Guest editorial

This special issue idea came to life with Prof. Ilker Topcu hosting the 25th International Conference on Multiple Criteria Decision Making in Istanbul from 16 to 21 June 2019 (https://mcdm2019.org/about/). International Society on Multiple Criteria Decision Making (MCDM) brings together academicians, professionals, researchers, students and policymakers at a bi-annual conference since 1975. MCDM 2019, one of those conferences, gathered 261 participants from five continents and 39 countries. The modern world is experiencing a shift from a production-focussed age to the information-focussed age. As the organisers of the conference believe that the information age will be followed by a decision age where MCDM will play a crucial role in using information and communication technology for making better decisions, they announced the theme of the conference as "MCDM beyond the information age". They also prepared the call for this special issue, inviting researchers across the world to submit their work supporting decision-making with multiple criteria methods.

MCDM models incorporate concerns about multiple conflicting criteria into the management planning processes covering a wide variety of topics. With a vast domain of applications, multiple criteria decision models are increasingly used for supply chain decision-making. This special issue covers decision-making studies on quality in manufacturing, sustainability in supply chains, location selection and employee selection.

We open the special issue with two papers on risk management. Unver *et al.* (2020) present a decision support system for proactive failure prevention in an automotive company. Automotive products have become increasingly complex, and the decision support system estimates risk scores for workstations using multiple attributes. Based on the analytic network process (AHP), the decision model brings together design-driven factors, process-driven factors and human-focussed factors to produce a risk index for each workstation. We expect this application to inform other similar applications of risk prevention in complex manufacturing environments.

Fattahi *et al.* (2020) highlight the importance of risk management in various industries and focus on assessing the risk of different failure modes as well as several risk factors, such as occurrence, severity and detection. Their fuzzy-based FMEA model is tested in a case study, Kerman Steel Industries Factory, and a sensitivity analysis is further conducted to validate their results.

Majd and Hobson (2020) develop an integrated decision model which evaluates provider agents with respect to reliability, unreliability, and uncertainty and proposes the most trustworthy provider agent in e-commerce multi-agent environments utilising TOPSIS method. The model is believed to enhance the fulfilment of purchasing between provider and requester agents.

Shifting the focus to sustainability, Calik (2020) introduces a hybrid approach for supplier selection, incorporating sustainability criteria into the process. This three-stage hybrid approach starts with identifying main and sub-criteria, constructing a hierarchical structure and prioritising the criteria using the fuzzy AHP in the second stage. Finally, the third stage comprises assigning orders to suppliers depending on suppliers' capabilities.

On a similar topic, Deniz (2020) focus on cognitive biases in the sustainable supplier selection problem and propose filters to reduce bias in MCDM. She uses an integrated approach combining AHP and TOPSIS and compares biased and debiased rankings for suppliers.

Yazdani *et al.* (2020) propose an integrated decision-making tool consisting of DEMATEL, best-worst method (BWM), a modified evaluation based on distance from average solution for

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a supplier selection problem in a hospital in Spain. The study is novel in the MCDM field in terms of the proposed integration.

Continuing with MCDM methods in healthcare, Yazdi *et al.* (2020) analyse reverse logistics operations of seven medical device companies in the healthcare industry. The authors prioritised these companies by using a three-phase decision-making framework containing the Delphi method, the BWM and the Additive Ratio Assessment method with Z-numbers.

Sustainable supply chain management is a well-researched area, with growing application domains. Kumar and Ramesh (2020) focus on the freight transport sector sustainability. For this purpose, they identify internal and external social sustainability practices, stakeholder participation in sustainability activities and macro-social performance. Using the fuzzy BWM, the authors conclude that freight transport organisations should prioritise internal social sustainability indicators to improve their overall social sustainability performance.

In supply chains, the consumption of natural resources is significant, and there exists a considerable variation in demand over time. To support sustainable resource management, Ewbank *et al.* (2020) propose a methodology to increase pallet demand forecast accuracy and reduce forest-harvesting waste in a pallet supply chain. They develop a zero-inflated fuzzy time series model to forecast this particular time series with an excess count of zeros.

Following on, Nazam *et al.* (2020) draw our attention to knowledge management adoption within sustainable supply chains in the food sector. Using fuzzy AHP, the authors identify and prioritise managerial, governmental, organisational, technological, socio-economic and soft-skills-related barriers to adopting knowledge management practices within a sustainable food supply chain.

In the Indian context, Sharma and Sehrawat (2020) aim at determining the drivers and barriers affecting the adoption of cloud computing in the manufacturing industry where Industry 4.0 implementations are of great importance to exemplify the adoption level. To this end, the authors initially employ the SWOT technique for investigating these factors from different aspects and then use the fuzzy AHP method to prioritise the most critical factors while DEMATEL is applied to find cause-and-effect relationships amongst these factors.

Singh *et al.* (2020) present a three-phase framework for manufacturers to identify the reasons for consumer dissatisfaction and inform subsequent corrective actions. Having demonstrated the application of the framework on a large data set of 36K reviews from carwale.com, the authors provide a root-cause analysis of weak performance as perceived by the users of the products.

In the humanitarian logistics domain, Yilmaz and Kabak (2020) incorporate AHP and TOPSIS, under interval type-2 fuzzy sets, to deal with the uncertainty of expert judgements in the evaluation of alternative disaster response distribution centres. After applying the techniques in the Turkish logistics context, their findings reveal that transportation cost, infrastructure and security are the prominent location selection criteria.

The next paper addresses the well-recognised hub location problem with a novel methodology based on weighted aggregated sum product assessment (WASPAS) and multi-objective optimisation by ratio analysis (MULTIMOORA). Both techniques are gaining popularity in various applications, and Aydin and Seker (2020) present their application for the hub airport selection problem of a low-cost carrier.

Next, Sohrabi *et al.* (2020) propose deterministic and robust scenario-based mathematical models based on three different paradigms to determine the pricing and design of mobile Internet plans in a multi-attribute environment. Their decision criteria include maximising expected revenue, minimising the negative deviation from expected revenue and minimising the maximum regret. They conclude that the revenue of network operators can be affected by consumer preferences for brand attribute and purchase frequency of consumers.

The special issue ends with the paper by Dwivedi *et al.* (2020) on selecting employees from a talent pool, presenting the readers with a vast range of applications of MCDM methods.

Dwivedi *et al.* (2020) identify different criteria for different job roles (e.g. transport manager, sales executive, warehouse executive) and demonstrated the application of AHP on forming a team for a new business entering the cold chain market.

As can be seen from these accepted papers, there is growing attention in addressing daily life challenges that humankind faces through the use of MCDM models. Due to the dynamic nature of the external environment, there is always a need for continually updating these models by incorporating soft and hard measures. Especially as a consequence of the non-ignorable impact of Industry 4.0 applications and technologies on both for-profit and not-for-profit organisations, we observe a rapid transition towards implementing digital decision models. In such changes, other external factors, such as the coronavirus disease 2019 (COVID-19) outbreak, also play a vital role for all parties. In line with these, it is worthy of noting that the future of MCDM models and techniques will be dealing with these issues to address the needs at all levels.

We hope you will enjoy this special issue on MCDM applications and apply the methods to support your decision problems.

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