee of the United Nations International Atomic Energy Agency (UN-IAEA) MAESTRI project and in the Steering Committee of the Agency's "Network of Environmental Remediation and NORM Management (ENVIRONET)". In the framework of the MAESTRI project, we are currently collaborating with IAEA, the US Department of Energy and the private company Longenecker & Associates for the environmental remediation of the Los Alamos site (Los Alamos Legacy Cleanup Strategic Vision).

- A family of new and different nuclear reactors – Small Modular Reactors (SMRs) – is under development in different parts of Europe and the world. JRC nuclear scientists are supporting EU Member States and Commission services in assessing risks and benefits of Small (and Micro) Modular Reactors. In this framework, the D.A. Lab is collaborating with the nuclear JRC colleagues to build a SMCE based multi-criteria assessment to look at and compare those SMR initiatives that could eventually be deployed in the EU.

Recent research activities of the D.A. Lab team:

- The development of the multi-criteria software tool SOCRATES (SOcial multi-CRiteria Assessment of European policieS), explicitly designed for impact assessment problems. The SOCRATES software is an innovative tool, based on exact and heuristic mathematical algorithms, which helps structuring the SMCE methodological framework (also including an equity analysis of the distributional impacts on stakeholders) and performs all complex mathematical steps that are necessary to compare options. SOCRATES also checks the robustness of resulting rankings by performing local and global sensitivity analyses of all relevant inputs such as weights attached to dimensions or criteria.

<https://web.jrc.ec.europa.eu/socrates/screen/home>

- The D.A. Lab conducted a structured workflow analysis with the objective of integrating SMCE seamlessly into the European Commission's impact assessments (IA) process. This involved a domain analysis to map out various artefacts ensuring that the concepts and artefacts of the two domains, SMCE's and EC IAs, semantically align. To communicate this integration to policy makers, we developed a visual workflow tool featuring nested processes. This tool allows users to navigate the complexity of the combined SMCE and IA processes at a level of detail they are comfortable with. Through this approach, we ensure that SMCE is interwoven into the IA workflow in a coherent manner that supports the overarching goals of thorough and effective policy assessment.
- A systematic literature review to identify and analyse all empirical applications of SMCE reported in peer-reviewed literature over the past 20 years, has been carried out. The review aimed to provide a comprehensive overview of how SMCE has been applied in real-world settings and to draw lessons for its future use in public policy design and appraisal. A total of 54 papers, each reporting on different case studies, were identified. These studies cover a wide range of policy areas and geographic contexts, spanning 20 countries across five continents. A scientific journal article is under preparation.

- The DA Lab team contributed to the design of FABLES: Framework for Autonomous Behaviour-rich Language-driven Emotion-enabled Synthetic populations. The research investigates how large language models (LLMs) emerge as reservoirs of a vast array of human experiences, behaviours, and emotions. Building upon prior work of the JRC on synthetic populations, it presents a complete step-by-step guide on how to use LLMs to create highly realistic modelling scenarios and complex societies of autonomous emotional AI agents. This technique is aligned with agent-based modelling (ABM) and facilitates quantitative evaluation.

- Other ongoing research activities focus on how to link machine learning - heuristic decision algorithms with data mining and on parallel computing. Furthermore, research activities in the area of interoperability and on possible dialogue between SOCRATES and GIS systems have been started.

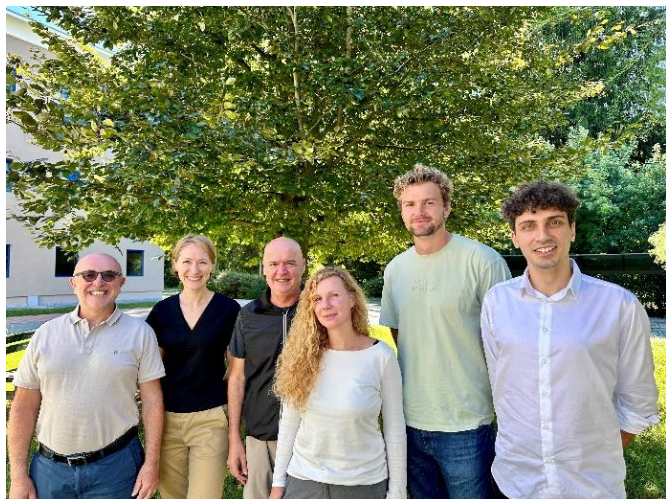


Figure 7 The D.A. Lab Team (from left to right): Giuseppe Munda, Egle Basyte Ferrari, Ivano Azzini, Nicole Ostlaender, Richard von Maydell, Nicola Morandi

Giuseppe Munda is scientific officer at the Joint Research Centre of the European Commission since 2015. Currently he is leading the Decision Analysis Lab. He was professor at the Department of Economics and Economic History (1994-2015) at Universitat Autònoma de Barcelona. He has also been visiting professor in various European and American universities (such as Université Panthéon-Sorbonne, Université de Versailles Saint-Quentin-en-Yvelines, University of Pisa, University of Buenos Aires, Rensselaer Polytechnic University). He holds a Ph.D. in Economics and Econometrics from the Free University of Amsterdam. He graduated in Economics from the University of Catania. He has authored numerous, highly cited scientific articles and book chapters on economics, decision theory and environmental studies. He has also written two books on Multi-Criteria Decision Analysis, mainly focusing on the incorporation of sustainability considerations into decision-making processes. He has developed the Social Multi-Criteria Evaluation (SMCE) framework for analyzing complex policy decisions that involve uncertain outcomes and the engagement

of stakeholders for incorporating their perspectives and values in the decision process.

