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A Recollection on Bernard ROY

L. Valadares Tavares

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I have decided to graduate in Engineering because I was passioned by the ability of solving problems using mathematical models and so when I met Operational Research (OR) in the University of Lancaster, UK, where I got my Master degree (1970), I understood that we could also modelling real decision problems of organizations using mathematical and stochastic models : even more fascinating!

I have pursued my academic career at the University of Lisbon and after becoming full professor of Systems and Management (1980), I started to become disappointed with OR because most of the research seemed to be more oriented to improve mathematical algorithms rather than solving problems.

Searching for a more problem oriented approach I have read some texts of Bernard ROY who I met for the first time at his home in Paris, on 1984, and I then I understood that he was a very exceptional example of the genuine OR approach initiated by well-known authors such as Ackoff, Keeney or Kaufmann.

Bernard ROY was committed to understand decision problems considering the multidimensionality of the single or collective decision makers, their values, culture and doubts explaining why his models have a mathematical description which is " open" to the introduction of multiple elements and avoiding automatic implications such as the transitivity axiom with the purpose of building a better representation of the decisional subject, object and process.

Since 1984 we had multiple meetings in Paris, in my cottage of Nafarros (near Lisbon) and elsewhere which were always an opportunity of learning how his humanistic culture could be so important to support decisional problems pursuing the original paradigm of Operational Research and refocusing the scientific work on the critical questions : Who, when, why, how?

Of course, B ROY is rightly remembered for his essential contributions to Decision Theory, for his model ELECTRE, for the organization of the European Group on Decision Aid and for many vivid debates on decision issues but I believe that he should be also considered as a "restart" of Operational Research rediscovering its original paradigm well described by the "Blacket Circus" and avoiding so many examples of OR "lost in technicalities ".

This is why with his death, OR lost one of its major scientists, the European community on decision aid lost its main source of inspiration and I have lost a friend.

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Opinion Makers Section

Big Data Analytics Using Multiple Criteria Decision Aiding Models

Juan C. Leyva López

Department of Economic and Management Sciences, Universidad Autónoma de Occidente (México)

Introduction

Over the last few years, public and private organizations and business entities around the world have had to work with different amounts of data from different sources. Analyzing these data has become increasingly complex because robust tools and high processing power have been required. Thus, a vast quantity of intellectual resources (data, information, and/or knowledge) has been accumulated and stored in numerical, textual, graphical, audio, and video forms. In general, such intellectual resources are called big data. Nowadays, big data can be found in sectors such as services, agriculture. health. government, climate, tourism, ecosystems, marketing, manufacturing, energy, marine, public safety, finance, consumers and scientific research. The fact is that big data acts as a source of relevant information for decision making while making both formal and informal decisions in all sectors mentioned above and beyond.

Big data is an evolving term that describes a large volume of structured, semi-structured and unstructured data that has the potential to be mined for information and used in machine learning projects and other advanced analytics applications. Big data is often characterized by the 3Vs: the extreme *volume* of data, the wide *variety* of data types and the *velocity* at which the data must be processed, all of which combine to make big data very difficult to manage.

On the other side, Big Data Analytics is a set of analytical techniques that are applied to big data that is collected, stored and interpreted by very high-performance software (Elgendy and Elragal, 2016). The analyses of massive volume of data can be performed by many tools, such as Hadoop, MapReduce and OpenRefine (Turet and Costa, 2018).

In this respect, Multiple Criteria Decision Aiding (MCDA) may have a lot to contribute. MCDA methods represent useful tools for structuring and evaluating complex decision situations, and can allow for more informed, potentially better decisions. MCDA techniques can build on the knowledge of decision makers, and produce assessment systems based on value judgements and experience. MCDA methods become increasingly popular in decision-making due to their capability to deal with ill-structured problems involving multiple and conflicting criteria, different stakeholders with different views and preferences, several sources of uncertainty and distinct time frames.

Among the many interesting trends developing in MCDA, the one focused on exploring the connections of MCDA with other fields, is particularly exciting for providing integrated decision support in the complex context described above. Among these, artificial intelligence (AI) has generated much attention. Nowadays, AI is a wide domain within which one can identify several notable research areas, including among others, machine learning, data mining, soft computing, evolutionary computation, knowledge engineering and management, expert systems, symbolic reasoning, etc. The methods and techniques developed in these research areas have much to offer and vice versa towards meeting the new requirement for decision support described above. This potential has been recognized by researchers working in MCDA and AI, and has conducted to a growing trend involved with a fusion of ideas developed (often) independently in the two fields. Among others, the results of this unification trend can be identified in the development of new decision modeling forms and paradigms, advanced solution techniques for complex decision problems, new approaches for preference elicitation and learning, as well as implementations in integrated intelligent systems.

Within this same line of action, although MCDA and the development of Big Data tools represent apparently two distinct areas of research, they can both benefit from their combined use, and for this reason handling their integration currently represents a research frontier. The conventional MCDA approach assumes the use of small amounts of data and attributes. *Small data* is data in a volume and format that makes it accessible, informative and actionable. Small data typically provides information that answers a specific question or addresses a specific problem. The term *small data* contrasts with *big data*, which usually refers to a combination of structured, semi-structured and unstructured data that may be measured in petabytes or exabytes.

A growing number of researchers are merging theories and methodologies from different disciplines to extract new meaning from data and to solve complex decision problems using new methods. The emerging area of research on integrating Big Data analytics and MCDA is an example of how linking concepts and methods from two distinct fields can yield new ways of tackling decision problems (Hsueh and Cheng, 2017). At the fundamental level, Big Data -MCDA Analytics can be thought of as a collection of advanced analytic methods and tools for transforming and combining very large and diverse data set and preferences (value judgments) to obtain information for decision making.

Opportunities

The opportunities for advancing research on integrating Big Data and MCDA come from the synergy between the two distinctive sets of decision support tools. The capabilities of handling and processing data distinguished Big Data from other fields. They also make Big Data a valuable technology in a wide variety of applications, because a wide range of the public and private sector organizations use large data to support their activities. Big Data can help in coordinating situation analysis through its ability to integrate data from diverse sources. It can enhance the MCDA capabilities for exploring decision situation and supporting the process of a constructive learning with subjective judgements, for example,

- Cases of large amounts of data and high numbers of criteria for evaluation of socio-economic objects are rather frequent (Podviezko, 2015). Evaluation can include thousands of entries of data and dozens of different criteria. The processing of these large amounts of data can be performed with statistical methods and MCDA methods, however, statistical methods impose strong limitations on data. In contrast, multiple criteria evaluation methods can deal with ill-defined problems and with multi-dimensional data. Results yielded by statistical methods can be comprised by specialists, while results yielded by the MCDA methods are specifically designed for decision makers. In addition, the MCDA methods provide results in the form of selection, sorting or ranking of alternatives by their preference to decision makers of various backgrounds.
- In the same line of structured data, considerable attention has been paid to preference queries in large database context. Preference queries aim at increasing personalized pertinence of a selection. Those queries aim to improve the relevance of information retrieval that may be different from one user to another. They consider user's preferences and the most well-known ones are the skylines queries based on the concept of dominance introduced by Pareto. The skyline operation is a typical MCDA process. The basic assumption of conventional skyline operator is preference-ordered values within multi-dimensional decision tables. This assumption utilizes preference-ordered values to simplify the complex human preference, which is subject to big challenges in real applications. In the literature, other dominances have been proposed. Other weaker forms of dominance aim at reducing the size of the answer of the skyline query because in the context of high dimensional databases, skyline queries alone do not provide an efficient decision support. Diverse approaches have been recommended to overcome that restriction. The key idea is based in introducing more comparability by defining other, weak dominance relations (Catania and Jain, 2014). In this connection, MCDA has a lot to provide. The relevance of the different dominance relations depends on the context and/or the user.
- Preference disaggregation approaches have been widely used for constructing multicriteria sorting and ranking models from data. Despite the huge progress achieved in this active field of MCDA, there are still many challenges and opportunities for further research. While important research has been made on developing robust decision making approaches, measuring robustness through analytical measures that can be applied to complex and large-scale instances, remains a challenge. Furthermore, the advances in big data analytics and the development of new application areas where big data are

highly relevant, raise challenges for scaling up existing MCDA sorting and ranking approaches to large data sets (Doumpos and Zopounidis, 2011, 2018), (Leyva et al., 2016).

• Multicriteria recommender systems represent an exciting and constantly changing research topic. Multicriteria recommender systems integrates MCDA techniques to consider a set of criteria that provide information on different aspects of the items to be recommended. These systems have not yet been studied extensively, and more research is necessary. Recommender systems have mainly integrated utility-based techniques. Although the outranking model has had a great impact in the MCDA field and has many applications, it has not been sufficiently introduced in recommender systems (Del Vasto, et al., 2016), (Lakiotaki et al., 2011).

Challenges

The hybridization of Big Data and MCDA brings about as a series of theoretical, methodological and operational contradictions and inconsistencies. For example, the problem of semantic heterogeneity caused by different meanings of data, terminologies, and models used in Big Data and MCDA is one of the key challenges in advancing research on integrating Big Data and MCDA. To this end, transparency issues are particularly troublesome to the Big Data-based decision making. For example, decision maker participants and Big Data experts often mix-up fundamental concepts of MCDA such as the notion of value structure, goal, criterion, objective, and attribute without recognizing similarities and differences. It has been only recently that some considerations have been given to how the problem of semantic heterogeneity inherent in Big Data - MCDA affects the quality of the decision-making process. Research into Big Data - MCDA has so far tended to concentrate on the technical questions of how to integrate Big Data and MCDA. Our understanding of the benefits of such integration is limited by the lack of research on conceptual and operational validation of the use of Big Data - MCDA in solving realworld decision-aiding problems. More research about modeling and human-computer interaction is needed to understand the way analysts and decision makers can employ Big Data - MCDA as a decision support tool.

Concluding remarks

The process of merging different disciplines requires a close collaboration among researchers and practitioners with different areas of expertise. Unfortunately, the collaboration between the two disciplines involved in integrating Big Data and MCDA has been rather limited. Most of the contributions to Big Data - MCDA research have come from disciplines outside the MCDA community. Specifically, the integration in one direction has dominated the approaches for interfacing Big Data and MCDA. Also, most of the Big Data - MCDA applied research has been done without any participation of the MCDA researchers and practitioners. The topic of a tighter collaboration between the Big Data and MCDA communities is of critical importance for advancing research and practices in Big Data - MCDA.

References

Catania, B. and Jain, L.C. *Advanced Query Processing: Volume 1 Issues and Trends*. Springer Verlag Berlin, 2014.

Del Vasto Terrientes, L. Valls, A. Zielniewicz, P., Borras, J. (2016). A hierarchical multicriteria sorting approach for recommender systems. *Journal of Intelligent Information Systems* 46 (2), 313–346.

Doumpos, M. and Zopounidis, C. Disaggregation Approaches for Multicriteria Classification: An Overview. N. Matsatsinis, E. Grigoroudis (eds.), *Preference Disaggregation in Multiple Criteria Decision Analysis*, Springer, 2018.

Doumpos, M., & Zopounidis, C. (2011). Preference disaggregation and statistical learning for multicriteria decision support: A review. *European Journal of Operational Research*, 209(3), 203–214.

Elgendy, N., Elragal, A. Big data analytics in support of the decision-making process. *Procedia Computer Science*. 100, 1071–1084 (2016)

Hsueh SL, Cheng A (2017) Improving air quality in communities by using a multicriteria decision-making model based on big data: A critical review. *Applied Ecology and Environmental Research*, 15(2): 15-31.

Lakiotaki, K., Matsatsinis, N.F., Tsoukias, T. (2011). Multicriteria user modeling in recommender systems. *IEEE Intelligent Systems*, 26(2):64–76.

Leyva López J.C., Solano Noriega, J.J, Garcia Alcaraz, J.L. and Gastelum Chavira, D. A. (2016). Exploitation of a Medium-Sized Fuzzy Outranking Relation Based on Multiobjective Evolutionary Algorithms to Derive a Ranking. *International Journal of Computational Intelligence Systems*. Vol 9 (4) pags. 745-764.

Podviezko, A. 2015. Use of multiple criteria decision aid methods in case of large amounts of data. *International Journal of Business and Emerging Markets* 7(2): 155–169.

Turet, J.G., Costa, A.P.C. (2018). Big Data Analytics to Improve the Decision-Making Process in Public Safety: A Case Study in Northeast Brazil. In F. Dargam, Pavlos Delias Isabelle Linden Bertrand Mareschal (Eds.). *Decision Support Systems VIII*, 76–87, 2018.

Multicriteria Methodologies for the enhancement of the Cultural Heritage

Maria Barbati^a, Maria Cerreta^b, Simona Panaro^a

^a Operations and Systems Management Group, Faculty of Business and Law, University of Porstmouth, UK

^b Dipartimento di Architettura, University of Naples 'Federico II', Italy

The importance of enhancing the cultural heritage

In the last decades, the conceptual and the policy framework for the cultural heritage has massively evolved due to the awareness of the benefits for the economy, the society, the culture, and the environment (CHCFE project, 2015). Nowadays, the cultural heritage has been identified by government authorities as a tool for the sustainable development (Council of the European Union, 2014), for the economic growth, to reconvert cities, to enable integration and inclusion processes and as a pillar for the identity of the nations (Arfaoui and Heid 2016).

