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MCDM Review in marketing and managerial decisions: Practical implications and Future research

Theodore Tarnanidis[a*], Jason Papathanasiou[a], Bertrand Mareschal[b] and Maro Vlachopoulou[a]

[a]*University of Macedonia, Greece*
[b]*SBS-EM, Université Libre de Bruxelles, Brussels, Belgium*

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ABSTRACT

This research presents a short review of Multiple Criteria Decision-Making (MCDM) methods and research in various fields, including marketing and business management. The academic literature shows that MCDM methods in the area of marketing are used by academics to solve problems related to the positioning of products and services, market segmentation, brand management, promotion and advertising strategies, product development and market entry strategies, customer relationship marketing and channel distribution. With regard to business and management domains they are used to prioritize various decision-making aspects, like project assessments, resource allocation, strategic planning, risk management, performance evaluation, supplier and vendor selection, human resource management and strategic investment decisions. We can claim that in both domains, MCDM brings a systematic and transparent approach to decision-making, helping marketing managers to make more informed and objective choices. In summary, the continual refinement of these methods and the integration of cutting-edge technologies hold promise for further enhancing the effectiveness and efficiency of decision-making processes in the dynamic landscape of business and management. Further, the analysis highlights emerging trends and challenges for the future of MCDM research.

1. Introduction

Multiple Criteria Decision-Making (MCDM) methods, which are widely used by scientists in various fields such as business, engineering, environmental science, public policy, and healthcare to support decision-making processes where there are conflicting objectives or multiple stakeholders with different preferences. Multicriteria Analysis provides a structured and systematic approach to decision-making, enabling decision-makers to consider multiple dimensions and preferences in a transparent manner. It is a valuable technique for handling complex decision problems with multiple, often conflicting, criteria. The multicriteria analysis techniques are applied by decision-makers when they have to make more realistic and practical decisions that include several and contradictory criteria of different units. The decisive task includes the identification of relevant criteria, the estimations of the relative importance of the alternative options and the assessment of their weights. For the use of MCDM methods in marketing and management problems, it's essential to carefully characterize the decision dilemma, by identifying the relevant criteria, involve stakeholders as participators, and consider the context-specific distinctiveness of the industry and market examined. MCDM methods have been extensively used and applied in diverse axioms such as mainly in operational research, engineering, environmental management, and finance. However, their adoption in marketing and management problems is relatively limited insofar. We can argue that the choice of the method depends on the nature of the decision problem and the preferences of decision-makers. Therefore, in this study we aim to build an overview or a mapping of the most widely used MCDM methods in the academic literature in general with relevance to marketing and

* Corresponding author.

E-mail address: tarnanidis@uom.edu.gr (T. Tarnanidis)

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management fields. In order to achieve that goal we will try to offer a comprehensive overview of different MCDM approaches and to provide relevant implications to the specified policy makers of each MCDM technique and by proposing future research directions.

2. Methodology

Through a scoping literature review based on the existing research of the most widely used MCDM methods in the academic literature in general with relevance to marketing and management fields. Unlike, other several forms of literature reviews (like the systematic reviews) scoping reviews are exploratory by nature and contain a critical appraisal, as they often examine a topic methodically by identifying essential concepts, and existing sources of relevant data (Mak and Thoma, 2022; Munn et al., 2018; Levac et al., 2010). Scoping examinations aid in identifying gaps in the current literature and indicating areas that need further research or skepticism (Arksey & O'Malley, 2005). Secondary data from journals, books, professional and industry websites, and reports were used in this study. This research seeks to answer the fundamental question of how MCDM methods are utilized in relevant marketing and management decision-making problems by offering additional implications and future research perspectives.

2.1 MCDM prescription and methods

The key steps of a decision-problem with multicriteria analysis include the following parameters:

- Decision-makers define the high-level goals or outcomes they want to achieve by setting the objectives of the relevant problem. The criteria are the specific factors or attributes that are used to evaluate and compare different alternatives. They represent the dimensions along which alternatives will be assessed.
- Alternatives are the different options or solutions that are being considered in the decision-making process. These can be projects, policies, products, or any other potential courses of action.
- Decision Matrix is a tabular representation of the alternatives and criteria, indicating the performance of each alternative against each criterion. Each cell in the matrix represents the evaluation of an alternative against a specific criterion.
- Assigning weights to criteria reflects their relative importance in achieving the objectives. Weighting helps to prioritize criteria based on their significance to the decision-makers.
- Scoring involves assessing and assigning numerical values to the performance of each alternative against each criterion. Ranking is the process of ordering alternatives based on their overall scores.
- Various aggregation methods are used to combine individual criterion scores into an overall score for each alternative. Common methods include weighted sum, weighted product, and outranking methods.
- Sensitivity analysis helps assess the robustness of the results by examining how changes in criteria, weights or scores affect the overall rankings and decisions.
- Visual tools, such as radar charts, spider diagrams, and bubble charts, can be used to present the results in a more understandable and accessible format.
- MCA involves multiple stakeholders in the decision-making process, where they provide their experiences and help for complex decision problems..

Popular MCDM methods used in the academic literature are: the Analytic Hierarchy Process (Saaty, 1977). It was created to solve difficult decisions with diverse variables, criteria, and alternatives with varying preferences. The Elimination and Choice Expressing Reality (ELECTRE) have the same characteristics and can prioritize the ranking of alternatives based on their performance. The MOORA (Multi-Objective Optimization by Ratio Analysis) is best suited for decision problems that have maximized or minimized criteria. The Technique for Order of Preference (TOPSIS) provides the ideal solution of the best alternative options, and is generally applied in fields such as business, engineering, and environmental management. The Complex Proportional Assessment (COPRAS) method is planned to deal with uncertainties and dependencies among the criteria. The Additive Ratio Assessment (ARAS) was developed as an extension of the AHP for problems where the criteria have different units or measurement scales. The Fuzzy Analytic Hierarchy Process (FAHP) incorporates blurry logic to handle uncertainty and vagueness in decision-making processes. The PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations), developed by Brans and Mareschal in the 1980s, and is designed to handle decision problems where alternatives are evaluated based on multiple criteria. It provides an approach to ranking and selecting alternatives according to their overall performance.

2.2 Smart review on multi-criteria decision-making

From an initial screening of the literature of the last two decades from some of the best search engine for an effective literature research, like the Web of science, Scopus and Google Scholar, we found that MCDM methods have been used in many diverse contexts, like: waste water treatment for resources protection (Garcia -Garcia, 2022; Coban et al., 2018; Hadipour et al., 2015;

Qin et al., 2017); Chandrakar and Limje, 2018), production and IT industries for the selection of materials and other organizational fields (Sandström, 1985; Brown & Wright,1998; Ghaleb et al., 2020; Zhu et al., 2021), Economics and logistics (Zavadskas & Turski, 2011; Yıldız & Aybar, 2019; Zopounidis et al., 2015; Yuksel et al., 2018; Kowalski et al., 2009), health sector (Frazão et al., 2018; Adunlin et al., 2015; Kahraman et al., 2020; Afshari & Khorsand, 2020) education (Malik et al., 2021; Ayyildiz et al., 2022; Bhattacharyya & Chakraborty, 2014; Alias, et al., 2008), environmental science (Zavadskas et.al., 2014; Geldermann, et al., 2000; Vaillancourt & Waaub, 2004; Huang et al., 2011; Bhanutej & Rao, 2023). We can argue that till today, several research projects were made for measuring the impact of multi-criteria decision-making methods in diverse fields by achieving a mapping of the number of articles and the most cited MCDM methods. For example, the disciplines with the highest average number of citations per publication were in engineering, energy, environmental and computing science, Similarly, low numbers have in mathematics, materials science, agricultural and business management and accounting (Taherdoost & Madanchian, 2023; Štilić & Puška, 2023; Ayan et al, 2023). For this, the prevalence of using different MCDM methods and criticism is also shown in Table 1.

Table 1
MCDM methods

Acronym	Methods/Authors/Articles	Description/field	Implications Decision Maker (DM))
AHP	**Analytic Hierarchy Process** Saaty (1977; 1980; 2005, 2008)	Measurement of intangible criteria, pairwise comparison of known items	Use cumulative information between/within criteria and comparability
ELECTRE	**Elimination Et hoix Traduisant la REalité** Roy (1981); Emamat et al. (2022)	Modeling imperfect data and problematic choice/rank	Use random values due to confused data Absolute choices with threshold preferences
MOORA	Multi-Objective Optimization on the basis of Ratio Analysis Brauers and Zavadskas (2006), 2009)	Calculates optimal solution values of more than one desired goal	Information and alternative criteria examine on utility Fundamental stability
TOPSIS	**Technique for Order of Preference by Similarity to Ideal Solution** Hwang et al. (1993); Hwang and Yoon (1981); Yoon and Kim (2017)	Compensatory aggregation of a set of alternatives, and calculating the geometric distance between each alternative and the best score in each	Assess criteria in the category of information Lacks standardized guiding principle for the choice of weight estimations and preference
COPRAS	**Complex PRoportional ASsessment** Zavadskas et al. (2008); Santawy (2015)	Evaluating uncertain environment with fuzzy sets	Use blurry data and the process loses information in evaluating the criteria
ARAS	**Additive Ratio ASsessment** Zavadskas and Turkis (2010); Šaparauskas et al. (2011)	The ranking of the evaluations and priorities of alternatives is determined according to the utility function value	Use both qualitative and quantitative information and data The method captures the interactions of alternative criteria set by the DM
FAHP	**Fuzzy Analytic Hierarchy Process** Mitra et al. (2019); Ayhan (2013); Lee (2010); Kayaa (2022); Goyal et al. (2022), Buckley (1985)	Classifies evaluation factors into levels and determines fuzzy priorities of Comparability ratios	Capture the information between and within the criteria. Difficulties with weight estimates due to complexity and fazziness and data analysis
PROMETHEE	**Preference Ranking for Organization Method for Enrichment Evaluation** Brans (1982); Mareschal et al. (1984); Brans and Vincke, 1985); Brans and Mareschal (2005); Brans and De Smet (2016); Kuncova and Seknickova (2022)	Evaluating alternatives with respect to criteria in multi-criteria decision-making problems	Use information between the criteria, the preference functions and parameters. Difficulties with many criteria and reverse information. Complicated explanations with preference information

We can argue that more complicated techniques and methods are more appropriate for competitive hard sectors, e.g. problems with production, location, supply chains, high tech and electricity (Mareschal and Tsaples, 2021; Stoycheva et al., 2018; Fattoruso, 2022; Jacobides et al., 2015; (Ishizaka and Siraj, 2018; Majumder et al., 2019; Cavallo et al., 2019). Some studies were targeted to operational and managerial concerns, such quality evaluations with lean processes Mumani et al., 2022; Yahya et al., 2016; Zeynali et al., 2012). As far as the method of the Analytic Hierarchy Process (AHP) is concerned, we can argue it is more appropriate for the assessment of resources and the performance strategy preparation. While the method of ELECTRE, helps in the assessment of complex environmental management variables and problems (i.e. transportation, energy, water). The MOORA has been fruitfully used to multi-attribute problems in engineering and agriculture. The TOPSIS procedure helps in problems related to operations, manufacturing, supply chain management, and other soft managerial examinations. Whilst the technique of fuzzy set theory is appropriate in the field of construction-engineering, medical and economics. As a final point, the PROMETHEE method examines the evaluation of different parameters and criteria set by the decision maker, and thus can be applied more easily to marketing and management problems. What is more, related to marketing problems, MCDM methods are applied for the selection of different products, where multiple criteria exist, and decision-makers have to manage conflicting goals, by analyzing the relevant criteria to the case examined (Baczkiewicz, 2022).

Though multiriteria decision-making (MCDM) methods have proven to be valuable in various decision contexts, they are not without criticism. For example, many methods require input from the users and the outcomes are sensitive by subjective judgments and preferences. Critics argue that the subjectivity involved in assigning weights, making pairwise comparisons, or defined utility functions can introduce bias into the decision process. In addition, the results obtained from MCDM methods can be highly sensitive to the weights assigned to criteria. We can say that different weighting schemes may lead to different rankings and decisions, raising questions about the robustness and reliability of the outcomes. On the other hand, some MCDM methods analyze the criteria independent of each other. However, in pragmatic problems, criteria are often interrelated. Ignoring interdependencies can lead to oversimplified models and false decisions. In methods like Analytic Hierarchy Process (AHP), consistency, the pairwise comparisons between the variables offers high reliability of the results.

MCDM methods cannot handle qualitative and imprecise data, preferences, i.e. when preferences change over time. Some methods may involve mathematical computations for the measurement of a large number of criteria that include information with uncertainty and fuzzy logic. Moreover, ongoing developments in the field aim to address some of these concerns and enhance the effectiveness of MCDM methods in practical decision-making scenarios. Hence, we can draw the conclusion the MCDM process is generally identical to all the aforementioned methods, but there are differences in the elicitation of the information analyzed (Belton and Stewart 2002; Papathanasiou and Ploskas, 2018).

2.3 MCDM methods for marketing and management decision-making tasks

Multi-Criteria Decision Making (MCDM) methods are valuable tools in addressing complex decision-making problems in various domains, including marketing and management. These methods help decision-makers consider multiple criteria and alternatives simultaneously, providing a structured approach to making informed decisions. Table 2 summarizes some commonly used MCDM methods and their application in the domain of marketing and management by providing their application on specific problems.

Table 2
MCDM methods in marketing and management

Acronym	Marketing implications	Management implications	Authors/articles
AHP	Prioritize marketing strategies, Helps market research and product features,	Prioritize goals, projects, resource allocation	Dhurkari (2023); Lin and Wu (2008) Al-Dawalibi et al. (2020); Wind and Saaty (1980); Nguyen et al. (2023)
ANP	Prioritize marketing strategies, market segments, analyzes the relationships, helps to model	Ranging goals, projects, or resource allocation,	Maity et al. (2023); Purwani (2023); Saaty (2009); Sadeghian and Sadeghian (2016)
TOPSIS	Selection of the best product or service from different alternatives	Selection of supplier, project prioritization, or performance evaluation.	Hang et al. (2023); Baldi and Cavallaro, (2022); Pawar, and Verma (2013); Arroyo -Cañada and Gil-Lafuente (2019); Dash et al. (2019); Devi and Wardhana (2018)
ELECTRE	Market segmentation, product positioning, and brand evaluation	Project selection, risk assessment, and performance evaluation	Zhou et al. (2015); Lévay et al. (2017); Sierzchula et al. (2014); Li et al. (2017)
PROMETHEE	Product or brand ranking and feature selection	Project prioritization, resource allocation, and supplier selection.	Tarnanidis et al. (2023); Brans, and Mareschal (1992); Le Téno and Mareschal (1998); Sheykhan et al. (2014); Samantraj et al. (2020); Lenz and Ablovatsk (2006); Deng et al. (2022); Ulutaş (2017); Sheykhan et al. (2014); Baourakis et al. (2002); Mareschal and Mertens (1992); Youssef and Webster (2022)
Decision Matrix	Marketing strategy evaluation, product development decisions	Project selection in management.	Stole and Ljungdahl (1974); Madden et al. (2021); Ustinovičius and Jakučionis (2000); Komari et al. (2020)
GRA	Customer segmentation, market trend analysis, and competitive positioning	Analyze the performance of different departments or projects	Oblena and Anapi (2023); Yao et al. (2023); Hessel et al. (2023); Hsu and Tseng (2016); Wei (2010); Yu et al. (2012)
Fuzzy Decision-Making	Handling uncertainty in consumer preferences, market trends, and product positioning	Decision-making in ambiguous or uncertain situations	Abu Hasan et al. (2023); Montes et al. (2015); Dovlatova (2022); Imanova (2022)
DEA	Benchmarking and performance evaluation of products or service	Assessing the efficiency of different departments or business units	Izadikhah ang Mirzaei (2019); Akdeniz et al. (2010); Karagiannis and Karagiannis (2023)

It can be observed that MCDM in the area of marketing have been used in researches related to the positioning of products and services, market segmentation, brand management, promotion and advertising strategies, product development and market entry strategies, customer relationship marketing and channel distribution. Whereas, in the area of management mostly are used to prioritize various decision-making aspects, like project assessments, resource allocation, strategic planning, risk management, performance evaluation, supplier and vendor selection, human resource management and strategic investment decisions. We can conclude that in both domains of marketing and management, MCDM brings a systematic and transparent approach to decision-making, helping organizations make more informed and objective choices in the face of complex and

multifaceted scenarios. The choice of specific MCDM methods depends on the nature of the decision problem and the preferences of decision-makers.

From the above analysis is can be seen that MCDM methods are more appropriate in marketing and managerial contexts, particularly when the decision-making problem is formulated with measurable criteria and consistent data that is not subjective, Additionally, some problems exist from the measurement of the weighs of qualitative factors, the lack of available historical and computational data (especially for new products and other organizational core processes and strategies). While MCDM methods have been widely applied in various fields such as operations research, engineering, environmental management, and finance, their adoption in marketing and management problems may be relatively limited. Though, successful implementations usually require a thorough examination of the specific context and the related challenges.

Concluding remarks and future directions

This study provides an overview of the main categories of MCDM techniques used in various domains, with relevance to marketing and management problems. In addition, a description of the characteristics of them has been revealed that all different types of MCDM depend upon specific and different merits based on the context of the problem examined. Furthermore, when decision-makers applying MCDM methods, it's essential to carefully define the decision problem, criteria, and alternatives. Additionally, obtaining reliable and accurate data for the criteria is crucial for the success of these methods. The choice of the most appropriate method depends on the specific characteristics of the decision problem and the preferences of decision-makers. Finally, future trends and directions in the field of Multicriteria decision-making (MCDM) methods should base on general patterns and ongoing technological developments, like the integration with machine learning as this will provide for more intelligent decision-making systems that can learn from data, adapt to changing conditions, and provide more accurate and dynamic decision support. For example marketers can identify effectively consumer preferences, forecast the supply/demand of their offerings, provide dynamic pricing strategies based on real data from the market, and enhance the mechanisms of customer relationship management (CRM), so to make informed choices that align with business objectives and better meet customer needs

What is more, the development of Hybrid models can leverage the strengths of various techniques, providing more robust and flexible decision support systems. As the volume of data continues to grow, MCDM methods are expected to evolve to handle big data analytics. Techniques for efficient processing, analysis, and extraction of valuable insights from large datasets will become increasingly important for visualization and Interpretability. Improved visualization techniques and methods for interpreting complex decision models are likely to be a focus. Decision-makers often prefer systems that provide clear visualizations and explanations of the decision processes. Future scholars should seek to make significant conceptual contributions, offering a strategic platform for new directions in the respective fields with a focus on theoretical underpinnings and accessible to a broad range of MCDM methods with the combination of existing multivariate analysis methodologies for complex relationships among a set of different quantitative and qualitative variables (i.e. dependence and interdependence, comparative analysis, discriminant analysis and/or factor analysis). This will improve the accuracy and robustness of the weights and scores assigned to the understanding of the evaluation problem. Empowering decision-makers and research traditions with tools and new statistical software packages that suit their specific needs and expertise resulting from the accuracy data entry on the decision-making scheme will be a focus on the social sciences.

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