Egle Basyte Ferrari is a policy analyst at the Decision Analysis Lab of the Joint Research Centre (European Commission). She holds a cum laude degree in Political Science and International Relations from the Catholic University of Milan and a PhD in Innovation and Evaluation of Education Systems from Roma Tre University. During her postdoctoral research at the Department of Management, University of Bologna, she specialised in school leadership and accountability policies. At the Joint Research Centre, Egle has contributed to projects aimed at strengthening the use of scientific evidence, promoting transparency, and fostering innovation in policy formulation processes. Currently, she leverages her expertise in EU Better Regulation to advance the use of Social Multi-Criteria Evaluation (SMCE) in policy decision-making. Furthermore, she leads the SMCE community of practice at the European Commission and conducts in-depth analyses of empirical SMCE applications.

Ivano Azzini holds a PhD in Artificial Intelligence in Medicine from the Laboratory for Bioengineering and Medical Informatics, University of Pavia. He has a degree in Computer Science from the University of Milan and a Master in "Advanced Technology of the Information and Communication Systems", from the International Institute for Advanced Scientific Studies (IIASS), "Edoardo R. Caianiello", Vietri sul Mare, Salerno, Italy. He has a wide research experience in various institutions such as the CEPREMAP "Centre Pour la Recherche ÉconoMique et ses Applications" (Paris, France), the bio-informatics group of the Bruno Kessler Center in Information and Communication Technology (formerly called IRST, Trento, Italy) and the Consorzio di Bioingegneria e Informatica Medica (CBIM, Pavia, Italy). He has also teaching experience in mathematics and computer science at Insubria University (Varese) and at University of Parma. His main research topics are artificial intelligence, sensitivity analysis, operational research, data analysis and robust statistics. Currently, he is supporting the JRC Decision Analysis Lab Team for software development, as consultant employed by Pikel Srl.

Nicole Ostlaender holds an MSc in Landscape Ecology and a PhD in Geoinformatics. She graduated from the University of Muenster, Germany. She has made significant contributions to the fields of interoperability and semantics, workflow analysis and design, knowledge management, and applications in sustainability and decision analysis. Since she initially joined the European Commission's Joint Research Centre, she has led the development of MIDAS (Modelling Inventory and Knowledge Management System of the European Commission), which enhances the transparency and efficiency of models used in EU policy design and evaluation. In her current role at the Decision Analysis Lab, Nicole continues to focus on decision analysis, interoperability, and workflow design, as well as the use of AI-generated synthetic data. Her work is aimed at supporting evidence-based policymaking, ensuring transparency and consistency in policy assessments.

Richard von Maydell has joined the Decision Analysis Lab (JRC Ispra, European Commission) in 2024. Prior to this role,

he received his doctoral degree from ETH Zurich and was an Oxford Global Priorities Fellow in 2023/24. Moreover, Richard holds a master's degree in Statistics from a Joint Masters Program of Charité, Humboldt, Technical and Free University in Berlin, and a bachelor's degree in Economics from Ludwig Maximilians University. He is interested in working at the intersection of research and politics to shape evidence-based public policies, with a focus on the economic effects of Artificial Intelligence coming in hand with novel political and regulatory challenges. His research explores the impact of AI on the economy, including its effects on competition, innovation, and income inequality. Throughout his professional journey, Richard has gained temporary insights into the activities of institutions such as the German Ministry of Economic Affairs and research institutes like the ifo Institute, Walter Eucken Institute, and Global Priorities Institute. He particularly enjoyed the opportunity to teach at ETH Zurich, the Technical University of Berlin and Ludwig Maximilians University.

Nicola Morandi has joined the Decision Analysis Lab (JRC Ispra, European Commission) in 2024. Prior to this role, Nicola was lecturer of Mathematics at the Tilburg School of Economics and Management (Tilburg, NL). Nicola holds a PhD in Operations Research from KU Leuven (BE) and a Master's degree in Mathematics from Trento University (IT). His professional interests include, among other things, the study of the quality of the decision-making process via quantitative methods. He specializes in mathematical programming, combinatorial optimization, and algorithm design. Over the last decade, Nicola has acquired experience in research and teaching at a number of institutions, including Skema Business School (Lille, FR). Having seen the positive impact of high-quality decisions on society in numerous European states, he is now committed to contribute in the shaping of evidence-based public policies.

Some D.A. Lab publications:

Policy analysis:

Contributions to "IMPACT ASSESSMENT REPORT Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on standards of quality and safety for substances of human origin intended for human application and repealing Directives 2002/98/EC and 2004/23/EC"

EUR-Lex - SWD:2022:190:FIN - EN - EUR-Lex (europa.eu)

Contributions to "COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document COMMISSION REGULATION (EU) .../... implementing Directive 2009/125/EC of the European Parliament and of the Council as regards ecodesign requirements for local space heaters and separate related controls and repealing Regulation (EU) 2015/1188".

[https://ec.europa.eu/transparency/documents-register/detail?ref=SWD\(2024\)62&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=SWD(2024)62&lang=en)

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Software

MCDA Calculator: A Streamlined Calculation Tool for Multi-Criteria Decision Analysis

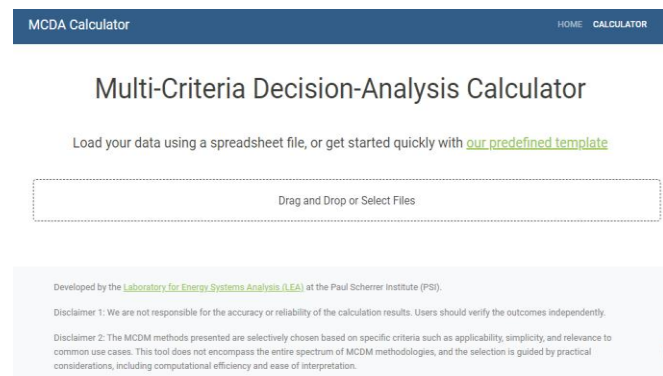
River Huang¹, Peter Burgherr¹
¹ Laboratory for Energy Systems Analysis, Paul Scherrer Institut, Villigen PSI, Switzerland
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<https://www.psi.ch/en/ta>

In the rapidly evolving field of Multi-Criteria Decision Analysis (MCDA), practitioners often face the challenge of navigating a complex landscape of methods and tools. The MCDA Calculator emerges as a novel web tool designed to simplify and enhance the decision-making process for experienced users by integrating multiple MCDA methodologies into a single, cohesive platform [1].

The MCDA Calculator offers a streamlined computational workflow that brings together various MCDA methods. Currently, the MCDA calculator has integrated the following MCDA methods:

- ELECTRE III - Élimination Et Choix Traduisant la Réalité III
- MAVT - Multi-Attribute Value Theory
- PROMETHEE II - Preference Ranking Organization METHod for Enrichment of Evaluations II
- SMART/SMARTS/SMARTER - Simple Multi-Attribute Rating Technique
- TODIM - Interactive and Multicriteria Decision Making
- TOPSIS - Technique for Order of Preference by Similarity to Ideal Solution
- VIKOR - ViseKriterijumska Optimizacija I Kompromisno Re-senje.

The tool is designed with a focus on user-friendliness, enabling practitioners to efficiently conduct their analyses without the need for time-consuming configurations or deep programming knowledge.



Features and Capabilities

The MCDA Calculator operates as a web-based application, accessible directly through a browser, and is tailored for use by decision-makers, analysts, and consultants. It supports multiple decision-making contexts by allowing users to import data from common formats like Excel or CSV, configure the necessary parameters, and quickly obtain insightful results. The tool's flexibility makes it suitable for a wide range of applications, from academic research to practical decision-making scenarios.

A key advantage of the MCDA Calculator is its emphasis on efficiency. The tool is designed to eliminate redundant steps, allowing users to concentrate on the analytical aspects of their decision-making process after obtaining results from the MCDA calculator. Once an MCDA method is selected, users

can proceed directly to result calculation, with the flexibility to easily adjust inputs and parameters as needed. Additionally, the calculator supports seamless transitions between different MCDA methods. It automatically retains unchanged universal information for MCDA, such as criteria weights, so users only need to provide additional data specific to the new method. This functionality enables quick comparisons of results across multiple MCDA approaches without the need to re-enter all information.

The MCDA Calculator is freely accessible online and continues to be developed with new features and enhancements. We invite you to explore the tool and provide feedback as we work to further improve its capabilities. For more information and to access the tool, visit <https://mcda-calculator.psi.ch>.

[1] Huang, H. and Burgherr, P., 2024, May. MCDA Calculator: A Streamlined Decision Support System for Multi-criteria Decision Analysis. In International Conference on Decision Support System Technology (pp. 31-45). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-59376-5_3



Forthcoming meetings

(This section is prepared by Carlos Henggeler Antunes ch@deec.uc.pt)

28/10-1/11/2024

CLAIO 2024/CSMIO 2024

Guadalajara, Mexico

<http://www.smio.org/home-claio-2024.html>

3-5/11/2024

AFROS2024 - third triennial gathering of the African Federation of Operations Research Societies

Tlemcen, Algeria

<https://afros2024.com/>

4-15/11/2024

EURO PhD School on Multiple Criteria Decision Making: Methodologies and Applications to the Sustainable Development Goals

Málaga, Spain

<https://eventos.uma.es/105882/detail/euro-phd-school-on-multiple-criteria-decision-making-methodologies-and-applications-to-the-sustaina.html>

5-10/11/2024

Research school on "Optimization models and methods for challenging energy problems"

Erice, Italy

<https://omcep23.univ-perp.fr/index.php?page=home>

18-21/11/2024

DEA2024: International Conference on Data Envelopment Analysis

Noida, Delhi, India

<https://dataenvelopment.com/dea2024/>

20-24/1/2025

11th ENOG Winter School on Network Optimization

Estoril, Portugal

<https://netopt2025.campus.ciencias.ulisboa.pt/>

26-30/1/2025

Short Course on Discrete Choice Analysis: Predicting Individual Behavior and Market Demand

Lausanne, Switzerland

<https://transp-or-academia.epfl.ch/dca>

13-15/2/2025

11th Annual International Conference on Algorithms and Discrete Applied Mathematics - CALDAM 2025

Tamilnadu, India

<https://caldam2025.psgtech.ac.in/>

4-6/3/2025

SIGOPT2025 International Conference on Optimization

Siegen, Germany

<http://www.sigopt2025.uni-siegen.de/>

14-16/3/2025

18th INFORMS Computing Society (ICS) Conference

Ontario, Canada

<https://www.informs.org/Meetings-Conferences/INFORMS-Conference-Calendar/18th-INFORMS-Computing-Society-ICS-Conference>

1-4/4/2025

11th International Conference on Railway Operations Modelling and Analysis - RailDresden 2025

Dresden, Germany

<https://tu-dresden.de/bu/verkehr/veranstaltungen/raildresden2025>

6-8/4/2025

2025 INFORMS Analytics Conference

JW Marriott Indianapolis, USA

https://meetings.informs.org/wordpress/analytics/?_gl=1%2A1qm00bi%2A_gcl_au%2ANDA1MTexNTk1LjE3MjgzMTY2MDM

10-12/4/2025

99th Meeting of EURO Working Group on MCDA

Venice, Italy

<http://www.unive.it/ewgmcda99>

23-25/4/2025

EvoCOP 2025 - The 25th European Conference on Evolutionary Computation in Combinatorial Optimisation

Trieste, Italy

<https://www.evostar.org/2025/evocop/>

30/4-2/5/2025

5th IMA and OR Society Conference on Mathematics of Operational Research

Birmingham, UK

<https://ima.org.uk/24367/5th-ima-and-or-society-conference-on-mathematics-of-operational-research/>

8-10/5/2025

ECCO XXXVIII-2025 The 38th Conference of the European Chapter on Combinatorial Optimization

Marrakech, Morocco

11-14/6/2025

WODCA 2025—Workshop on Optimization, Dynamics, and Convex Analysis

Aveiro, Portugal

<https://sites.google.com/view/wodca2025/>

15-19/6/2025

LION - 19th Learning and Intelligent Optimization Conference

Prague, Czech Republic

<https://lion19.org/>

16-20/6/2025

Applications of metaheuristics to large-scale problems

Sozopol, Bulgaria

<http://parallel.bas.bg/Conferences/SciCom25/>

17-20/6/2025

MOPTA 2025 and 70th Birthday of Tamás Terlaky

Bethlehem, Pennsylvania

<https://coral.ise.lehigh.edu/mopta2025/>

22-27/6/2025

TRISTAN XII

Okinawa, Japan

<https://tristanconference.org/>

22-25/6/2025

EURO 2025

Leeds, UK

<https://euro2025leeds.uk/>

30/6-3/7/2025

11th IFAC Conference on Manufacturing Modelling, Management and Control – IFAC MIM 2025

Trondheim, Norway

<http://conferences.ifac-control.org/mim2025/blog/2023/01/27/welcome-ifac-mim2025/>

17-19/9/2025

XXX Meeting of EURO Working Group on Locational Analysis

Jerez, Spain

<https://ewgla2025.uca.es/>

Fall 2025

100th Meeting of EURO Working Group on MCDA

Poznan, Poland

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

26-29/10/2025

2025 INFORMS Annual Meeting

Atlanta Convention Center, Georgia, USA

<https://www.informs.org/Meetings-Conferences/INFORMS-Conference-Calendar/2025-INFORMS-Annual-Meeting>

10-13/11/2025

CPAIOR 2025: 22nd International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research

Melbourne, Australia

<https://sites.google.com/view/cpaior2025/home>

Spring 2026

101st Meeting of EURO Working Group on MCDA

Leeds, UK

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

Spring-Summer 2026

28th International Conference on Multiple Criteria Decision Making (MCDM2026)

Marrakech, Morocco

<https://mcdm2024.org/>

12-17/7/2026

IFORS 2026

Vienna, Austria

<https://www.ifors2026.at/home/>

11-14/7/2027

EURO 2027

Athens, Greece

<https://www.euro-online.org/>



Books

Multi-Criteria Decision-Making Sorting Methods Applications to Real-World Problems

Luis Martínez, Alessio Ishizaka, Jindong Qin, Pavel Anselmo
Álvarez Carrillo

Decision-making processes involve different steps that demand data, information, knowledge, and computational tools. Multi-criteria decision-making (MCDM) methods support decision-makers in eliciting their preferences on the alternatives of the problem and computing solutions for the decision situations under study, which can be either, choose the best alternative, or rank the alternatives or sorting the alternatives. The "Multi-Criteria Decision-Making Sorting Method" book focuses on the sorting problematic whose objective is to assign the decision alternatives into some

predefined classes and sort them according to the expert's preferences. Solving MCDM sorting problems involves grouping the alternatives with similar performance regarding multiple attributes for descriptive, organizational, or predictive reasons.

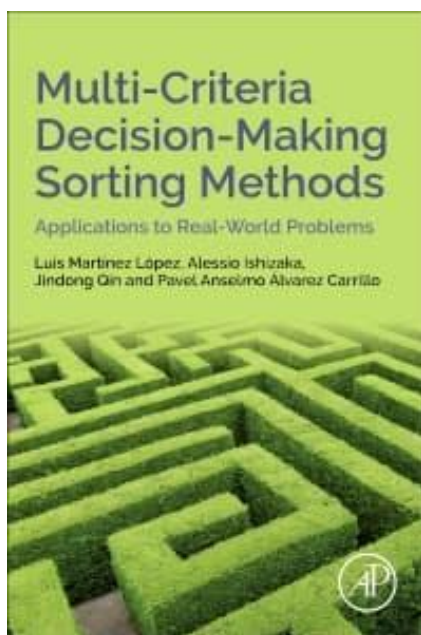
The book delves into practical Applications to Real-World Problems, such as environmental management, security level of cities, solar energy, economic attractiveness of the landscape, geographical marginality and so on. These examples illustrate the versatility and applicability of the Multi-Criteria Decision-Making Sorting methods in addressing complex, real-world issues.

The book provides a comprehensive overview of sorting methods, covering those from full aggregation, outranking, and goal (aspiration or reference level) approaches. This thorough coverage ensures that readers gain a complete understanding of the various sorting methods and their applications. Some methods described in the book are AHPsort, ANPsort, UTADIS and MACBETHsort for the full aggregation approach; ELECTRE TRI and FlowSort for the outranking approach; TOPSIS-Sort, VIKORsort, CODAS-sort and DEASort for the goal, aspiration or reference level approach.

Due to the fact that, uncertainty is often present in MCDM Sorting problems because of lack of information, parameter understanding, expert knowledge, or preference expression. The book also presents a background of fuzzy sets theory to accompany beginning readers in matching the knowledge constructed by MCDM methods with fuzzy set theory in fuzzy sorting methods. The background will help readers identifying the functions and operations of fuzzy numbers in the fuzzy extension of MCDM methods. Those methods are helpful in the decision-making process because there are situations in which the decision-maker deals with uncertainty. In that case, uncertainty can be modeled by fuzzy information that better suits to real-world situations.

The book underscores the practicality and applicability of sorting methods in decision-making situations that require repetition or automation. Furthermore, it highlights how these methods can be used for screening processes in MCDM, for effectively reducing the number of alternatives to be considered in subsequent decision steps. This emphasis on practicality and applicability makes the book a valuable resource for readers seeking actionable insights.