Many cities have already recognized the role and importance of cultural and creative industries in local development. Preserving and enhancing the cultural heritage is integrated into urban agendas and local development strategies in a variety of sectors such as innovation, branding, tourism and social inclusion (Blake, 2000).

Indeed, the protection and enhancement of cultural values (tangible and intangible) start to have a recognizable role in the urban regeneration processes. For example, when the cultural actions (e.g. reuse of the building, reclamation of open space, arts 'festivals', events and public art) are the core of a local policy aimed at urban renovation, the processes are defined as cultural-led regeneration (Evans, 2005; Vickery, 2007).

Even more, strategies that want to enhance cultural heritage can generate positive interlinked impacts on context. On the other hand, the dimension of these synergistic effects depends on the process activated and the capacity to create a shared and inclusive social representation of a context, that respect the identity and the local values (Ferilli et. al., 2017).

Therefore, local and international agencies, such as the European Commission, and the 2030 Agenda for Sustainable Development Goals of the UN General Assembly and UNESCO's Governing Bodies, encourage the public awareness of cultural heritage, motivating governmental institutions to act for the preservation of the local and the national heritage (e.g., McKercher et al., 2005).

The use of multicriteria methods in the cultural heritage context

Despite the increasing interest in enhancing the cultural heritage, due to the increasing lack of public funding in the current economic context, is necessary to rethink the strategies to deal with such huge quantity of heritage to preserve (Yau, 2009). In this sense, emerges the possibility of supporting decision makers with appropriate methodologies that aim at classifying, prioritizing and selecting the appropriate strategies to preserve and enhance cultural heritage (Fusco Girard and De Toro, 2007; Fusco Girard et al., 2014). To support such complex decisions, those methodologies need to deal simultaneously with all these aspects building a participative and sharable decision.

In the past, the MCDM methods have been used in the context of cultural heritage in different case studies (e.g., Hong and Chen (2017), Dutta and Husain (2009), Giove et al. (2011)). However, given the complexity of the problem, it seems that the natural evolution of these methods is the integration of those MCDM methods in appropriate frameworks. Some attempts in this direction have been made for MCDM Methods that have been used together with GIS environment (see e.g. Tarragu^eel et al. (2012) or Oppio et al. (2015)).

In this perspective, a versatile framework for the evaluation and the subsequent selection of interventions for the preservation of the cultural heritage has been proposed by Ferretti and Comino (2015). They consider both qualitative and quantitative values, to help decision makers in developing urban strategies. They stress the necessity of interacting with the different stakeholders in a transparent process, to prioritize the most important elements in the context of the cultural heritage and to support the choices of public and, eventually, private stakeholders.

Recently, a further aspect has been introduced in the literature that considers the choice of the interventions in the cultural heritage context as a portfolio of choices to be made altogether in order to take into account potential synergies among the different projects to implement. An attempt in this direction has been made by (Nestico et al., 2018) that propose to apply MCDM methods to generate a plan that chooses a portfolio of interventions to be made altogether.

The integration of all the above elements can be retrieved in the work proposed by (Barbati et al., 2019). The methodology integrates a MCDM method and the resolution of a portfolio problem. It is characterized by the continuous interaction with the different stakeholders involved and it also allows to consider potential synergies and possible linked effects in the urban context.

Discussion and insights

From the analysis of the evolution of the way of dealing with the cultural heritage, it seems that a new paradigm could and is being developed in which decisions are taken, with the support of structured methodologies, considering multiple aspects of the problem, multiple stakeholders, multiple criteria and the relevant restrictions, including the not economic ones. The decision processes tend to become more inclusive and, consequentially, the procedures to evaluate the potential intervention requires the use of participatory and collaborative approaches that support the interaction between the actors involved, and identify possible ongoing improvements.

Moreover, reducing funding encourages the councils to look for new ways to fund the culture policies (cultural, educational, social activities, preservation of cultural heritage, local engagement, and enterprise, etc.) and to optimize the available resources. Furthermore, it is important to consider that a cultural enhancement strategy could be implemented in very different periods, where the conditions could change quickly and the enabling context can be identified.

More in detail, when dealing with decisions in the cultural heritage system, several aspects need to be considered as:

- Several stakeholders are involved in the decision-making process of the strategy to adopt (Yung and Chan, 2013). Indeed, the cooperation between public, private and nongovernment sectors is important to start and carry out projects but also to sustain the places over time (Macdonald and Cheong, 2014);
- Several points of view need to be taken into account and integrated in order to reach an agreement among the several stakeholders involved (Fusco Girard et al., 2014);
- Citizens want to be fully informed of the decision to be made, therefore a clear and transparent procedure to get

to the decision must be adopted (Dutta and Husain, 2009);

- Awareness of the identity shared values of the different local communities should be promoted (Cerreta and Panaro, 2017);
- Economic aspects can be revitalized as for example the promotion of tourism (e.g., McKercher et al., 2005), local entrepreneurship and local businesses (e.g., Tuan and Navrud, 2008);
- Monetary aspects need to be considered together with other elements (Wang and Zeng 2010) such as improvement of the environment and the urban landscape (Veldpaus et al., 2013), protection of place identity and heritage values, sustainability, well-being and life quality of citizens (Tweed and Sutherland, 2007);
- Indeed, this type of processes cannot be planned in each aspect. It is necessary that the local communities feel part of the same vision, participate, cooperate and even compete together.

Therefore, it is crucial that methodologies that support decisions in the cultural heritage context are characterized by:

- Integration of different methods and tools, structuring multi-methodological and hybrid decision-making processes;
- Versatility and easiness of adaptation in different complex problems;
- Consideration of the different interventions as interlinked and not isolated;
- Efficiency in monitoring the impacts of the selected actions in the urban context;
- Capability of handling dynamic aspects such as unforeseen changes in the economy;
- Ability to deal with uncertainty and risk conditions;
- Capability to stimulate cooperation between different actors, reducing conflicts.

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References

Arfaoui, M., Heid, K., 2016. Culture, Cities and Identity in Europe. European Economic and Social Committee, Brussel. [Online] Available at:

https://www.eesc.europa.eu/resources/docs/qe-01-16-463en-n.pdf [Accessed: 5 May 2019].

Barbati, M., Figueira, J. R., Greco, S., Ishizaka, A., & Panaro, S. (2019). A multiple criteria methodology for prioritizing and selecting portfolios of urban projects. arXiv preprint arXiv:1812.10410.

Blake, J., 2000. On defining the cultural heritage. International & Comparative Law Quarterly 49, 61–85.

Cerreta, M., 2010. Thinking through complex values. In Cerreta M., Concilio G., Monno V. (eds) Making Strategies in Spatial Planning. Knowledge and Values, Springer, Netherlands, 381-404.

Cerreta, M., Panaro, S., 2017. From perceived values to shared values: A multi-stakeholder spatial decision analysis (M-SSDA) for resilient landscapes. Sustainability 9, 1113.

CHCFE project, 2015. Cultural Heritage COUNTS for Europe, Full Report. [Online] Available at: https://resources.riches-project.eu/wp-

content/uploads/2015/11/CHCfE_FULL-REPORT_v2.pdf [Accessed: 5 May 2019].

Council of the European Union, 2014. Council conclusions of 21 May 2014 on cultural heritage as a strategic resource for a sustainable Europe. [Online] Available at: http://eurlex.europa.eu/legal-

content/EN/TXT/?uri=CELEX:52014XG0614%2808%29 [Accessed: 5 May 2019].

Dutta, M., Husain, Z., 2009. An application of multicriteria decision making to built heritage. The case of Calcutta. Journal of Cultural Heritage 10, 237–243.

Evans, G., 2005. Measure for Measure: evaluating the evidence of culture's contribution to regeneration. Urban Studies, 42 (5/6), 959-983.

Ferilli, G., Sacco, P.L., Tavano, B.G., Forbici, S., 2017. Power to the people: When culture works as a social catalyst in urban regeneration processes (and when it does not). European Planning Studies, 25(2), 241-258.

Ferretti, V., Comino, E., 2015. An integrated framework to assess complex cultural and natural heritage systems with multi-attribute value theory. Journal of Cultural Heritage 16, 688–697.

Fusco Girard, L., De Toro, P., 2007. Integrated spatial assessment: A multicriteria approach to sustainable development of cultural and environmental heritage in San Marco dei Cavoti, Italy. Central European Journal of Operations Research 15, 281–299.

Fusco Girard, L., Cerreta, M., De Toro, P., 2014. Integrated Assessment for Sustainable Choices. Italian Journal of Regional Science, Special Issue Adaptive Evaluations in Complex Contexts (Cerreta M., Diappi L. eds), 13, 111-142.

Giove, S., Rosato, P., Breil, M., 2011. An application of multicriteria decision making to build heritage: The redevelopment of Venice Arsenale. Journal of Multi-Criteria Decision Analysis 17, 85–99.

Hong, Y., Chen, F., 2017. Evaluating the adaptive reuse potential of buildings in conservation areas. Facilities 35(3-4), 202–219.

Macdonald, S., Cheong, C., 2014. The Role of Public-Private Partnerships and the Third Sector in Conserving Heritage Buildings, Sites and Historic Urban Areas. The Getty Conservation Institute, Los Angeles. [Online] Available at: https://www.getty.edu/conservation/publications_resources/p df_publications/pdf/public_private.pdf [Accessed: 5 May 2019]. McKercher, B., Ho, P., Du Cros, H., 2005. Relationship between tourism and cultural heritage management: Evidence from hong kong. Tourism Management 26, 539–548.

Nestico, A., Morano, P., Sica, F., 2018. A model to support the public administration decisions for the investments selection on historic buildings. Journal of Cultural Heritage Forthcoming.

Oppio, A., Bottero, M., Ferretti, V., Fratesi, U., Ponzini, D., 2015. Giving space to multicriteria analysis for complex cultural heritage systems: The case of the castles in Valle D'Aosta region, Italy. Journal of Cultural Heritage 16, 779–789.

Tarraguel, A., Krol, B., Van Westen, C., 2012. Analysing the possible impact of landslides and avalanches on cultural heritage in upper Svaneti, Georgia. Journal of cultural heritage 13, 453–461.

Tuan, T., Navrud, S., 2008. Capturing the benefits of preserving cultural heritage. Journal of cultural heritage 9, 326–337.

Tweed, C., Sutherland, M., 2007. Built cultural heritage and sustainable urban development. Landscape and urban planning 83, 62–69.

Veldpaus, L., Pereira, A., Colenbrander, B., 2013. Urban heritage: Putting the past into the future. The Historic Environment: Policy & Practice 4, 3–18.

Vickery, J.: The Emergence of Culture-led Regeneration: A Policy Concept and its Discontents. Warwick, Centre for Cultural Policy Studies (2007). [Online] Available at: https://warwick.ac.uk/fac/arts/theatre_s/cp/research/publicati ons/centrepubs/ccps.paper9.pdf [Accessed: 5 May 2019].

Wang, H.J., Zeng, Z.T., 2010. A multi-objective decisionmaking process for reuse selection of historic buildings. Expert Systems with Applications 37, 1241–1249.

Yau, Y., 2009. Multi-criteria decision making for urban built heritage conservation: application of the analytic hierarchy process. Journal of Building Appraisal 4, 191–205.

Yung, E., Chan, E., 2013. Evaluation for the conservation of historic buildings: Differences between the laymen, professionals and policy makers. Facilites 31(11-12), 542–564.



MCDA Research Groups

Decision analysis at University of Trento

Michele Fedrizzi and Matteo Brunelli

Department of Industrial Engineering, University of Trento

michele.fedrizzi@unitn.it; matteo.brunelli@unitn.it

Research on decision analysis methods has been carried out in the University of Trento since the late Eighties, mostly thanks to the initiative of Mario Fedrizzi, now Emeritus Professor. The research group initially focused on preference relations, consensus and their representations with fuzzy sets theory. In that period, fruitful collaborations were established with other researchers such as Hannu Nurmi (University of Turku, Finland), Janusz Kacprzyk (Polish Academy of Sciences), José Luis Verdegay (University of Granada, Spain). During the Nineties the research group, then called (Multi-Expert Decisions MEDIA and Interactive Aggregation), was composed also by Michele Fedrizzi and Ricardo Alberto Marques Pereira and developed mathematical models to describe consensus in the case when the preferences of decision makers are fuzzy.

After the Italian University reform in 2010, and until present days, the research in MCDA in Trento has been carried out by different researchers in three different departments.

Michele Fedrizzi and Matteo Brunelli (Dept. of Industrial Engineering) have studied cardinal preference relations, especially with respect to the condition of consistency. This led to some studies, both theoretical and numerical, on inconsistency indices, i.e. indices commonly used to quantify the degree of inconsistency of a set of preferences. Some of the results spotted how seemingly different measures of inconsistency are, instead, functionally related, and thus equivalent. Furthermore, more axiomatic studies have been proposed in order to study the mathematical structures of inconsistency indices by means of an analysis of their properties. In this context it was shown that a number of well-known indices fail to satisfy some properties and therefore their use as inconsistency indices remains questionable. Other research directions include fuzzy sets theory and, more recently, the optimization and management of maintenance operations.

Silvia Bortot and **Ricardo Alberto Marques Pereira** (Dept. Of Economics and Management) have research interests related to aggregation functions, especially the Choquet integral and the ordered weighted averaging (OWA) functions.

The Choquet integral was applied, for instance, in the context of project management and properties of OWA functions have been studied in the light of their binomial decomposition.

Additionally, among their proposals there is that of using the binomial decomposition of OWA functions to study the non-additive structure of some well- known welfare functions and inequality indices like those introduced by Gini, Bonferroni and De Vergottini.

Finally, they have proposed an extension of the AHP in which aggregation was defined on the basis of 2-additive Choquet integrals sensitive to inconsistency, and they have investigated the general algebraic representations of the mean particularly in relation with the AHP framework of pairwise comparison matrices.

Finally, **Stefano Benati** (Dept. of Sociology and Social Research) has conducted research in game theory and portfolio optimization. Among his proposals there is the use of the median, instead of the expected mean value, to make portfolio optimization more robust. His current research on

decision making regards the use of regret in optimization models.

References

Aristondo, O., García-Lapresta, J. L., de la Vega, C. L., & Marques Pereira, R. A. (2013). Classical inequality indices, welfare and illfare functions, and the dual decomposition. *Fuzzy Sets and Systems*, *228*, 114-136.

Benati, S. (2015). Using medians in portfolio optimization. *Journal of the Operational Research Society*, 66(5), 720-731.

Benati, S., & Rizzi, R. (2007). A mixed integer linear programming formulation of the optimal mean/value-at-risk portfolio problem. *European Journal of Operational Research*, 176(1), 423-434.

Bonetti, A., Bortot, S., Fedrizzi, M., Marques Pereira, R. A., & Molinari, A. (2012). Modelling group processes and effort estimation in project management using the Choquet integral: An MCDM approach. *Expert Systems with Applications*, *39*(18), 13366-13375.

Bortot, S., Marques Pereira, R. A., & Stamatopoulou, A. (2019). Maximum entropy ordered weighted averaging in the binomial decomposition framework. *International Journal of Intelligent Systems*, 34(5), 966-1000.

Bortot, S., Fedrizzi, M., Marques Pereira, R. A., & Nguyen, T. H. (2018). The binomial decomposition of generalized Gini welfare functions, the S-Gini and Lorenzen cases. *Information Sciences*, 460-461, 555-577.

Bortot, S., & Marques Pereira, R. A. (2013). Inconsistency and non-additive capacities: the Analytic Hierarchy Process in the framework of Choquet integration. *Fuzzy Sets and Systems*, 213, 6-26.

Bortot, S., & Marques Pereira, R. A. (2017). Algebraic representations of the weighted mean. *Fuzzy Sets and Systems*, 308, 85-105.

García-Lapresta, J. L., & Marques Pereira, R. A. (2015). The dual decomposition of aggregation functions and its application in welfare economics. *Fuzzy Sets and Systems*, 281, 188-197.

Bortot, S., & Marques Pereira, R. A. (2014). The binomial Gini inequality indices and the binomial decomposition of welfare functions. *Fuzzy Sets and Systems*, 255, 92-114.

Brunelli, M. (2015). *Introduction to the Analytic Hierarchy Process*. Springer.

Brunelli, M., Canal, L., & Fedrizzi, M. (2013). Inconsistency indices for pairwise comparison matrices: a numerical study. *Annals of Operations Research*, 211(1), 493-509.

Brunelli, M., & Fedrizzi, M. (2015). Axiomatic properties of inconsistency indices for pairwise comparisons. *Journal of the Operational Research Society*, 66(1), 1-15.

Brunelli, M., & Fedrizzi, M. (2015). Boundary properties of the inconsistency of pairwise comparisons in group decisions. *European Journal of Operational Research*, 240(3), 765-773.

Brunelli, M., & Mezei, J. (2013). How different are ranking methods for fuzzy numbers? A numerical study. *International Journal of Approximate Reasoning*, 54(5), 627-639. Krejčí, J., Petri, D., & Fedrizzi, M. (2017). From measurement to decision with the Analytic Hierarchy Process: Propagation of uncertainty to decision outcome. *IEEE Transactions on Instrumentation and Measurement*, 66(12), 3228-3236.

About the 89th meeting of the EWG-MCDA

The Department of Industrial Engineering of the University of Trento hosted the 89th meeting of the EWG-MCDA. The meeting was held between the 11th and the 13th of April 2019 in the "Economics building" of the University of Trento. The main topic of the meeting was "Pairwise comparisons (pros and cons)". As usual, in spite of the special theme, the conference welcomed all contributions on both theoretical and applied aspects of MCDA. The scientific committee received more than 60 abstract submissions and the actual participants included scholars from non-EU countries such as Canada and Japan. Out of all the abstracts, for reasons of time, only 20 were selected for presentation.

The meeting was opened by the welcome message of Dario Petri, the head of the Department of Industrial Engineering, who encouraged the development of MCDA methods to be applied into the new paradigm of Industry 4.0. The meeting then proceeded with five sessions: two on the pairwise comparison method, one on regional and urban planning and the remaining two on miscellanea aspects of MCDA. A positive note, which is already a "trademark" of these meetings, were the lively and participated discussions following most of the presentations.

In addition to these sessions, a keynote titled "Paired voting methods in restricted domains: are the ghosts returning?" was given by Hannu Nurmi. In his keynote, Hannu showed, thanks to simple and intelligible examples, how some seemingly reasonable and well-known voting methods based on pairwise comparisons may end up giving some counterintuitive results.

As a rule, the social events included a social dinner on Thursday and an outing day on Saturday. The social dinner took place at Palazzo delle Albere, an old palace from the 16th century. The number of attendees, including participants to the conference and accompanying persons, was 49. After a convivial moment where it was possible to socialize and appreciate some wine and with local finger food, the dinner proceeded at the tables in the entry hall of the palace.

On Saturday the participants took a shuttle to be transferred to Arte Sella, which is an open air contemporary art exhibition. The pieces at Arte Sella are all inspired by nature; most of them are made of materials such as wood and rock. After the visit we stopped in a rustic restaurant to eat some local food for lunch.

It all went well, although the rainy weather did not help, or, to look at the positive side, it increased the already mysterious atmosphere of Arte Sella!

Finally, we want to communicate to the MCDA community that there will be a special issue of the Springer journal

"Decisions in Economics and Finance". Although the special issue was inspired by the meeting, the invitation to contribute is, of course, open to the entire community. The call for papers can be found in the website of the meeting.

Last but not least, we want to thank the participants, the real protagonists of these meetings.

Trento, 28th April 2019 Michele Fedrizzi Matteo Brunelli



Photo by Matteo Brunelli

MEETING PROGRAM

Thursday, 11 April

Session 1 (MCDA I)

Presentations

- Ghaderi, Kadzinski: Incorporating Group-Level Uncovered Structural Patterns in Construction of Individual-Level Value Functions
- Tomczyk, Kadzinski, Slowinski: Preference-based cone contraction algorithms for interactive evolutionary multiple objective optimization
- Profili, Scarelli: Multi-Criteria Analysis in Food Management
- Bottero, D'Alpaos, Oppio: Weighting procedures and environmental sustainability assessment: an experiment based on an urban regeneration programme in Northern Italy

Discussion

- Abastante, Corrente, Greco, Lami, Mecca: Multiple criteria decision analysis to compare hypotheses of adaptive reuse for an iconic historical building
- Arcidiacono, Corrente, Greco: Financial rating with ordinal classification based on the hierarchical SMAA Choquet integral approach
- Balaman Yyilmaz, Kaya: A multi criteria assessment and clustering based decision support system for analytic customer relationship management
- Cantone, Giarlotta, Watson: Decomposing Choice Behavior: One-Point Resolutions
- Greco, Matarazzo, Slowinski: Distinguishing Vagueness from Ambiguity in Rough Set Approximations
- Clivillé, Verjus, Berrah, Pourraz, Hotel: A Recommender System in a Touristic Context
- D'Alpaos, Faleschini, Andreolli: Evaluation of Seismic Retrofit of Industrial Buildings: A Hierarchical Approach

- Di Caprio, Santos Arteaga: The information lost in expectations
- Fernandes, Carrico: Multicriteria Decision Support Tool to Evaluate the Replacement of Water Meters

Session 2 (Pairwise comparisons I) Presentations

- De Marinis, Sali: Simplified pair-wise ranking for identification of triggering interventions on agricultural development in Masisi, Nord Kivu, Democratic Republic of Congo
- Scala, Oliva, Setola, Dell'Olmo: Optimal group formation based on incomplete Analytic Hierarchy Process
- Stoklasa, Siebert: Constructing absolute-type evaluations by pairwise comparisons: utilizing the strengths of AHP relative- evaluation methodology to obtain absolute ratings (this time for real, not stopping half way through as Saaty's absolute-measurement AHP does)
- Csató: Axiomatizations of inconsistency indices for triads

Discussion

- Antal, Bozóki, Fulop: Efficiency of weight vectors derived from pairwise comparison matrices
- Bregar: Some experimental findings on the role of inconsistency and relativity in pairwise comparisons
- Kulakowski, Szybowski, Prusak: Indices of incompleteness for the pairwise comparisons method
- Mazurek: When is the condition of order preservation met? Theoretical and numerical approach
- Oliva, Bozoki: Incomplete Analytic Hierarchy Process with Minimum Ordinal Violations
- Oppio, Ferretti, Dell'Ovo, Colorni Vitale: Strengths and limitations of the pairwise comparison approach for the definition of suitable coalitions of actions

Friday, 12 April

Session 3 (MCDA II)

Presentations

- Colorni, Tsoukias: Generating Alternatives in Decision Models
- Figueira, Greco, Roy: ELECTRE Score: a first Outranking Based Scoring Method
- Marais, Abi-Zeid, Rodriguez: Ranking with ELECTRE III: Difficulties encountered in a real life project with a large set of alternatives
- Benati, Conde, Mansini, Zanotti: Variations on Portfolio Efficient Frontiers

Discussion

- Giarlotta, Watson: The interplay between two rationality tenets: Extending Schmeidler's theorem to bi-preferences
- Greco, Ishizaka, Tasiou, Torrisi: Robust noncompensatory aggregation of composite indicators: the PROMETHEE scoring method

- Greco, Ishizaka, Panaro, Tasiou: Sigma-Mu efficiency analysis to evaluate the cultural and creative vitality of cities
- Guitouni: Formalization of a nested distributed decision-making model in co-production networks: The case of Global Value Chains
- Huttin: Engineering approaches in life science and health care and MCDA
- Imoussaten, Montmain: The worth index based on the credibility index
- Kosova, Xhafaj, Qendraj, Kullolli, Rakipllari: Performance and Governance of the Albanian Universities by Multi-Criteria Analysis
- Le Tellier, Berrah, Clivillé, Stutz, Audy, Barnabé: Definition of the ecopark's multi-criteria decisionmaking problems and their challenges

Keynote Lecture

Hannu Nurmi: Paired Voting Methods in Restricted Domains: Are the Ghosts Returning?

Session 4 (Pairwise comparisons II)

Presentations

- Ben Amor, Pelissari: Uncertainty and pairwise comparisons in multi-criteria decision making aid: a literature review
- Sato: Review on Ratio Scales for Pairwise Comparison
- Liang, Rezaei, Brunelli: Consistency Threshold for Best Worst Method
- Corrente, Figueira, Greco: An improved version of the deck of cards method to build evaluation scales

Discussion

- Porro, Pardo, Sanchez, Agell: Strategic priorities for European energy companies location: A multi-criteria decision approach based on AHP
- Ishizaka, Pereira: ANPSort for sorting researchers
- Srdjevic, Srdjevic: Pairwise comparisons in multicriteria decision making – experience and feedback gained during multiple individual and group applications of the AHP method
- Siebert, Stoklasa: Aggregation in the Analytic Hierarchy Process: Why weighted geometric mean should be used instead of weighted arithmetic mean
- Szybowski: The tournament index of inconsistency

Session 5 (Territorial and Urban Planning) Presentations

- Barbati, Figueira, Greco, Ishizaka, Panaro: A multiple criteria decision aiding approach to prioritize and to select tangible urban cultural heritage projects.
- Rolando, Curto, Norese: MCDA and an outstanding urban system
- Cerreta, Poli, Regalbuto, Mazzarella: Choosing a sustainable development alternative in an urban context: the ANP method application
- Thebault, Berrah, Gaillard, Clivillé, Desthieux, Ménézo: BIPV suitability analysis in the Genève agglomeration using GIS-based multi-criteria evaluation

Discussion

- Zolfani: BWM and SWARA similarities; advantages and disadvantages
- Lentini, Polettini, Luè, Colorni Vitale: Assessing and rating the level of smartness of mountain areas by the use of Electre Tri: the pilot case of the ongoing Alpine Space project SmartVillages
- Mouhrim, El Hilali Alaoui, Boukachourb: Mixed Vehicle Routing Problem under Emissions Allowances
- Norese, Bono: A project selection problem in an organizational process of Information Technology management
- Ogryczak: Mean-Inequity Ratio Models for Equitable Multiple Criteria Optimization
- Orejuela, Bocanegra, Bravo, Londono: Electre method for choosing a school routing in a Pareto front
- Quartieri: Rankability as a strong form of coherence
- Rocchi, Paolotti, Boggia: Environmental valuation and MCDA: where we are going?
- Siebert: How proactive decision making influences life satisfaction
- Siebert, Siebert: Debiasing belief perseverance in the context of fake news
- Yazdani, Chattarjee: An improved version of Best Worst Method (BWM)

Persons and Facts

Professor-Academician Constantin Zopounidis was awarded the Honorary Doctorate of the Aristotle University of Thessaloniki

On 19/12/2018 at 12.00, Prof. Constantin Zopounidis, Professor of the School of Production Engineering and Management of the Technical University of Crete, was awarded the Honorary Doctorate of the Department of Economics at the School of Economics and Political Science of the Aristotle University of Thessaloniki.

In the past, honorary doctorates were awarded the following professors distinguished personalities:

- Eric John Ernest Hobsbawm (member of the British Academy and the American Academy of Arts and Sciences, honorary member of King's College in Cambridge and an honorary doctor of many universities in several countries)
- Clive W. J. Granger (Nobel Prize in Economics in 2003)
- Harry Markowitz (1990 Nobel Prize Economy)
- Anwar Mir Mohammed Shaikh (Professor at New School for Social Research in New York for more than 30 years)
- George Vassiliou (President of the Republic of Cyprus)
- Prodromos Emfietzoglou (honored by the Academy of Athens, the Ecumenical Patriarch Bartholomew, the Patriarch of Jerusalem Diodorus A)

• George M. Konstantinidis (President of the American Finance Association, considered to be the world's leading scientific association of Financial Economists)

Constantin Zopounidis is Professor and Vice Dean of the School of Production Engineering and Management. He is also Director of the Financial Management, Data Analysis and Forecasting Systems Laboratories of the Technical University of Crete. From 2012 he is Distinguished Research Professor at Audencia Business School (France). He is Editor in Chief of International Journal of Operational Research: An International Journal (Springer), International Journal of Multicriteria Decision Making (Inderscience), International Journal of Financial Engineering and Risk Management (Inderscience), International Journal of Corporate Finance and Accounting) and the International Journal of Food and Beverage Manufacturing and Business Models (IGI Global). He is also a Associate Editor of New Mathematics and Natural Computing, (World Scientific), Journal of Banking and Financial Technology (Springer), International Journal of Accounting and Finance (Inderscience), Banking, International Journal of Data Analysis Strategies (Inderscience) and member of the Scientific Committee of the European Journal of Operational Research (Elsevier) Prof. C. Zopounidis presented a speech entitled "Multi Criteria Analysis: A Holistic Approach to Decision Making".





Software

The COMET method: the first MCDA method completely resistant to rank reversal paradox Wojciech Sałabun^{1*}, Andrzej Piegat¹, Jarosław Wątróbski², Artur Karczmarczyk³, and Jarosław Jankowski³

¹ Department of Artificial Intelligence Method and Applied Mathematics in the Faculty of Computer Science and Information Technology, West Pomeranian University of Technology, Żołnierska 49, 71-210 Szczecin, Poland

² Department of Information Systems Engineering in the Faculty of Economics and Management, University of Szczecin, Mickiewicza 64, 71-101 Szczecin, Poland

³ Department of Information Systems Engineering in the Faculty of Computer Science and Information Technology, West Pomeranian University of Technology, Żołnierska 49, 71-210 Szczecin, Poland

* corresponding author: <u>wsalabun@ieee.org</u>

Abstract

In this paper, we present a new multi-criteria decisionmaking method, called Characteristic Objects METhod (COMET), along with its software implementation¹. First of all, we discuss the essential properties of COMET, which make it unique. Next, the paper presents the basic concepts of fuzzy sets theory and the COMET algorithm. We introduced the operation of web software. Finally, we describe the COMET applications and give final remarks.

1. Introduction

The Characteristic Objects METhod (COMET) is a newlydeveloped method of multicriteria identification of expert decision-making models used for solving multi-criteria decision-making problems [1].

The presented method is characterized by unique properties that are rare in the field of multicriteria decision-making methods. The most crucial is the fact that COMET is entirely resistant to the rank reversal phenomenon. This property is possible because the COMET method evaluates alternatives using a model identified by characteristic objects that are independent of the set of evaluated decisional variants. Unlike most of the other techniques of multicriteria decisionmaking analysis, there are no comparisons between the assessed decision variants themselves. A decision-maker obtains the preference values of considered alternatives by using the resulting model. Therefore, if we use the same decision model, the rating values for decisional variants will not change regardless of their number, so the paradox will never occur. The once completed identification of the decision model allows additional evaluation of any set of alternatives in the considered numeric space without reengaging the expert in the assessment process, as the model has been already identified for the entire problem space. The methods alternative to COMET, in such situations most often require the complete identification and calculation procedure

¹ <u>www.comet.edu.pl</u> ² www.comet.edu.pl

www.comet.edu.pl

to be repeated from the beginning, since they only identify the values of the grades for the currently considered set of alternatives and not for the entire problem state space [2].

The COMET method additionally enables relatively easy identification of both linear and non-linear expert decision functions, which allows increasing the scope of its applicability to solving both linear and non-linear problems. Another issue is the use of global criterion weights, which determine the average significance of a given criterion for the final assessment. The linear inclusion of the weights in nonlinear problems additionally leads to a reduction in the accuracy of the results obtained. Besides, the problem is how the weights should be set. Therefore, in the calculation procedure of the COMET method, the arbitrary determination of weights for individual criteria was omitted [3], [4].

The COMET method is based on the idea of the characteristic objects, i.e., points regularly distributed in the problem state space. These objects are obtained as a combination of values characteristic to individual criteria. Among the characteristic objects, there are not only real objects, but there may also be those that do not represent the decision variants existing in reality. Thanks to this, the distances between the characteristic objects are usually larger than in the case of the considered alternatives and arranged in space regularly, which facilitates the process of setting preferences for them [5].

In addition to the basic COMET method, its extensions have been developed that use in the calculations the achievements of the interval arithmetic, hesistant fuzzy sets as well as intuistionic fuzzy sets [6], [7], [8].

The remaining part of this paper is composed as follows. The preliminary of the fuzzy set theory is shown in Section 2. In Section 3, the COMET algorithm is presented in details. Section 4 is dedicated to the COMET software. Finally, we present the COMET application examples and provide the concluding remarks in Section 5.

2. Fuzzy Set Theory: Preliminaries

The development of the fuzzy set theory was initiated by Lofti Zadeh, who presented the idea and the first conception of fuzzy sets in [9]. Today, the fuzzy set theory is a very important approach to the control and model creation in various scientific fields. Modeling with the usage of the fuzzy sets has proven to be an effective way to formulate the multi-criteria decision problems [10], [11], [12]. The basic notions and concepts of the Fuzzy Set Theory are defined below [1], [10], [12].

Fuzzy set and membership function

The characteristic function μ_A of a crisp set $A \subseteq X$ assigns a value of either 0 or 1 to each member of as well as the crisp sets only allow a full membership $(\mu_A(x) = 1)$ or no membership at all $(\mu_A(x) = 0)$. This function can be generalized to a function $\mu_{\mathcal{H}}$ so that the value assigned to the element of the universal set X falls within a specified range, i.e., $\mu_{\mathcal{H}} : X \rightarrow [0,1]$. The assigned value indicates the degree of membership of the element in the set A. The function $\mu_{\mathcal{H}}$ is

called the membership function and the set $\mathcal{A} = \{(x, \mu_{\mathcal{A}}(x))\}$, where $x \in X$, defined by $\mu_{\mathcal{A}}(x)$ for each $x \in X$, is called a fuzzy set.

Triangular fuzzy number (TFN)

A fuzzy set \tilde{A} , defined on the universal set of real numbers \Re , is told to be a triangular fuzzy number $\mathcal{A}(a, m, b)$ if its membership function has the following form (1):

$$\mu_{\tilde{A}}(x,a,m,b) = \begin{cases} 0, & x \le a \\ \frac{x-a}{m-a}, & a \le x \le m \\ 1, & x = m \\ \frac{b-x}{b-m}, & m \le x \le b \\ 0, & x \ge a \end{cases}$$
(1)

moreover, the following characteristics (2, 3):

$$x_1, x_2 \in [a, b] \land x_2 > x_1 \Longrightarrow \mu_{\mathcal{A}}(x_2) > \mu_{\mathcal{A}}(x_1)$$
⁽²⁾

 $x_1, x_2 \in [b, c] \land x_2 > x_1 \Longrightarrow \mu_{\mathcal{A}}(x_2) < \mu_{\mathcal{A}}(x_1)$ (3)

The support of a TFN

The support of a TFN \tilde{A} is defined as a crisp subset of the set \tilde{A} in which all elements have a non-zero membership values in the \tilde{A} set (4):

$$S(A) = \{x : \mu_{A}(x) > 0\} = [a, b]$$
(4)

The core of a TFN

The core of a TFN \tilde{A} is a singleton (one-element fuzzy set) with the membership value equal to 1 (5):

$$C(\mathcal{A}) = \{x : \mu_{\mathcal{A}}(x) = 1\} = m$$
(5)

The fuzzy rule

The single fuzzy rule can be based on the Modus Ponens tautology. The reasoning process uses the IF-THEN, OR and AND logical connectives.

The rule base

The rule base consists of logical rules determining the causal relationships existing in the system between the input and output fuzzy sets.

The T-norm operator: product

The T-norm operator is a T function modeling the intersection operation of two or more fuzzy numbers, e.g. \tilde{A} and \tilde{B} . Currently, the arithmetic product of real numbers is used as the T-norm operator (6):

$$\mu_{\mathscr{H}}(x)AND\mu_{\mathscr{H}}(y) = \mu_{\mathscr{H}}(x) \cdot \mu_{\mathscr{H}}(y) \tag{6}$$

The S-norm operator: sum

The S-norm operator is a S function modeling the union operation of two or more fuzzy numbers, e.g. \tilde{A} and \tilde{B} . Currently, the arithmetic sum of real numbers is used as the S-norm operator.



Fig. 1. An example of a triangular fuzzy number with the support [a, b] and the core m.

3. COMET algorithm

The COMET method is completely free of the Rank Reversal phenomenon. In the previous works, the accuracy of the COMET method was verified [2]. The formal notation of the COMET method should be briefly recalled [1], [2], [8].

Step 1. Define the space of the problem – the expert determines the dimensionality of the problem by selecting *r* criteria, $C_1, C_2, ..., C_r$. Then, a set of fuzzy numbers is

selected for each criterion C_i , e.g., $\{ C_{i1}^{\prime 0}, C_{i2}^{\prime 0}, ..., C_{ic_i}^{\prime 0} \}$ (7):

where $c_1, c_2, ..., c_r$ are the ordinals of the fuzzy numbers for all criteria.

Step 2. Generation of the characteristic objects – the characteristic objects (CO) are obtained with the usage of the Cartesian product of the fuzzy numbers' cores of all the criteria (8)

$$CO = C(C_1) \times C(C_2) \times ... \times C(C_r)$$
(8)
As a result, an ordered set of all *CO* is obtained (9):

$$CO_1 = \{C(\mathcal{C}_{11}^{0}), C(\mathcal{C}_{21}^{0}), ..., C(\mathcal{C}_{r1}^{0})\}$$
(9)

$$CO_2 = \{C(\mathcal{C}_{11}^{0}), C(\mathcal{C}_{21}^{0}), ..., C(\mathcal{C}_{r2}^{0})\}$$
(9)

$$CO_t = \{C(\mathcal{C}_{10}^{0}), C(\mathcal{C}_{2c}^{0}), ..., C(\mathcal{C}_{rc}^{0})\}$$

where *t* is the number of *Cos* and is equal to (10):

$$t = \prod_{i=1}^{r} c_i \tag{10}$$

Step 3. Evaluation of the characteristic objects – the expert determines the Matrix of Expert Judgment (MEJ) by comparing the COs pairwise. The matrix is presented as (11):

$$MEJ = \begin{pmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1t} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2t} \\ \dots & \dots & \dots & \dots \\ \alpha_{t1} & \alpha_{t2} & \dots & \alpha_{tt} \\ CO_1 & CO_2 & \dots & CO_t \end{pmatrix} \begin{pmatrix} CO_1 \\ CO_2 \\ \dots \\ CO_t \end{pmatrix}$$
(11)

where α_{ij} is the result of comparing CO_i and CO_j by the expert. The function f_{exp} denotes the mental judgment function of the expert. It depends solely on the knowledge of

the expert. The expert's preferences can be presented as the following form (12):

$$\alpha_{ij} = f(CO_i, CO_j) = \begin{cases} 0.0, f_{\exp}(CO_i) < f_{\exp}(CO_j) \\ 0.5, f_{\exp}(CO_i) = f_{\exp}(CO_j) \\ 1.0, f_{\exp}(CO_i) > f_{\exp}(CO_j) \end{cases}$$
(12)

The most important properties are described by the formulas (13) and (14):

$$\alpha_{ii} = f(CO_i, CO_i) = 0.5 \tag{13}$$

$$\alpha_{ji} = 1 - \alpha_{ij} \tag{14}$$

Therefore, the number of comparisons is reduced from t^2 cases to *p* cases (15):

$$p = \begin{pmatrix} t \\ 2 \end{pmatrix} = \frac{t(t-1)}{2} \tag{15}$$

After the MEJ matrix is prepared, a vertical vector of the Summed Judgments (SJ) is obtained as follows (16):

$$SJ_i = \sum_{j=1}^t \alpha_{ij} \tag{16}$$

Eventually, the values of preference are approximated for each characteristic object. As a result, a vertical vector P is obtained, where the *i*-th row contains the approximate value of preference for CO_i .

Step 4. The rule base - each characteristic object and its value of preference is converted to a fuzzy rule like the following form (17):

$$IF C(\mathcal{C}_{1i}^{0}) AND C(\mathcal{C}_{2i}^{0}) AND... THEN P_{i}$$
(17)
In this way, a complete fuzzy rule base is obtained (18):
$$IF CO_{1} THAN P_{1}$$
(18)
$$IF CO_{2} THAN P_{2}$$
(18)
$$IF CO_{t} THAN P_{t}$$

Step 5. Inference in a fuzzy model and final ranking – each alternative is presented as a set of crisp numbers, e.g., $A_i = \{a_{1i}, a_{2i}, ..., a_{ri}\}$. This set corresponds to the criteria $C_1, C_2, ..., C_r$. Mamdani's fuzzy inference method is used to compute the preference of the *i*-th alternative. The rule base guarantees that the obtained results are unequivocal. The bijection makes the COMET completely rank reversal free.

4. Software

The Decision Support System (DSS) software has been written by using leading web technologies like HTML, CSS, and JavaScript. The paper presents a simple example to show the software operation.

The decision-making problem is the selection of the bidder in the tender for public investment. Only two criteria are analyzed:

- C1 experience as the number of years of operation on the market (domain $C_1 \in [0,15]$ yrs), and
- C2 price as the total price of the offer in a million PLN (domain C₂ ∈ [10,50] mil PLN).

Let us assume that ten companies $(A_1 - A_{10})$ have applied for the tender and their offers are presented in Table 1. (random data from the criteria domain).

A _i	Experience [yrs]	Price [mil PLN]
A ₁	10	38
A ₂	1	11
A ₃	13	21
A ₄	14	12
A ₅	10	14
A ₆	11	43
A ₇	11	38
A ₈	6	23
A ₉	10	48
A ₁₀	3	11

Table 1. The performance table of the alternatives $A_1 - A_2$	A_{10}
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Fig. 2. The main page of the site www.comet.edu.pl



Fig. 3. The initial window

We enter the project website² (see Fig. 2.) to identify the decision-making model³ and we press the '*Create model*' button in the initial window (see Fig. 3.). Next, we define the dimensionality of the problem (number of criteria). We give the names of all criteria and characteristic values (including domain boundaries). The characteristic values for the experience are chosen as 0, 5, and 15 years; for the price are selected as 10, 30, and 50 mil PLN. The method of entering data is shown in the Fir. 4.

In that way, we obtained nine characteristic objects, and we shall make 36 pairwise comparisons. In the browser window, we see the pairs of characteristic objects, and we have to choose which one is better (there is a possible draw). Fig. 5. presents an exemplary pairwise comparison. After the last comparison, we can save the identified model as an Excel file. There is an available *MEJ* matrix (19), and we can easily calculate *SJ* vector (20). In the next window, we see the complete rule base, and the preference vector (Fig. 6.). Afterward, we can see the visualization of TFNs for all criteria (Fig. 7. and 8.), and we can make an inference by using the identified model.

Experience	0,5,15
Price	10,30,50

Fig. 4. Selecting dimensionality, names, and characteristic values of



Fig. 5. An example of a pairwise comparison.

the chosen criteria.

$\begin{pmatrix} 0.5 \\ 0 \\ 0 \\ 1 \\ 0.5 \\ 0.5 \\ 1 \\ 1 \\ 1 \end{pmatrix}$	1 0.5 0 1 1 0.5 1 1 1	1 1 0.5 1 0.5 1 1 1 1	0 0 0.5 0 0 1 0,5 0	0.5 0 0.5 1 0.5 0 1 1 0,5	$0.5 \\ 0.5 \\ 0 \\ 1 \\ 1 \\ 0.5 \\ 1 \\ 1 \\ 1 \\ 1$	0 0 0 0 0 0.5 0 0	$egin{array}{c} 0 \\ 0 \\ 0.5 \\ 0 \\ 0 \\ 1 \\ 0.5 \\ 0 \end{array}$	$\begin{array}{c} 0 \\ 0 \\ 0 \\ 1 \\ 0.5 \\ 0 \\ 1 \\ 1 \\ 0.5 \end{array}$	(19)
$SJ_i =$	(3.5) 2.0 1.0 7.0 4.0 2.5 8.5 7.0 5.0								(20)
		IF Exp IF Exp IF Exp IF Exp IF Exp	erience: erience: erience: erience: erience:	0 AN 0 AN 0 AN 5 AN 5 AN	ID Price: ID Price: ID Price: ID Price: ID Price:	10 TH 30 TH 50 TH 10 TH 30 TH	HEN 0.42 HEN 0.14 HEN 0.00 HEN 0.85 HEN 0.57	286 429 000 571 714	

Experience: 5 AND Price: 50 THEN Experience: 15 AND Price: 10 THEN

15 AND Price: 15 AND Price: 1.0000

0.8571

30 THEN 50 THEN

Fig. 6. The identified model presents as a rule base.

IF

IE

Experience:

Experience:

² www.comet.edu.pl

³ a short tutorial: <u>www.comet.edu.pl/Fuzzi/manual.pdf</u>



Fig. 7. Visualization of TFNs for criterion C1.



Fig. 8. Visualization of the TFNs for criterion C_2 .

Finally, we select an evaluation for the alternatives set and fill in the form. After the press '*Compute*' button the result will be displayed as shown in Fig. 9 and 10. According to the ranking generated by the COMET method, the A_4 alternative is the best, and the worst is the A_2 alternative (see Table 2.). The Pearson correlation between preference value and experience is 0.5868 (p-value 0.075). The relationship between price and preference is -0.4929 (p-value 0.148). The obtained ranking seems to be rational. However, we cannot forget that this is a purely didactic example, and for real decisional model identification, we need a real expert. In the next section, the brief review of the COMET applications will be presented.

Table 2. The results of the COMET method.

Ai	Experience	Price	P _i	Rank
A_1	10	38	0.628549	7
A ₂	1	11	0.500015	10
A ₃	13	21	0.877117	3
A_4	14	12	0.969992	1
A ₅	10	14	0.885690	2
A ₆	11	43	0.612846	8
A_7	11	38	0.662836	6
A_8	6	23	0.694967	4
A ₉	10	48	0.521425	9
A ₁₀	3	11	0.671414	5

Single alternative	Alternatives set	
Experience	Price	
10	38	Result: 0.628549
1	11	Result: 0.500015
13	21	🛍 Result: 0.877117
14	12	🛍 Result: 0.969992
10	14	🛍 Result: 0.885690
11	43	🛍 Result: 0.612846
11	38	🛍 Result: 0.662836
6	23	🛍 Result: 0.694967
10	48	🛍 Result: 0.521425
3	11	🛍 Result: 0.671414
Ð		Compute

Fig. 9. Inference of preference for a set of alternatives.



Fig. 10. Alternatives and Cos in the space of the problem.

5. Conclusions

The full version of the COMET method was presented for the first time in the paper [1]. Since then COMET has continuously been improved, e.g., reduction of the number of pairwise comparisons [13], [14] or taking into account the uncertainty of data [6], [8], [15]. Presented software is based on the classical version of the COMET method and helps to identify the model with the omission of mathematical nuances. The COMET method has been used to identify a decisional model in such multi-criteria problems as:

- assessing the severity of chronic liver disease 3 criteria were used to compare COMET, AHP and TOPSIS methods according to select the patient with the worst condition. [16],
- the mortality in patients with acute coronary syndrome assessment 3 criteria were used to compare analysis results obtained by COMET, AHP, and TOPSIS methods [2],
- assessing the 10-year risk of hard arteriosclerotic cardiovascular disease events 4 criteria were applied to identify decisional mini-model [17],
- the significance of drainage pumping stations in Poland
 3 criteria were involved in identifying the multi-criteria

model by using COMET, which defines the size drainage pumping stations in Poland [18],

- identify the best e-banking websites in Poland 20 criteria and 21 alternatives have been used to identify decisional mini-model with 1048576 rules [19],
- assessment model of the relationship between editorial and commercial content in web systems – 3 criteria were used to present a hybrid approach that combines the COMET and PROMETHEE II method [20],
- selection of online advertising content for the habituation effect reduction – 2 criteria were involved in identifying three different models, which represent different strategies, by using the COMET method [21],
- the ammonium nitrate transport management 3 criteria have been involved in obtaining model, which was compared to the simple linear model [22],
- the electric powered cars selection 6 criteria were used to choose the most rational solution, and the interval numbers concept is proposed [15],
- location assessment for renewable energy sources 10 criteria were proposed to solve the problem of offshore wind farm localization [23] and show the modular approach proposed in [14],
- the electric city buses selection 3 criteria were used to compare the classical COMET method and hesitant fuzzy set (HFS) extension [24].

Future works focus mainly on the further development of the software, extended software by including new functionalities, better handling data uncertainty, and generally further development of the COMET method and its popularization.

Acknowledgments

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References:

- Sałabun, W. (2015). The Characteristic Objects Method: A New Distance based Approach to Multicriteria Decision making Problems. Journal of Multi Criteria Decision Analysis, 22(1-2), 37-50.
- [2] Sałabun, W., & Piegat, A. (2017). Comparative analysis of MCDM methods for the assessment of mortality in patients with acute coronary syndrome. Artificial Intelligence Review, 48(4), 557-571.
- [3] Sałabun, W. (2014). Application of the fuzzy multicriteria decision-making method to identify nonlinear decision models. Interantional Journal of Computer Applications, 89(15), 1-6
- [4] Piegat, A., Sałabun, W. (2012). Nonlinearity of human multi-criteria in decision-making. Journal of Theoretical and Applied Computer Science, 6(3), 36-49.
- [5] Piegat, A., Sałabun, W. (2014). Identification of a multicriteria decision-making model using the characteristic objects method. Applied Computational Intelligence and Soft Computing, 2014, 14.
- [6] Faizi, S., Rashid, T., Sałabun, W., Zafar, S., & Wątróbski, J. (2018). Decision making with uncertainty using hesitant fuzzy sets. International Journal of Fuzzy Systems, 20(1), 93-103.

- [7] Faizi, S.; Sałabun, W.; Rashid, T.; Wątróbski, J.; Zafar, S. Group Decision-Making for Hesitant Fuzzy Sets Based on Characteristic Objects Method. Symmetry 2017, 9, 136.
- [8] Sałabun, W., Karczmarczyk, A., Wątróbski, J., & Jankowski, J. (2018, November). Handling Data Uncertainty in Decision Making with COMET. In 2018 IEEE Symposium Series on Computational Intelligence (SSCI) (pp. 1478-1484). IEEE.
- [9] Zadeh, L. A. (1965). Fuzzy sets. Information and control, 8(3), 338–353.
- [10] Pedrycz, W., Ekel, P., & Parreiras, R. (2011). Fuzzy multicriteria decision-making: models, methods and applications. John Wiley & Sons.
- [11] Yager, R. R., & Filev, D. P. (1994). Essentials of fuzzy modeling and control. New York, 388.
- [12] Piegat, A. (2013). Fuzzy modeling and control (Vol. 69). Physica.
- [13] Sałabun, W. (2014). Reduction in the number of comparisons required to create matrix of expert judgment in the comet method. Management and Production Engineering Review, 5(3), 62-69
- [14] Sałabun, W. (2015). Fuzzy Multi-Criteria Decision-Making Method: the Modular Approach in the Characteristic Objects Method. Studies & Proceedings of Polish Association for Knowledge Management, 77, 54-64.
- [15] Sałabun, W., & Karczmarczyk, A. (2018). Using the comet method in the sustainable city transport problem: an empirical study of the electric powered cars. Procedia computer science, 126, 2248-2260.
- [16] Piegat, A., Sałabun, W. (2015, June). Comparative analysis of MCDM methods for assessing the severity of chronic liver disease. In International Conference on Artificial Intelligence and Soft Computing (pp. 228-238). Springer, Cham
- [17] Sałabun, W. (2015). Assessing the 10-year risk of hard arteriosclerotic cardiovascular disease events using the characteristic objects method. Studies & Proceedings Polish Association for Knowledge Management, 77, 65-76.
- [18] Sałabun, W., Napierała, M., Bykowski, J. (2015). The Identification of Multi-Criteria Model of the Signicficance of Drainage Pumping Stations in Poland. Acta Scientiarum Polonorum. Formatio Circumiectus, 14(3), 147-163.
- [19] Chmielarz, W., & Zborowski, M. (2018). On Analysis of e-Banking Websites Quality–Comet Application. Procedia Computer Science, 126, 2137-2152.
- [20] Jankowski, J., Sałabun, W., Wątróbski, J. (2017). Identification of a multi-criteria assessment model of relation between editorial and commercial content in web systems. In Multimedia and Network Information Systems (pp. 295-305). Springer International Publishing.
- [21] Lewandowska, A., Jankowski, J., Sałabun, W., & Wątróbski, J. (2019, April). Multicriteria Selection of Online Advertising Content for the Habituation Effect Reduction. In Asian Conference on Intelligent

Information and Database Systems (pp. 499-509). Springer, Cham.

- [22] Wątróbski, J., Sałabun, W., Karczmarczyk, A., & Wolski, W. (2017, September). Sustainable decisionmaking using the COMET method: An empirical study of the ammonium nitrate transport management. In 2017 Federated Conference on Computer Science and Information Systems (FedCSIS) (pp. 949-958). IEEE.
- [23] Sałabun, W., Wątróbski, J., & Piegat, A. (2016, June). Identification of a Multi-criteria Model of Location Assessment for Renewable Energy Sources. In International Conference on Artificial Intelligence and Soft Computing (pp. 321-332). Springer, Cham.
- [24] Sałabun, W., Karczmarczyk, A., & Wątróbski, J. (2018, November). Decision-Making using the Hesitant Fuzzy Sets COMET Method: An Empirical Study of the Electric City Buses Selection. In 2018 IEEE Symposium Series on Computational Intelligence (SSCI) (pp. 1485-1492). IEEE.

Decision Support System for supporting MCDM/A ranking problems with partial information based on FITradeoff

Eduarda Asfora Frej¹, Rodrigo José Pires Ferreira¹

¹Universidade Federal de Pernambuco, Center for Decision Systems and Information Development, Brazil

Introduction

In multicriteria decision making/aiding (MCDM/A) additive models, one of the major challenges is how best to elicit criteria scaling constants, since these parameters are not related only to the level of importance of the criteria, but a scaling factor has also to be considered. Traditional procedures for preference elicitation in additive models – such as the traditional *tradeoff* procedure (Keeney & Raiffa, 1976) and the *swing* procedure (Von Winterfeldt & Edwards, 1986) – sometimes require decision-makers (DMs) to provide precise information which they find is difficult and highly cognitively demanding to do, especially as some inconsistencies may emerge when this information applied (Borcherding et al., 1991). This issue has prompted the development of several methods that work with partial information as to the DMs' preferences.

A recently developed partial information method is the Flexible and Interactive Tradeoff (FITradeoff) method (de Almeida et al., 2016). By preserving the whole axiomatic structure of the traditional tradeoff procedure, this method works based on DMs giving preference statements, which are obtained by a question-and-answer process, operated while an interactive Decision Support System (DSS) is being run. Based on these statements, inequalities with the criteria weights are obtained and incorporated as constraints into a linear programming problem (LPP) model, which runs at each interaction in order to search for potentially optimal alternatives. When a unique alternative is found to be potentially optimal, the choice problematic is solved.

Although it has been shown to be a useful approach for solving choice problems based on the concept of the potential optimality of the alternatives, the original conception of the FITradeoff method is only suitable for solving problems within the scope of the choice problematic. The potential optimality approach is not sufficient to build a ranking of the alternatives.

In this context, Frej et al. (2019) developed a new approach for solving ranking problems based on the whole structured elicitation process of the FITradeoff method, but which incorporates the verification of pairwise dominance relations between alternatives into the mathematical model of FITradeoff. Based on these relations, it becomes possible to build a ranking of the alternatives. This method is operated by means of a Decision Support system, which is described in the next section.

Decision Support System for the ranking problematic using FITradeoff

The Decision Support System of the FITradeoff for the ranking problematic was developed for the Windows platform. It is available for download on request at www.fitradeoff.org/download.

First, the DM defines a consequence matrix and some features of the problem. Then, the DM ranks the criteria weights according to his/her own preferences, considering the ranges of consequences in each criterion. This step can be conducted by making a holistic evaluation of the criteria or by pairwise comparison.

Once the ranking of criteria weights is completed, an interactive question-and-answer process starts. In this step, the DM answers questions in which he/she has to state his/her preference between two hypothetical alternatives. Fig 1 illustrates an example of a question put to a DM during this step. The first hypothetical alternative, on the left side of the screen, has an intermediate outcome for the first-ranked criterion and the worst possible outcome for all other criteria. The other hypothetical alternative, on the right side of the screen, has the best possible outcome for the second-ranked criterion, and the worst possible outcome for the others. The DM should decide which of these alternatives he/she prefers according to his/her preferences.



Fig.1. Elicitation question in FITradeoff DSS.

Based on this preference statement, an inequality involving the scaling constants of criteria 1 and 2 is obtained. As the DM answers more questions of this type, more inequalities are obtained. These inequalities act as constraints for LPP models that run, at each interaction, in order to search for pairwise dominance relations between alternatives.

Based on these relations obtained by the LPPs, a partial – or complete – ranking of the alternatives is built. The more information the DM gives, the more complete is the ranking. After each interaction, the DM may visualize the partial results obtained up until that moment. The DSS provides graphical visualization of the ranking obtained at that point, from which it is possible to visualize the dominance relations between alternatives. Fig 2 illustrates an example of the ranking visualization diagram of a partial ranking. This diagram is similar to a Hasse diagram, which has the transitivity reduction property. This feature makes the diagram simpler to visualize, and therefore unnecessary cognitive effort is avoided.



Fig.2. Diagram that displays the ranking in FITradeoff DSS

The question-and-answer process in the DSS is conducted until a complete ranking of the alternatives is achieved, or the DM may choose to stop the process before that, if he/she thinks that the partial ranking obtained is already enough for his/her purposes.

Final remarks

The DSS of the FITradeoff for the ranking problematic is a flexible and interactive system for aiding decision-making processes in which the goal is to build a ranking of the alternatives. This approach expands the applicability of the FITradeoff method to a broader range of problems, since the original conception of FITradeoff was suitable only for solving choice problematic.

The diagram that enables the ranking to be visualized is a useful tool incorporated into the DSS that lets DMs have an idea of how the ranking evolves during the process, based on the new dominance relations that are obtained at each step and thus the ranking progressively becomes more and more refined.

References

Borcherding, Katrin; Eppel, Thomas; Von Winterfeldt, Detlof (1991). Comparison of weighting judgments in multiattribute utility measurement. *Management science*, v. 37, n. 12, p. 1603-1619.

de Almeida, A. T.; Almeida, J. A.; Costa, A. P. C. S.; Almeida-Filho, A. T. (2016). A new method for elicitation of criteria weights in additive models: Flexible and interactive tradeoff. European Journal of Operational Research, v. 250, n. 1, p. 179-191.

Frej, E. A.; de Almeida, A. T., Costa, A. P. C. S. (2019). Using data visualization for ranking alternatives with partial information and interactive tradeoff elicitation. Operational Research, 2019. doi: 10.1007/s12351-018-00444-2.

Keeney, R.L.; Raiffa, H. (1976). *Decision analysis with multiple conflicting objectives*. Wiley & Sons, New York.

The website of the FITradeoff method: http://www.fitradeoff.org/

Von Winterfeldt, D.; Edwards, W. (1986). Decision analysis and behavioral research.

Preference – Supplier of tools for aiding decisions under strong uncertainty

Kjell Borking, Mats Danielson, Love Ekenberg and Aron Larsson

Preference AB, Universitetsvägen 8 SE-114 18 Stockholm Sweden

Abstract

The requirement to assign precise numerical values to model entities such as criteria weights, probabilities, and utilities is too strong in most real-life decision situations, and hence alternative representations and evaluation mechanisms are important to consider. In this paper, we briefly present the activities of the company Preference and its main software products: DecideIT 3.0 decision tool, Decision Wizard, and Business Risk Solver. The tools are based on a belief mass interpretation of the decision information, where the components are imprecise by means of intervals and qualitative estimates.

Introduction

Preference is a world-leading Swedish company based on hundreds of research papers, software programs and other IPs such as patents. The approach favoured by the company is somewhat original since it takes uncertainty seriously. More precisely, they view numerically precise probability, utility, and weight estimates not supported by adequate data or considerations of symmetry with great suspicion. The same holds of course for value judgments. Nowadays, the company is occupied with everything from formal risk and decision analyses to participatory democracy and has been working with customers such as Ericsson Telecom, Vattenfall, and Skanska. Preference develops and maintains the *DecideIT* and Preference Decision Wizard decision software packages for decision analysis, and the Preference Business Risk Solver for project risk analyses.

There have been many suggestions for how to deal with the strong requirements of most decision models and tools to provide precise information, such as the theory of capacities, sets of probability measures, interval probabilities, evidence and possibility theories, fuzzy measures, preference rankings and higher-order probability theory to name just a few in the extensive literature in the fields. Often these theories require significant mathematical knowledge and great care on the part of the decision-maker, and they sometimes include relatively harsh methods for discriminating between decision alternatives. Furthermore, the computational complexity can be high in various respects, which has limited the number of readily available software packages.

Our software have been successfully used in a variety of decision situations, such as large-scale energy planning [Komendatova et al., 2019], demining [Ekenberg et al., 2017], financial risks [Danielson and Ekenberg, 2018], gold mining [Mihai et al., 2015], and many others.

Modelling Decision Structures

Our decision tools are based on a combination of probability based decision trees and multi-criteria hierarchies, where we evaluate the value of the alternatives as expected values derived from decision trees under an overall multi-criteria tree evaluation. Figure 1 shows a combined tree, where the alternatives' values under the weight w_{11} are derived from the entire underlying probabilistic decision tree.



Figure 1. Combined multi-criteria and probabilistic representation

Figure 2 shows the multi-criteria multi-stakeholder tool Decision Wizard, developed for group decisions regarding infrastructure policymaking [Larsson et al., 2018] in Swedish municipalities.



Figure 2. The Group Decision tool Decision Wizard

Evaluating Probabilistic Multi-Criteria Hierarchies

When evaluating with uncertain information, the Preference tools utilise belief distributions that indicate the strengths with which we believe in different values. In the evaluation, we use different distributions for weight and probabilities and values because of the normalisation constraints for the former two; natural candidates are the Dirichlet distribution for weights and probabilities and two- or three-point distributions for values. Using our tools, we can make use of these distributions in the decision evaluation, providing strong means for embedded sensitivity analysis. We thus aim to enable decision-makers and analysts with limited decision theoretical knowledge to use advanced models but to stay focused on the decision context. Figure 3 shows an evaluation window of the *DecideIT* 3.0 tool, where the final alternative ranking can be seen as well as the robustness of the result.



Figure 3. Stacked bar chart evaluation showing the value contribution to an alternative from each criterion, together with the results of a support analysis

Concluding Remarks

It is normally impossible to assign precise numerical values to the different components of a decision model, and there is a strong need for representation and evaluation mechanisms that can handle information incompleteness. We are therefore building software tools, based on an evaluation method using a belief mass interpretation of the data involved, where second-order information can be used for analysing combined decision trees for real-life problems in a variety of sectors. Currently, Preference is engaged in the JPI Urban Europe programme on testing its decision analysis methods in urban planning with many stakeholders involved.⁴

References

N. Komendantova, L. Ekenberg, L. Marashdeh, A. Al-Salaymeh, M. Danielson and J. Linnerooth-Bayer, Are Energy Security Concerns Dominating Environmental Concerns? Evidence from Stakeholder Participation Processes on Energy Transition in Jordan, Climate, 2018.

A. Larsson, T. Fasth, M. Wärnhjelm, L. Ekenberg and M. Danielson, Policy Analysis on the Fly with an Online Multi-Criteria Cardinal Ranking Tool, Journal of Multi-Criteria Decision Analysis, 2018:1–12. https://doi.org/10.1002/mcda.1634. L. Ekenberg, T. Fasth, and A. Larsson, Hazards and Quality Control in Humanitarian Demining, International Journal of Quality & Reliability Management 35(4), pp. 897–913. 2018, doi:10.1108/IJQRM-01-2016-0012.

M. Danielson and L. Ekenberg, Efficient and Sustainable Risk Management in Large Project Portfolios, proceedings of BIR 2018 (17th International Conference on Perspectives in Business Informatics Research), Springer, 2018.

A. Mihai, A. Marincea, and L. Ekenberg, A MCDM Analysis of the Roşia Montană Gold Mining Project, *Sustainability* Vol. 2015(7), pp. 7261–7288, doi:10.3390/su7067261, 2015.



Forthcoming meetings

• 22-24/5/2019 Integer Programming and Combinatorial Optimization -IPCO XX Michigan, USA http://umich.edu/~ipco2019conf/

• 27-29/5/2019 ICDSST 2019 EWG-DSS 5th International Conference on Decision Support System Technology Madeira, Portugal https://icdsst2019.wordpress.com/

• 27-29/5/2019 2019 CORS Conference Saskatoon, Saskatchewan, Canada https://www.cors2019.ca

• 5-7/6/2019 EWGLA XXV - EURO Working Group on Location Analysis Brussels, Belgium http://www.vub.ac.be/en/events/ewgla2019

• 9-12/6/2019 INFORMS-ALIO 2019 Cancun, Mexico http://meetings2.informs.org/wordpress/2019international/

• 10-12/6/2019 INOC 2019 International Network Optimization Conference Avignon, France https://inoc2019.sciencesconf.org/

• 11-15/6/2019 GDN 2019 - 19th International Conference on Group Decision and Negotiation in 2019 a Joint GDN-EWG/BOR meeting Loughborough, UK http://gdnconference.org/gdn2019/

⁴ <u>https://informenlight.preference.nu/</u>

 16-21/6/2019
 The 25th International Conference on Multiple Criteria Decision Making (MCDM 2019)
 Istanbul, Turkey
 http://www.mcdm2019.org/

• 19-21/6/2019 Advances in Decision Analysis Conference Milan, Italy http://connect.informs.org/das/conferences#ADA2019

23-26/6/2019
 EURO 2019
 Dublin, Ireland
 https://www.euro2019dublin.com/

• 25-28/6/2019 Summer School on Preferences, Decisions and Games, Paris, France https://decisionschool.lip6.fr

• 13-17/7/2019 GECCO 2019 - Genetic and Evolutionary Computation Conference Prague, Czech Republic http://gecco-2019.sigevo.org/

• 28-31/7/2019 MIC 2019 - 13th Metaheuristics International Conference Cartagena de Indias, Colombia http://mic2019.uniandes.edu.co

• 3-8/8/2019 Sixth International Conference on Continuous Optimization (ICCOPT) Berlin, Germany https://iccopt2019.berlin/

• 28-30/8/2019 9th IFAC Conference on Manufacturing Modeling, Management and Control MIM 2019 Berlin, Germany https://blog.hwr-berlin.de/mim2019

• 3-6/9/2019 Operations Research 2019 Dresden, Germany http://tu-dresden.de/or2019

• 4-7/9/2019 ODS2019 - XLIX Annual Meeting of AIRO - Italian Operations Research Society Genova, Italy http://www.airoconference.it/ods2019/

• 12-14/9/2019 EUROGEN 2019 Conference - Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems Guimarães, Portugal http://eurogen2019.dep.uminho.pt • 18-20/9/2019 EURO Mini Conference. Modelling and Simulation of Social-Behavioural Phenomena in Creative Societies (MSBC-2019) Vilnius, Lithuania http://www.msbc2019.mii.vu.lt/

• 18-20/9/2019 EWGT 2019 - 22nd edition of the Euro Working Group of Transportation Meeting Barcelona, Spain <u>https://ewgt19.upc.edu/en</u>

• 18-20/9/2019 2nd KTU Big Data school Kaunas, Lithuania https://bigdataschool.ktu.edu

• 19-20/9/2019 Workshop on Robust Optimization Universität Siegen, Germany <u>https://www.wiwi.uni-siegen.de/goerigk/workshop/ro-</u> workshop2019.html

• 25-27/9/2019 SOR '19 The 15th International Symposium on Operations Research in Slovenia Bled, Slovenia http://sor19.fov.uni-mb.si/

• 26-28/9/2019 90th Meeting of EURO Working Group on MCDA IMT Atlantique, Brest, France http://conferences.imt-atlantique.fr/mcda90

• 26-28/9/2019 Medicon 2019 Coimbra, Portugal http://www.medicon2019.org/

• 20-23/10/2019 2019 INFORMS Annual Meeting Seattle, USA http://meetings2.informs.org/wordpress/seattle2019/

• 25-27/10/2019 EWG on Preference Handling Annual meeting @ 6th International Conference on Algorithmic Decision Theory Durham, NC, USA https://conferences.fuqua.duke.edu/adt/

• 28-31/10/2019 MOPGP'2019 Int. Conference on Multiple Objective Programming and Goal Programming Marrakech, Morocco http://www.mopgp.org

• 25-29/11/2019 Summer School on Model-Based Decision Analysis 2019 UNSW Canberra, Australia https://www.unsw.adfa.edu.au/capability-systemscentre/events/summer-school-model-based-decision-analysis-2019

8-11/12/2019
2019 Winter Simulation Conference
Maryland, USA
http://meetings2.informs.org/wordpress/wsc2019/

 April 2020
 91st Meeting of EURO Working Group on MCDA Ispra, Italy
 http://www.cs.put.poznan.pl/ewgmcda/

26-28/4/2020
2020 INFORMS Conference on Business Analytics &
Operations Research
Gaylord Rockies, Aurora, Colorado, USA
<u>https://www.informs.org/Meetings-Conferences/INFORMS-Conference-Calendar</u>

• 21-26/7/2020 IFORS 2020 Seoul, South Korea www.informs.org

 September 2020
 92nd Meeting of EURO Working Group on MCDA Budapest, Hungary
 http://www.cs.put.poznan.pl/ewgmcda/

8-11/11/2020
2020 INFORMS Annual Meeting National Harbor
Gaylord National Resort and Convention Center, Maryland,
USA
https://www.informs.org/Meetings-Conferences/INFORMSConference-Calendar

 April 2021
 93rd Meeting of EURO Working Group on MCDA Cracow, Poland
 http://www.cs.put.poznan.pl/ewgmcda/

• 11-13/4/2021 2021 INFORMS Business Analytics Conference Hyatt Regency Grand Cypress, Orlando, Florida, USA https://www.informs.org/Meetings-Conferences/INFORMS-Conference-Calendar

• 11-14/7/2021 EURO 2021 Athens, Greece https://www.euro-online.org

Seminars

SEMINAIRE «Aide à la décision»

Responsable: Daniel VANDERPOOTEN (le mardi de 13h45 à 15h15)

Prochaines reunions

11 June 2019 - Conférence de **Stéphane Airiau** LAMSADE - Université Paris Dauphine *Génération d'Emploi du Temps: un étude sur le département MIDO*

Web site for Annoucements and Call for Papers: www.cs.put.poznan.pl/ewgmcda



Books

New Perspectives in Multiple Criteria Decision Making

Doumpos, M., Figueira, J.R., Greco, S., Zopounidis, C.

This book provides comprehensive coverage of the latest research on multiple criteria research analysis (MCDA) and related areas, gathering a collection of high-quality chapters prepared by leading scholars in the field. By covering the established streams in MCDA research and simultaneously exploring new and emerging areas of application, it offers a unique reference resource for the future development of MCDA. The book approaches MCDA as one of the most active areas in operations research and management science (OR/MS). It presents not only the significant advances achieved to date, but also the new opportunities and challenges arising for both the theory and practice of MCDA. Among many others, the book addresses behavioral and conceptual aspects of decision aiding and decision making, problem structuring issues in the framework of new technological and socio economic advances, methodological and algorithmic advances for analytical modeling and decision aiding, as well as a number of new application areas in engineering, business, and the social sciences.

https://www.springer.com/gp/book/9783030114817

Call for Participation: International Summer School on "Preferences, Decisions and Games"

June 25-28, 2019, LIP6, Sorbonne University, Paris, France <u>https://decisionschool.lip6.fr/</u>

Purpose and Intended Audience

The purpose of the Summer School is to bring together PhD students, postdoctoral researchers, and researchers interested in mathematical and computational aspects of preference modeling, decision making and game theory. We expect participants with different backgrounds (Operations Research, Artificial Intelligence, Economics). During 4 days, the instructional program will involve two types of activities: lectures given by prominent scientists and workshops during which participants to the school will have the opportunity to present their research and exchange ideas.

Lectures

- Denis Bouyssou (CNRS, Paris Dauphine University): Preference Modeling.
- Matthias Ehrgott (Lancaster University): Multiobjective Combinatorial Optimization.
- Jürgen Eichberger (University of Heidelberg): Decision Under Uncertainty and Risk.
- Michel Grabisch (Paris 1 University): Preference Aggregation with Interacting Criteria.
- Eyke Hüllermeier (Paderborn University): Preference Learning and Recommendation.
- Christophe Labreuche (Thalès Research and Technology): Multicriteria Decision Making in practice.
- Jérôme Lang (CNRS, Paris Dauphine University): Computational Social Choice.
- Patrice Perny (Sorbonne University): Preference-based Optimization.
- Agnieszka Rusinowska (CNRS, CES, Paris School of Economics): Opinion Dynamics in Networks.
- Philippe Solal (Jean Monnet University): Game Theory.
- Stéphane Zuber (CNRS, CES, Paris School of Economics): Inequality Measurement.

The school will be held at Sorbonne University in the center of Paris and is supported by the CNRS (Ecole thematique du CNRS) and by GDR RO (French national group in Operational Research) and LIP6 lab.

Information on the organisation, application procedure and fees are given on https://decisionschool.lip6.fr/

Important Dates:

- Dealine for application : April 30th, 2019.
- Notification of acceptance: May 15th, 2019.

Contact: <u>patrice.perny@lip6.fr</u> | denis.bouyssou@dauphine.fr | <u>michel.grabisch@univ-</u> paris1.fr

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

Policy:

- The Bernard Roy Award of EWG MCDA is a recognition conferred to a researcher under 40 years old for an outstanding contribution to the methodology and/or applications of Multiple Criteria Decision Aiding (MCDA).
- The award will be officially bestowed at the opening session of the EWG 2019 Autumn meeting in Brest, France (https://mcda90.sciencesconf.org/), 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 EURO WG on MCDA.
- A candidature for the Bernard Roy Award of EWG MCDA is composed of the nomination letter along with a recent and detailed CV, up to 5 best publications, as well as a self-description of the achievements up to 3 page long in a standard manuscript format. The nominations must be sent to the Jury chair by the due date of July, 31st 2019.

Selection process:

- Only one award may be assigned on each occasion.
- One person may receive the award at most once in her/his lifetime.
- The jury evaluates the nominees essentially on the basis of their scientific activities (papers in top journals, editorials, relevance of methodological proposals and/or applications...).

Jury: The jury for the current edition is composed of Professors Irène Abi-Zeid, Nuria Agell, José Rui Figueira (chair), Benedetto Matarazzo, and Yannis Siskos.

Timing:

- Deadline for nominations: July, 31st 2019
- The Jury chair informs the EWG coordinators who invite the laureate to the meeting: August 31st 2019.
- Preparation of the diploma by the EWG coordinators. Presentation of the laureate and her/his talk during the EURO WG on MCDA Autumn meeting. An electronic copy of the laureate's presentation handed over to the EWG coordinators will be made available on the EWG on MCDA Web Site.

Applications should be sent to José Rui Figueira at: figueira@tecnico.ulisboa.pt



Articles Harvest

(This section is prepared by Salvatore CORRENTE, salvatore.corrente@unict.it)

(Ai-Chih) Chang, J., Lu, H., (Junmin) Shi, J. (2019). Stockout risk of production-inventory systems with compound Poisson demands. Omega, 83, 181-198.

Abdelhameed, S.A., Moussa, S.M., Khalifa, M.E. (2019). Restricted Sensitive Attributes-based Sequential Anonymization (RSA-SA) approach for privacy-preserving data stream publishing. Knowledge-Based Systems, 164, 1-20.

Abdelmaguid, T.F., Elrashidy, W. (2019). Halting decisions for gas pipeline construction projects using AHP: a case study. Operational Research, 19(1), 179-199.

Abolghasem, S., Solano, F., Bedoya, C.D., Navas, L.P., Pios, A.P., Pinzon, E.A., Medaglia, A.L., Sarmiento, O.L. (2019). A robust DEA-centric location-based decision support system for expanding Recreovía hubs in the city of Bogotá (Colombia). International Transactions in Operational Research, 26(4), 1157-1187.

Abooshahab, M.A., Ekramian, M., Ataei, M., Ebrahimpour-Boroojeny, A. (2019). Time-Delay Estimation in State and Output Equations of Nonlinear Systems Using Optimal Computational Approach. Journal of Optimization Theory and Applications, 180(3), 1036-1064.

Afshari, H., Jaber, M.Y., Searcy, C. (2019). Investigating the effects of learning and forgetting on the feasibility of adopting additive manufacturing in supply chains. Computers & Industrial Engineering, 128, 576-590.

Aggarwal, M. (2019). Confidence soft sets and applications in supplier selection. Computers & Industrial Engineering, 127, 614-624.

Aggarwal, M. (2019). Modelling subjective utility through entropy. Journal of the Operational Research Society, 70(4), 634-654.

Ahire, S.L., Pekgüna, P. (2018). Harvest Hope Food Bank optimizes its promotional strategy to raise donations using integer programming. Interfaces, 48(4), 291-306.

Ahmed, F., Kilic, K. (2019). Fuzzy Analytic Hierarchy Process: A performance analysis of various algorithms. Fuzzy Sets and Systems, 362, 110-128.

Ahmed, L., Mumford, C., Kheiri, A. (2019). Solving urban transit route design problem using selection hyper-heuristics. European Journal of Operational Research, 274(2), 545-559.

Ahrari, A., Deb, K. (2018). A Novel Class of Test Problems for Performance Evaluation of Niching Methods. IEEE Transaction on Evolutionary Computation, 22(6), 909-919.

Akgün, İ., Erdal, H. (2019). Solving an ammunition distribution network design problem using multi-objective mathematical modeling, combined AHP-TOPSIS, and GIS. Computers & Industrial Engineering, 129, 512-528.

Al Chami, Z., Manier, H., Manier, M.-A. (2019). A lexicographic approach for the bi-objective selective pickup

and delivery problem with time windows and paired demands. Annals of Operations Research, 273(1-2), 237-255. Alavi Fard, F., He, J., Ivanov, D., Jie, F. (2019). A utility adjusted newsvendor model with stochastic demand. International Journal of Production Economics, 211, 154-165.

Aleskerov, F., Shvydun, S. (2019). Allocation of Disputable Zones in the Arctic Region. Group Decision and Negotiation, 28(1), 11-42.

Alikhani, R., Torabi, S.A., Altay, N. (2019). Strategic supplier selection under sustainability and risk criteria. International Journal of Production Economics, 208, 69-82.

Alipouri, Y., Sebt, M.H., Ardeshir, A., Chan, W.T. (2019). Solving the FS-RCPSP with hyper-heuristics: A policydriven approach. Journal of the Operational Research Society, 70(3), 403-419.

Allawi, M.F., Jaafar, O., Mohamad Hamzah, F., Koting, S.B., Mohd, N.S.B., El-Shafie, A. (2019). Forecasting hydrological parameters for reservoir system utilizing artificial intelligent models and exploring their influence on operation performance. Knowledge-Based Systems, 163, 907-926.

Allen, T.T., Roychowdhury, S., Liu, E. (2018). Rewardbased Monte Carlo-Bayesian reinforcement learning for cyber preventive maintenance. Computers & Industrial Engineering, 126, 578-594.

Almehdawe, E., Jewkes, B., He, Q.-M. (2019). Optimization in a two-stage multi-server service system with customer priorities. Journal of the Operational Research Society, 70(2), 326-337.

Almeida, B.F., Correia, I., Saldanha-da-Gama, F. (2019). Modeling frameworks for the multi-skill resourceconstrained project scheduling problem: a theoretical and empirical comparison. International Transactions in Operational Research, 26(3), 946-967.

Almohri, H., Chinnam, R.B., Colosimo, M. (2019). Datadriven analytics for benchmarking and optimizing the performance of automotive dealerships. International Journal of Production Economics, 213, 69-80.

Alqahtani, A.Y., Gupta, S.M., Nakashima, K. (2019). Warranty and maintenance analysis of sensor embedded products using internet of things in industry 4.0. International Journal of Production Economics, 208, 483-499.

Al-Siyabi, M., Amin, G.R., Bose, S., Al-Masroori, H. (2019). Peer-judgment risk minimization using DEA cross-evaluation with an application in fishery. Annals of Operations Research, 274(1-2), 39-55.

Alsolami, F., Amin, T., Chikalov, I., Moshkov, M. (2018). Bi-criteria optimization problems for decision rules. Annals of Operations Research, 271(2), 279-295.

Amindoust, A. (2018). A resilient-sustainable based supplier selection model using a hybrid intelligent method. Computers & Industrial Engineering, 126, 122-135.

Amoako-Gyampah, K., Boakye, K.G., Adaku, E., Famiyeh, S. (2019). Supplier relationship management and firm performance in developing economies: A moderated mediation analysis of flexibility capability and ownership structure. International Journal of Production Economics, 208, 160-170.

An, Q., Wen, Y., Ding, T., Li, Y. (2019). Resource sharing and payoff allocation in a three-stage system: Integrating network DEA with the Shapley value method. Omega, 85, 16-25.

Angelopoulos, D., Siskos, Y., Psarras, J. (2019). Disaggregating time series on multiple criteria for robust forecasting: The case of long-term electricity demand in Greece. European Journal of Operational Research, 275(1), 252-265.

Anholcer, M., Fülöp, J. (2019). Deriving priorities from inconsistent PCM using network algorithms. Annals of Operations Research, 274(1-2), 57-74.

Antczak, T. (2019). Exactness of the absolute value penalty function method for nonsmooth (Φ,ρ) -invex optimization problems. International Transactions in Operational Research, 26(4), 1504-1526.

Antheaume, N., Thiel, D., de Corbière, F., Rowe, F., Takeda, H. (2018). An analytical model to investigate the economic and environmental benefits of a supply chain resource-sharing scheme based on collaborative consolidation centres. Journal of the Operational Research Society, 69(12), 1888-1902.

Aouam, T., Vanhoucke, M. (2019). An agency perspective for multi-mode project scheduling with time/cost trade-offs. Computers and Operations Research, 105, 167-186.

Aouni, B., Doumpos, M., Pérez-Gladish, B., Steuer, R.E. (2018). On the increasing importance of multiple criteria decision aid methods for portfolio selection. Journal of the Operational Research Society, 69(10), 1525-1567.

Aragão, D.P., Novaes, A.G.N., Luna, M.M.M. (2019). An agent-based approach to evaluate collaborative strategies in milk-run OEM operations. Computers & Industrial Engineering, 129, 545-555.

Arana-Jiménez, M., Blanco, V. (2019). On a fully fuzzy framework for minimax mixed integer linear programming. Computers & Industrial Engineering, 128, 170-179.

Aravkin, A.Y., Burke, J.V., Drusvyatskiy, D., Friedlander, M.P., Roy, S. (2019). Level-set methods for convex optimization. Mathematical Programming, 174(1-2), 359-390.

Arbib, C., Felici, G., Servilio, M. (2019). Common operation scheduling with general processing times: A branch-and-cut algorithm to minimize the weighted number of tardy jobs. Omega, 84, 18-30.

Ardjmand, E., Shakeri, H., Singh, M., Sanei Bajgiran, O. (2018). Minimizing order picking makespan with multiple pickers in a wave picking warehouse. International Journal of Production Economics, 206, 169-183.

Arlotto, A., Frazelle, A.E., Wei, Y. (2019). Strategic open routing in service networks. Management Science, 65(2), 735-750.

Arnold, F., Gendreau, M., Sörensen, K. (2019). Efficiently solving very large-scale routing problems. Computers and Operations Research, 107, 32-42.

Arnold, F., Sörensen, K. (2019). Knowledge-guided local search for the vehicle routing problem. Computers and Operations Research, 105, 32-46.

Artigues, C., Bourreau, E., Jost, V., Kedad-Sidhoum, S., Ramond, F. (2018). Trains do not vanish: the ROADEF/EURO challenge 2014. Annals of Operations Research, 271(2), 1091-1105. Asadabadi, M.R. (2018). The stratified multi-criteria decision-making method. Knowledge-Based Systems, 162, 115-123.

Asafuddoula, M., Verma, B., Zhang, M. (2018). A Divideand-Conquer-Based Ensemble Classifier Learning by Means of Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 22(5), 762-777.

Asdaghi, F., Soleimani, A. (2019). An effective feature selection method for web spam detection. Knowledge-Based Systems, 166, 198-206.

Asefi, H., Lim, S., Maghrebi, M., Shahparvari, S. (2019). Mathematical modelling and heuristic approaches to the location-routing problem of a cost-effective integrated solid waste management. Annals of Operations Research, 273(1-2), 75-110.

Assimizele, B., Royset, J.O., Bye, R.T., Oppen, J. (2018). Preventing environmental disasters from grounding accidents: A case study of tugboat positioning along the Norwegian coast. Journal of the Operational Research Society, 69(11), 1773-1792.

Aswani, A. (2019). Statistics with set-valued functions: applications to inverse approximate optimization. Mathematical Programming, 174(1-2), 225-251.

Avci, M.G. (2019). Lateral transshipment and expedited shipping in disruption recovery: A mean-CVaR approach. Computers & Industrial Engineering, 130, 35-49.

Azad, N., Hassini, E. (2019). Recovery strategies from major supply disruptions in single and multiple sourcing networks. European Journal of Operational Research, 275(2), 481-501.

Baber, W.W. (2018). Identifying Macro Phases Across the Negotiation Lifecycle. Group Decision and Negotiation, 27(6), 885-903.

Babonneau, F., Haurie, A. (2019). Energy technology environment model with smart grid and robust nodal electricity prices. Annals of Operations Research, 274(1-2), 101-117.

Bacci, L.A., Mello, L.G., Incerti, T., Paulo de Paiva, A., Balestrassi, P.P. (2019). Optimization of combined time series methods to forecast the demand for coffee in Brazil: A new approach using Normal Boundary Intersection coupled with mixture designs of experiments and rotated factor scores. International Journal of Production Economics, 212, 186-211.

Bach, L., Hasle, G., Schulz, C. (2019). Adaptive Large Neighborhood Search on the Graphics Processing Unit. European Journal of Operational Research, 275(1), 53-66.

Baek, S., Kim, D.-Y. (2019). Abrupt variance and discernibility analyses of multi-sensor signals for fault pattern extraction. Computers & Industrial Engineering, 128, 999-1007.

Bag, S., Ghadge, A., Tiwari, M.K. (2019). An integrated recommender system for improved accuracy and aggregate diversity. Computers & Industrial Engineering, 130, 187-197. Bagheri Hosseini, M., Dehghanian, F., Salari, M. (2019). Selective capacitated location-routing problem with incentive-dependent returns in designing used products collection network. European Journal of Operational Research, 272(2), 655-673.

Bagheri, F., Noorossana, R., Najmi, M. (2019). The extent of EFQM effectiveness in routine and non-routine organizations

based on multivariate techniques: an empirical study. Operational Research, 19(1), 237-267.

Bai, C., Shi, B., Liu, F., Sarkis, J. (2019). Banking credit worthiness: Evaluating the complex relationships. Omega, 83, 26-38.

Bai, X., Chin, K.-S., Zhou, Z. (2019). A bi-objective model for location planning of electric vehicle charging stations with GPS trajectory data. Computers & Industrial Engineering, 128, 591-604.

Balaji, A.N., Mukund Nilakantan, J., Nielsen, I., Jawahar, N., Ponnambalam, S.G. (2019). Solving fixed charge transportation problem with truck load constraint using metaheuristics. Annals of Operations Research, 273(1-2), 207-236.

Balbás, A., Garrido, J., Okhrati, R. (2019). Good deal indices in asset pricing: actuarial and financial implications. International Transactions in Operational Research, 26(4), 1475-1503.

Banbara, M., Inoue, K., Kaufmann, B., Okimoto, T., Schaub, T., Soh, T., Tamura, N., Wanko, P. (2019). teaspoon : solving the curriculum-based course timetabling problems with answer set programming. Annals of Operations Research, 275(1), 3-37.

Banguera, L.A., Sepúlveda, J.M., Ternero, R., Vargas, M., Vásquez, Ó.C. (2018). Reverse logistics network design under extended producer responsibility: The case of out-ofuse tires in the Gran Santiago city of Chile. International Journal of Production Economics, 205, 193-200.

Baron, O., Berman, O., Fazel-Zarandi, M.M., Roshanaei, V. (2019). Almost Robust Discrete Optimization. European Journal of Operational Research, 276(2), 451-465.

Basak, I. (2018). Aggregation of group priorities in analytic hierarchy process—When to aggregate and when not to. Journal of Multi-Criteria Decision Analysis, 25(5-6), 162-168.

Basir, S.A., Mazdeh, M.M., Namakshenas, M. (2018). Bilevel genetic algorithms for a two-stage assembly flow-shop scheduling problem with batch delivery system. Computers & Industrial Engineering, 126, 217-231.

Bastos, L.S.L., Marchesi, J.F., Hamacher, S., Fleck, J.L. (2019). A mixed integer programming approach to the patient admission scheduling problem. European Journal of Operational Research, 273(3), 831-840.

Beck, F.G., Biel, K., Glock, C.H. (2019). Integration of energy aspects into the economic lot scheduling problem. International Journal of Production Economics, 209, 399-410.

Bei, X., Zhu, X., Coit, D.W. (2019). A risk-averse stochastic program for integrated system design and preventive maintenance planning. European Journal of Operational Research, 276(2), 536-548.

Bejenaru, A., Pîrvan, M. (2019). Discrete Multivariate Optimal Control. Journal of Optimization Theory and Applications, 180(2), 442-450.

Bektaş, T., Ehmke, J.F., Psaraftis, H.N., Puchinger, J. (2019). The role of operational research in green freight transportation. European Journal of Operational Research, 274(3), 807-823.

Bektaş, T., Gouveia, L., Martínez-Sykora, A., Salazar-González, J.-J. (2019). Balanced vehicle routing: Polyhedral

analysis and branch-and-cut algorithm. European Journal of Operational Research, 273(2), 452-463.

Bektur, G., Saraç, T. (2019). A mathematical model and heuristic algorithms for an unrelated parallel machine scheduling problem with sequence-dependent setup times, machine eligibility restrictions and a common server. Computers and Operations Research, 103, 46-63.

Bélanger, V., Ruiz, A., Soriano, P. (2019). Recent optimization models and trends in location, relocation, and dispatching of emergency medical vehicles. European Journal of Operational Research, 272(1), 1-23.

Belkhamsa, M., Jarboui, B., Masmoudi, M. (2018). Two metaheuristics for solving no-wait operating room surgery scheduling problem under various resource constraints. Computers & Industrial Engineering, 126, 494-506.

Ben Abdelaziz, F., Saadaoui, R., Masmoudi, M. (2018). Single criterion vs. multi-criteria optimal stopping methods for portfolio management. Journal of the Operational Research Society, 69(10), 1557-1567.

Ben Ticha, H., Absi, N., Feillet, D., Quilliot, A. (2019). Multigraph modeling and adaptive large neighborhood search for the vehicle routing problem with time windows. Computers and Operations Research, 104, 113-126.

Benati, S., García, S., Puerto, J. (2018). Mixed integer linear programming and heuristic methods for feature selection in clustering. Journal of the Operational Research Society, 69(9), 1379-1395.

Benavent, E., Corberán, Á., Laganà, D., Vocaturo, F. (2019). The periodic rural postman problem with irregular services on mixed graphs. European Journal of Operational Research, 276(3), 826-839.

Benavides, A.J., Ritt, M. (2018). Fast heuristics for minimizing the makespan in non-permutation flow shops. Computers and Operations Research, 100, 230-243.

Benita, F., López-Ramos, F., Nasini, S. (2019). A bi-level programming approach for global investment strategies with financial intermediation. European Journal of Operational Research, 274(1), 375-390.

Benítez, J., Carpitella, S., Certa, A., Izquierdo, J. (2019). Characterization of the consistent completion of analytic hierarchy process comparison matrices using graph theory. Journal of Multi-Criteria Decision Analysis, 26(1-2), 3-15.

Bentkowska, U., Król, A. (2019). Fuzzy α–C-equivalences. Fuzzy Sets and Systems, 360, 49-64.

Ben-Zvi, T. (2018). Learning automata decision analysis for sensor placement. Journal of the Operational Research Society, 69(9), 1396-1405.

Beretta, V., Harispe, S., Ranwez, S., Mougenot, I. (2018). Truth selection for truth discovery models exploiting ordering relationship among values. Knowledge-Based Systems, 159, 298-308.

Berk, L., Bertsimas, D., Weinstein, A.M., Yan, J. (2019). Prescriptive analytics for human resource planning in the professional services industry. European Journal of Operational Research, 272(2), 636-641.

Besseris, G.J. (2019). Evaluation of robust scale estimators for modified Weibull process capability indices and their bootstrap confidence intervals. Computers & Industrial Engineering, 128, 135-149. Bilbao-Terol, A., Arenas-Parra, M., