

# Editorial: MCDM/A and AI as Drivers of Innovation and Entrepreneurship: Editorial Note

**T**HE constant socio-economic transformations that have marked the last few decades mean that individuals are continually in contact with economic, political, social, and technological changes. This has given rise to a new type of consumer who is more informed about, critical of, and sensitive to the role of technology and innovation on entrepreneurship and business performance.

Given this context, it is worth noting that decision problems have been complicated by an ever-greater degree of complexity, forcing decision makers to seek out new approaches that facilitate decision-making processes [1]. In this regard, MCDM and MCDA are now well-known acronyms for multiple-criteria decision-making and multiple-criteria decision analysis, respectively, and although epistemological differences exist between these two branches of operational research (OR) (see [2]–[4]), both share a focus on decision aids, allowing for more informed and potentially better decisions. These techniques are able to build on the knowledge of expert participants in a given field and produce assessment systems based on their values and experience [1].

The application of MCDM/A methods has grown exponentially over the past few years, causing a change in the OR arena in general [1], [5]. In the light of the most recent developments in the field, this special issue aims to bring together recent developments and methodological contributions within MCDM/A and artificial intelligence (AI) in innovation, entrepreneurship, and business development.

Each submission received was desk reviewed by the guest editors, and when judged suitable for publication, it was then sent to three independent referees for double-blind peer review, ensuring the high quality of the final contributions. The twelve papers included in this special issue are diverse, wide-reaching, and reflective of MCDM/As' and AI's vast potential. It is worth noting that the papers were not selected based on their use of MCDM or MCDA, or on the mathematical techniques that support these tools' implementation, but instead by the way they contribute to the special issue topic.

Focusing on the integration of AI and frugal innovation, Govindan [A1] motivated industries to explore different options for successfully integrating AI and sustainable frugal thinking using gray DEMATEL. The results allow business competitiveness to be enhanced in a more sustainable way. Freire et al. [A2]

also used DEMATEL to develop and test a dynamic analysis system that allows smart city initiatives to address AI challenges based on their cause-and-effect relationships. La Torre et al. [A3] proposed an innovative multicriteria model based on goal programming for solving the optimal allocation of individuals to different groups. By incorporating an aggregated measure of attitude toward AI tools in a team formation model, each team can be guaranteed to have less resistance to change in adopting machine-based decisions. Jammeli et al. [A4] approached waste management from different forecasting viewpoints to prevent either waste overflow or an excess in the number of bins. For better time series modeling, the authors use relevant sequential AI models [e.g., long short-term memory (LSTM) and the bidirectional LSTM] that allow to predict the number of waste bins given the amount of waste recorded through a year. Next, using data from 294 Greek small- and medium-sized enterprises, Kitsios and Kamariotou [A5] analyzed the impact of IS strategic planning on IT executive satisfaction. The results allow managers to understand how an IS strategy supports the development of innovative technologies that incorporate opportunities to enhance business development and innovation, revealing the versatility of MCDA techniques. Using ELECTRE III, Koliouka et al. [A6] analyzed Greek companies involved with alternative tourism services in the region of Chania, and presented an evaluation of the content features of their websites that allow for competitive advantages. Carlucci et al. [A7] proposed a decision model for job-shop manufacturing scheduling that deals simultaneously with power constraint and the variable speed of machine tools. Based on the value-focused thinking approach and using fuzzy cognitive mapping, Sonje et al. [A8] provided a flexible and adaptive decision-aid framework for cognitively analyzing the premise of technology-driven innovation and for quantifying the assessment through realistic scenario planning. Wu et al. [A9] used expectation values and entropy measures to describe the meaning of linguistic evaluation information, thus allowing MCDM evaluations to be strengthened. Liern and Pérez-Gladish [A10], in turn, suggested the use of unweighted TOPSIS to develop any composite index. The authors show that their method allows for the ranking of a set of alternatives without prior establishment of criteria weights. Bryson et al. [A11] presented a scalarization-based technique to address an extended data-fitting model that involves different and conflicting criteria. Finally, based on the integration of weighted sum and weighted product approaches, Stanujkić et al. [A12] presented the WISP method for selecting the most acceptable alternative.

By highlighting MCDM/A methods and AI's potential and demonstrating these methods' role as aids to decision making in the fields of innovation, entrepreneurship, and business development, we believe this special issue will alert management practitioners, policymakers, and researchers to the theoretical developments and practical applications of these methodologies. This project's completion would not have been possible without Tugrul Daim's editorial support. We are extremely grateful for his faith in this endeavor's worth and the opportunity to bring it into fruition.

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#### APPENDIX: RELATED ARTICLES

- [A1] K. Govindan, "How artificial intelligence drives sustainable frugal innovation: A multitheoretical perspective," *IEEE Trans. Eng. Manage.*, to be published, doi: [10.1109/TEM.2021.3116187](https://doi.org/10.1109/TEM.2021.3116187).
- [A2] C. A. R. Freire, F. A. F. Ferreira, E. G. Carayannis, and J. J. M. Ferreira, "Artificial intelligence and smart cities: A DEMATEL approach to adaptation challenges and initiatives," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1881–1899, May 2023, doi: [10.1109/TEM.2021.3098665](https://doi.org/10.1109/TEM.2021.3098665).
- [A3] D. La Torre, C. Colapinto, I. Durosini, and S. Triberti, "Team formation for human-artificial intelligence collaboration in the workplace: A goal programming model to foster organizational change," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1966–1976, May 2023, doi: [10.1109/TEM.2021.3077195](https://doi.org/10.1109/TEM.2021.3077195).
- [A4] H. Jammeli, R. Ksantini, F. B. Abdelaziz, and H. Masri, "Sequential artificial intelligence models to forecast urban solid waste in the city

of Sousse, Tunisia," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1912–1922, May 2023, doi: [10.1109/TEM.2021.3081609](https://doi.org/10.1109/TEM.2021.3081609).

- [A5] F. Kitsios and M. Kamariotou, "Information systems strategy and innovation: Analyzing perceptions using multiple criteria decision analysis," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1977–1985, May 2023, doi: [10.1109/TEM.2021.3103318](https://doi.org/10.1109/TEM.2021.3103318).
- [A6] C. Koliousska, Z. Andreopoulou, M. Doumpos, E. Galariotis, and C. Zopounidis, "Multicriteria evaluation of the websites of alternative tourism enterprises: Case study in the region of Crete," *IEEE Trans. Eng. Manage.*, to be published, doi: [10.1109/TEM.2021.3076059](https://doi.org/10.1109/TEM.2021.3076059).
- [A7] D. Carlucci, P. Renna, and S. Materi, "A job-shop scheduling decision-making model for sustainable production planning with power constraint," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1923–1932, May 2023, doi: [10.1109/TEM.2021.3103108](https://doi.org/10.1109/TEM.2021.3103108).
- [A8] S. A. Sonje, R. S. Pawar, and S. Shukla, "Assessing blockchain-based innovation for the "right to education" using MCDA approach of value-focused thinking and fuzzy cognitive maps," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1945–1965, May 2023, doi: [10.1109/TEM.2021.3128192](https://doi.org/10.1109/TEM.2021.3128192).
- [A9] X. Wu, H. Liao, B. Lev, and E. K. Zavadskas, "A multiple criteria decision-making method with heterogeneous linguistic expressions," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1857–1870, May 2023, doi: [10.1109/TEM.2021.3072590](https://doi.org/10.1109/TEM.2021.3072590).
- [A10] V. Liern and B. Pérez-Gladish, "Building composite indicators with unweighted-TOPSIS," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1871–1880, May 2023, doi: [10.1109/TEM.2021.3090155](https://doi.org/10.1109/TEM.2021.3090155).
- [A11] B. Bryson, H. Kunze, D. La Torre, and D. Luzzi, "A generalized multiple criteria data-fitting model with sparsity and entropy with application to growth forecasting," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1900–1911, May 2023, doi: [10.1109/TEM.2021.3078831](https://doi.org/10.1109/TEM.2021.3078831).
- [A12] D. Stanujkić, G. Popović, D. Karabasević, I. Meidutė-Kavaliauskienė, and A. Ulutaš, "An integrated simple weighted sum product method—WISP," *IEEE Trans. Eng. Manage.*, vol. 70, no. 5, pp. 1933–1944, May 2023, doi: [10.1109/TEM.2021.3075783](https://doi.org/10.1109/TEM.2021.3075783).

#### REFERENCES

- [1] F. Ferreira, G. Pérez-Bustamante, and J. Ferreira, "MCDM/A in practice: Methodological developments and real-world applications," *Manage. Decis.*, vol. 57, no. 2, pp. 295–299, 2019.
- [2] B. Roy, *Méthodologie Multicritère d'Aide à La Décision*. Paris, France: Economica, 1985.
- [3] B. Roy and D. Vanderpooten, "An overview on 'The European school of MCDA: Emergence, basic features and current works'," *Eur. J. Oper. Res.*, vol. 99, no. 1, pp. 26–27, 1997.
- [4] E. Carayannis, J. Ferreira, M. Jalali, and F. Ferreira, "MCDA in knowledge-based economies: Methodological developments and real-world applications," *Technological Forecasting Social Change*, vol. 131, pp. 1–3, 2018.
- [5] E. Zavadskas, Z. Turskis, and S. Kildienė, "State of art surveys of overviews on MCDM/MADM methods," *Technological Econ. Develop. Economy*, vol. 20, no. 1, pp. 165–179, 2014.



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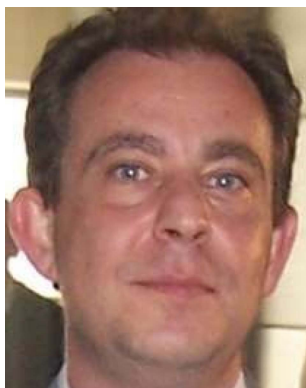
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