The book provides in Chapter 1 a historical perspective of sorting problems and an overview of the development of MCDM methods for sorting issues. Chapter 2 revises 10 classical MCDM methods and details their extensions to MCDM sorting methods, showing different examples of their application. Chapter 4 reviews the fuzzy set concepts and their application in MCDM sorting problems. Chapter 5 analyzes MCDM sorting methods to characterize and evaluate their necessity and suitability. Chapter 6 shows the application of MCDM sorting methods to different real-world problems. Chapter 7 concludes the book and provides insightful conclusions and a view of the future challenges of MCDM sorting.



Announcements and Call for Papers

Call for the "Bernard Roy Award 2025" of the EURO Working Group on Multiple Criteria Decision Aiding

Policy

-The Bernard Roy Award of EWG MCDA (<http://www.cs.put.poznan.pl/ewgmcda/>) 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 EWG MCDA Autumn meeting (in 2024 organized in Catania) 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. Becoming a member is free (Please, send an email to [Milosz Kadziński](mailto:Milosz.Kadziński)).
- 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 May 20, 2024.

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 Salvatore Greco (chair), Constantin Zopounidis, Yves De Smet, Sarah Ben Amor and Francis Macary.

Timing

- Deadline for nominations: May 20, 2025.
- The Jury chair informs the EWG coordinators who invite the laureate to the meeting: July 31, 2025.
- Preparation of the diploma by the EWG coordinators.
- Presentation of the laureate and her/his talk during the EWG MCDA 100th EWG MCDA meeting, September 2024, Poznan University of Technology, Poznan, Poland. 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 Professor Maria Franca Norese at: salgreco@unict.it.

Previous BR award winners

- 2024: Mohammad Ghaderi, Pompeu Fabra University, Spain
- 2023: Eleftherios Siskos, Technical University of Crete, Greece
- 2022: Banu Lokman, University of Portsmouth; UK
- 2021: Matteo Brunelli, University of Trento, Italy
- 2020: Salvatore Corrente, University of Catania, Italy
- 2019: Miłosz Kadziński, Poznan University of Technology, Poland

Special Issues

Annals of Operations Research

Special Issue on "Decision-making under Uncertainty for Commodities and Financial Markets"

Submission deadline: December 31, 2024

Special Issue Editors:

Rita D'Ecclesia, Department of Statistical Sciences, Sapienza University of Rome, Italy

Audrius Kabašinskas, KTU Faculty of Mathematics and Natural Sciences, Kaunas University, Kaunas, Lithuania

Alois Pichler, Faculty of Mathematics, University of Technology, Chemnitz, Chemnitz, Germany

More details can be found [here!](#)

Annals of Operations Research

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Special Issue on "Multiobjective Optimization on a Budget"

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Special Issue on "Multi-objective Programming"

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Sophie N. Parragh, Johannes Kepler University Linz, Austria

Michael Stiglmayr, University of Wuppertal, Germany

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Recent contributions in brief

Atteya, T.E.M., Chakhar, S., Labib, A., Cox, C. & Ishizaka, A. (2024). Estimating relative importance of criteria by post-processing dominance-based rough set approach's outputs. *European Journal of Operational Research*, 315(3), pp. 1096-1122. DOI: 10.1016/j.ejor.2023.12.027.

The ability to explain and justify final decisions to stakeholders is crucial to the successful appropriation and implementation of these decisions. The relative importance of criteria can play an essential role in this regard. While the dominance-based rough set approach (DRSA) does not use the relative importance of criteria, it has some important features that are very useful to explain and justify final decisions. To further enhance the explainability and interpretability power of the DRSA, this paper introduced a series of measures to estimate the relative importance of the criteria relying on the characteristics of the outputs from DRSA. The estimated values permit the understanding of the role that each criterion plays and how it contributes to the final decision. The four measures proposed in this paper are respectively based on the characteristics of decision rules, the characteristics of attribute reducts, the marginal contributions of criteria to the quality of classification, and the information gain (entropy) with respect to partitions of decision classes. The paper also extends some of these measures to estimate the relative importance of criteria for specific decision classes, offering thus a more local interpretation of estimated values. The Pareto analysis can then be used to identify the vital criteria that represent about 20% of criteria, but significantly affect the final decision. A simple procedure based on the dominance relation can also be employed to cluster the criteria according to their overall vitality by jointly using all the measures. The proposed measures generally lead to different results as they rely on different granules of knowledge. The proposed measures have been used to analyse Brexit results, assess depressive symptoms in online forums, analyse the role played by

different sustainability criteria in the UK automotive industry, and explain investment decisions concerning UK start-ups.

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da Silva, A. L. C. L., Costa, A. P. C. S., de Almeida, A. T. (2022). Analysis of the cognitive aspects of the preference elicitation process in the compensatory context: a neuroscience experiment with FITradeoff. International Transactions in Operational Research 31, 2472-2503. DOI: 10.1111/itor.13210

The Laboratory for Neuroscience and Behavioral Studies in Decision-Making (NSID – www.cdsid.org.br/nsid/) has been focused on investigating the neural processes involved in Multi-Criteria Decision-Making (MCDM). The lab proposes enhancements to methods and systems, going beyond mathematical considerations to ensure success in the preference modeling process. The compensatory method Flexible and Interactive Tradeoff (FITradeoff) has been extensively studied at NSID, with several published papers on the subject. Derived from the tradeoff procedure and inheriting its strong axiomatic structure, FITradeoff has undergone changes making it cognitively more accessible and overcoming the inconsistencies observed with tradeoff when using partial preference information. However, other issues are relevant in the process of preference elicitation with compensatory rationality, such as the effects of the number and type of criteria and the number of questions in the process. This study aimed to investigate the impact of these factors using eye-tracking and electroencephalogram (EEG) data in an approach known as decision neuroscience. The results showed that problems involving equal types of criteria tend to require less effort from the decision-maker while generating more engagement, in other words, an activation in the left hemisphere of the brain (see figure below). Moreover, a nonlinear relationship with cognitive effort was observed in relation to the number of criteria and questions during the preference elicitation process, suggesting the adoption of strategies to minimize effort when complexity increases, leading to disengagement. Since it is crucial for the decision-maker to provide information consistent with their true preferences during preference elicitation, ensuring engagement and the application of necessary effort are important aspects. Thus, this study offers findings that can guide improvements to FITradeoff and other compensatory rationality methods, as well as to the interaction process between the decision analyst and the decision-maker to ensure the decision-maker's involvement.

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Bortot, S., Marques Pereira, R. A. (2024). On linear combinations of binomial OWA functions. Fuzzy Sets and Systems, 488, 109010. DOI: 10.1016/j.fss.2024.109010

We consider the binomial decomposition of ordered weighted averaging (OWA) functions proposed by Calvo and De Baets (1998) in the framework of Choquet integration. The binomial decomposition expresses OWA functions as constrained linear combinations of the n binomial OWA functions C_j , with $j=1,\dots,n$, whose weights are defined by means of binomial coefficients.

For any given OWA function, the j 'th coefficient of its binomial decomposition is essentially the common value of the symmetric Möbius transform of coalitions of cardinality j , where $j=1,\dots,n$. In the Choquet integration framework, the binomial decomposition of an OWA function is therefore a natural way of describing the degree of non-additivity of its weighting structure.

The binomial decomposition of OWA functions has interesting applications in the context of welfare and inequality, in which OWA functions with non-increasing weights (i.e., Schur-concave) constitute the class of generalized Gini welfare functions, as in Weymark (1981). Each generalized Gini welfare function is associated with a generalized Gini inequality index by means of the correspondence formula of Blackorby and Donaldson (1978, 1980). In particular, binomial OWA functions are generalized Gini welfare functions and therefore their associated binomial Gini inequality indices provide natural interesting generalizations of the classical Gini index, see Bortot and Marques Pereira (2014).

In this paper we recall the definitions and main properties of the binomial OWA functions and we describe the construction of the binomial decomposition of OWA functions, focusing on the equivalence between the canonical and the binomial representations. We describe and discuss in detail the linear transformations that relate the coefficients of these two equivalent representations: the original expression of the weights in terms of the coefficients of the binomial representation, due to Calvo and De Baets (1998); and its inverse, the expression of those coefficients in terms of the weights, subsequently obtained by Thuy Nguyen (2019) with a complex proof based on strong induction. In this paper a simple direct proof is presented.

Moreover, we extend the discussion to the case of general linear combinations of binomial OWA functions, in the classical linear algebra framework. In this perspective we obtain compact matrix expressions for the linear transformations between the canonical and the binomial representations, applicable to constrained or unconstrained linear combinations of binomial OWA functions. In the former case, the argument offers new insight on the geometry of the constraints regarding the coefficients of the binomial representation of OWA functions.

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Kandakoglu, M., Walther, G., & Ben Amor, S. (2024). The use of multi-criteria decision-making methods in project portfolio selection: a literature review and future research directions. Annals of Operations Research, 332(1), 807-830. DOI: 10.1007/s10479-023-05564-3

Project portfolio selection (PPS) is a complex strategic decision problem in which a subset of projects is selected to form a portfolio by dealing with multiple, conflicting, and incommensurable criteria, decision makers' preferences and underlying real-world constraints. Since Multi-criteria Decision Analysis (MCDA) methods provide a well-suited framework to deal with these challenges in PPS problems, MCDA-based solutions have been developed in the literature over the years.

In this regard, the motivation behind our research lies in the need for a classification of these solutions into approaches to assist the researchers and the practitioners in the use of MCDA methods in a specific PPS context, considering the problem characteristics and the comparison of the approaches through detailed analysis.

In our comprehensive literature review, we first introduced the PPS problem with its mathematical notation and highlighted different terminologies referring to the same problem. We then analyzed and summarized the use of different MCDA methods, and their individual or combined utilization with other modeling techniques to deal with PPS problems. Later, based on our observation on how the portfolios are formed and MCDM methods are used for evaluation of individual projects and/or possible portfolios, we classified existing studies into two main modelling approaches. As a next step, we presented the advantages and disadvantages of the approaches and then provided a detailed investigation on the combined utilization of MCDA methods with mathematical programming techniques. We also proposed a decision-tree visualization as well as a rule set extracted from this tree that can be effectively used as a decision support tool by scholars and practitioners. This decision tree aims to facilitate the selection of an appropriate modeling approach and method for a specific PPS problem. Finally, we discussed the recent advances and highlighted areas for future research.

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Fernández, E., Figueira, J. R., Navarro, J., & Solares, E. (2024). An Outranking-Based Approach Modeling Satisfaction–Dissatisfaction Intensity, Preference Dependence, and Discordance Strength in Group Decision. Group Decision and Negotiation, 1-26. DOI: 10.1007/s10726-024-09880-2.

This paper describes a new method for group decision-making inspired by the ELECTRE family of methods. It addresses three crucial effects in group decision: i) reinforced preference (modeling the intensity of satisfaction or dissatisfaction without using cardinal information); ii) preference interaction and dependence (accounting for complementarity, redundancy, and antagonism among group members); and iii) the relative strength of the coalition that is discordant with the outranking statement (evaluating opposition within the group). While these topics have been previously examined by other adaptations of the ELECTRE III method, this paper uniquely

integrates them for the first time, tailoring them specifically to group decision-making.

The proposed method is particularly useful in situations where a Supra-Decision Maker (SDM) or a governing entity guides group decision-making. The SDM has the authority to weigh the preferences and interactions among group members, aiming for a fair and balanced decision outcome that minimizes dissatisfaction within the group, especially in cases where opinions diverge significantly. The approach is applicable in collaborative environments, especially within organizations or government agencies seeking to reconcile the diverse viewpoints of stakeholders. The risk of malicious manipulation diminishes in larger groups or when the group operates under certain identified collaborative rules. The method's application is shown through examples, showing how it improves decision-making by addressing issues neglected by previous methods. The proposed approach provides a comprehensive tool for group decision-making, balancing majority preferences and minority rights in complex scenarios. Although the paper focuses on group ranking problems, the model is versatile for representing collective preferences in any group decision problem.

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Díaz, R., Fernández, E., Figueira, J. R., Navarro, J., & Solares, E. (2024). Revisiting relational-based ordinal classification methods from a more flexible conception of characteristic profiles. Omega, 127, 103080. DOI:10.1016/j.omega.2024.103080

This paper presents a novel approach to multiple criteria ordinal classification, focusing on enhancing the flexibility of characteristic profiles used in relational-based methods. Traditional methods, such as those in the ELECTRE family, often rely on central profiles that represent classes or limiting profiles that define boundaries between them. While effective, these approaches can be cognitively demanding for decision-makers (DMs) and may lead to inappropriate assignments, especially when profiles fail to capture the full spectrum of class nuances.

The proposed method introduces greater flexibility by being able to consider both central and non-central profiles, including those from the 'least preferred' or 'most preferred' parts of a class, as well as profiles that lie on the boundaries between adjacent classes. Thus, the method bridges the gap between different paradigms in relational multiple criteria ordinal classification. The expanded set of reference actions is intended to improve the accuracy and appropriateness of class assignments while reducing the cognitive load on DMs. The practical implications of this approach are significant, as it enables the use of a broader range of assignment examples to better characterize classes and avoid paradoxical outcomes that might occur in other methods. Additionally, the method relies on a highly general reflexive preference relation, S , which enables the approach to accommodate a wide range of preference models. By merging this feature with considerable flexibility in handling profiles, the proposal arguably attains

the highest level of generality. Its theoretical and practical advancement provides a more nuanced and robust foundation for decision-making in ordinal classification.

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Dias, L. C. (2024). On the sigma-mu stochastic multicriteria analysis: Exact solutions for common particular cases. Omega, 127, 103093.

Monte-Carlo simulations have become a popular approach to explore the space of weights (or other parameters) when analysts cannot, or do not wish to, elicit a precise vector of values for these parameters. This is the case of stochastic multicriteria acceptability analysis (SMAA) methods, and more recently also the sigma-mu approach for MCDA and composite indicators construction. This short article can save time in some particular cases when the analysts are interested in computing the mean (μ) or standard deviation (σ) of MCDA aggregation under stochastic weights, being therefore particularly suitable to accelerate the sigma-mu method. In terms of aggregation, these cases are characterized by an additive model, such as a weighted sum, a multiattribute value function, or PROMETHEE II, as used in SMAA, SMAA-2, SMAA-PROMETHEE and Sigma-Mu. In terms of stochastic distributions, these cases include uniformly distributed unconstrained vectors of weights (any non-negative weights adding up to 1 are accepted), rank-ordered vectors of weights (a ranking of the weights is further enforced), or lower-bounded weights (a minimum value for the weights is enforced). The paper develops closed-form formulas to obtain exact values for μ and σ without the need for approximations via Monte-Carlo simulations and presents a didactic example showing step by step how to proceed.

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Aghaei Pour, P., Bandaru, S., Afsar, B., Emmerich, M., Miettinen, K., A Performance Indicator for Interactive Evolutionary Multiobjective Optimization Methods, IEEE Transactions on Evolutionary Computation, 28(3), 778-787, 2024. DOI: 10.1109/TEVC.2023.3272953

Interactive solution processes often have phases, where the DM first explores the problem by providing varying preferences, gaining insights of trade-offs and the feasibility of preferences. This guides the method to a phase, where the DM refines solutions until the most preferred one is found. The proposed indicator, called PHI, uses the DM's reference point to determine the desired objective function values and divides a hypervolume indicator contribution into positive and negative contributions. The former are used as the main performance measure, while the latter penalize the method's performance. The paper demonstrates how the indicator evaluates the overall performance of interactive methods and assesses different solution phases on an engineering problem.

The indicator provides insights into the effectiveness of interactive methods and can guide analysts in selecting suitable methods for their problems.

The study highlights the computational challenges of PHI, particularly for problems with a high number of objectives, and suggests future research directions to develop computationally less expensive indicators and methods that can handle other types of preferences. Additionally, the paper explores the potential for an indicator-based interactive evolutionary method. The research also opens avenues for further investigation into identifying different phases of solution processes.

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Seyed Mahdi Shavarani, Manuel López-Ibáñez, and Richard Allmendinger. Detecting Hidden and Irrelevant Objectives in Interactive Multi-Objective Optimization. IEEE Transactions on Evolutionary Computation, 28(2):544–557, 2023. doi: 10.1109/TEVC.2023.3269348

Imagine the human operator of a manufacturing plant who has to decide which production plan is going to be implemented today. The operator uses a decision support system that optimizes production plans by means of an interactive evolutionary multi-objective optimization algorithm (iEMOA). This iEMOA has been designed to optimize specific quantitative features of a production plan, that is, a fixed number of so-called objectives. However, the system interface presents to the operator a very detailed analysis of each potential production plan containing many more quantitative and qualitative features that are not being optimized by the iEMOA, some of which are only relevant under specific circumstances and/or are computed only on-demand, because they require expensive simulation or forecasting analysis to compute. In such a scenario, there are irrelevant objectives that are optimized by the EMOA but ignored by the DM (the operator), as well as, hidden objectives that the DM considers when judging the utility of solutions but are not optimized. This discrepancy between the iEMOA and the DM's preferences impedes the search for the most-preferred solution and wastes resources evaluating irrelevant objectives.

Research on objective reduction has focused so far on the structure of the problem and correlations between objectives and neglected the role of the DM.

We formally define here the concepts of irrelevant and hidden objectives and propose methods for detecting them, based on uni-variate feature selection and recursive feature elimination, that use the preferences already elicited when a DM interacts with a ranking-based iEMOA. We incorporate the detection methods into an iEMOA capable of dynamically switching the objectives being optimized.

Our experiments show that this approach can efficiently identify which objectives are relevant to the DM and reduce the number of objectives being optimized, while keeping and often improving the utility, according to the DM, of the best solution found.

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Csató, L., Ágoston, K. Cs., Bozóki, S. (2024). On the coincidence of optimal completions for small pairwise comparison matrices with missing entries. *Annals of Operations Research*, 333(1): 239-274.
DOI: <https://doi.org/10.1007/s10479-023-05586-x>

Pairwise comparisons are used in many decision-making frameworks such as the Analytic Hierarchy Process (AHP). Several procedures have been suggested to derive priorities from pairwise comparison matrices; probably the two most popular techniques are the eigenvector and the logarithmic least squares methods. Both of them have been extended to the set of incomplete pairwise comparison matrices where some entries can be missing for several reasons, for example, because the number of pairwise comparisons asked from the decision-maker has been reduced.

These approaches are based on choosing the unknown comparisons such that an inconsistency index is minimised: the consistency ratio in the case of the eigenvector method and the geo-metric consistency index in the case of the logarithmic least squares method. Therefore, they provide an optimal filling for any incomplete pairwise comparison matrix. The completion is unique if and only if the undirected graph representing the missing comparisons is connected, namely, any pair of alternatives can be compared at least indirectly, through other alternatives.

Our paper reveals an unexpected result: the two methods imply the same optimal filling if the number of alternatives is at least four. The finding is trivial if there are three alternatives since one missing comparison can be chosen such that the resulting complete pairwise comparison matrix becomes consistent. On the other hand, the eigenvector and the logarithmic least squares methods can provide different priority vectors for pairwise comparison matrices of order four. Furthermore, most theoretical shortcomings of the eigenvector method (Pareto inconstancy, left-right asymmetry) emerge if there are at least four alternatives.

However, a counterexample shows that the theorem cannot be generalised: the optimal filling according to the two approaches may differ if the number of alternatives is at least five and one missing comparison exists. It remains an open question whether other completion methods for pairwise comparison matrices with missing entries lead to the same solution.

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Angilella, S., Doumpos, M., Pappalardo, M. R., & Zopounidis, C. (2024). Assessing the performance of banks through an improved sigma-mu multicriteria analysis approach. *Omega*, 127, 103099.
DOI: <https://doi.org/10.1016/j.omega.2024.103099>

The σ - μ efficiency methodology, recently introduced by Greco et al. (2019) for multicriteria evaluation problems within the Stochastic Multi-Attribute Acceptability Analysis (SMAA) framework, addresses uncertainty in the performance of a set of decision alternatives. This methodology iteratively builds a set of Pareto-Koopmans efficiency frontiers to assess alternatives based on their expected performance (μ) and variability (σ) across various weight scenarios for evaluation criteria. In this paper, we note that the standard iterative implementation of σ - μ efficiency analysis may produce results that are inconsistent with the Pareto dominance relation among alternatives in the σ - μ plane. To address this limitation, we propose an enhanced iterative algorithmic procedure, to assess the performance of a sample of European banks that participated in the European Banking Authority's stress tests over the last five years available (2017–2021). The banks' performance and efficiency are analysed using both financial and non-financial criteria, including environmental, social, and governance (ESG) factors. Results from comprehensive and disaggregated analysis reveal performance disparities among banks in financial and ESG factors, highlighting the influence of country-specific green policies and individual bank practices. Valuable for the banking sector and various regulatory bodies, including the European Banking Authority, the Basel Committee on Banking Supervision, and the Financial Stability Board, the findings help identify operational inefficiencies and areas where banks can improve their performance, enhance their operations, and encourage improvements and innovation, with a focus on green practices.

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Pelissari, R., Ben Amor, S., de Oliveira D'Antona, Á., Marandola Júnior, E.J., Duarte, L.T. (2024). A semi-supervised multi-criteria sorting approach to constructing social vulnerability composite indicators. *Annals of Operations Research*, 337, 235–260. DOI: <https://doi.org/10.1007/s10479-024-05900-1>

This paper introduces a conceptual sorting framework that combines SMAA and a novel aggregation method based on the Choquet integral, integrating data-driven insights with subjective judgments of decision makers. The proposal of this framework was motivated by the need to develop a new São Paulo Social Vulnerability Index (IPVS), which allows decision makers to explore different scenarios, unlike the current, fully data-driven IPVS.

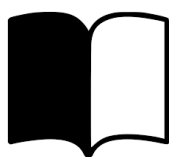
Given the high correlation among IPVS variables, our approach uses the Choquet integral to model dependencies. However, since the traditional Choquet integral does not support different reference values for each criterion in sorting problems, we propose a modified version, called Choquet-Dist. This variation computes the distance between an alternative's evaluation and category reference values, leading

to k Choquet utility values (one per category) for each alternative, with the final category determined by the minimum utility value.

A challenge in the application of the Choquet-Dist, as well as in the Choquet Integral, is defining interaction indices, which is a less intuitive task for decision makers compared to criteria importance definition. Our framework addresses this by combining data-driven and participatory weighting methods. We apply SMAA to account for decision maker preferences in the definition of criteria weights without excessive cognitive load, while interaction indices are derived from statistical correlations in the data. By analyzing Spearman correlations, we determine interactions between criteria and elicit interaction indices under the Choquet integral's constraints using the SMAA methodology.

While demonstrated in the IPVS context, the proposed framework is applicable to broader decision problems.

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Articles Harvest

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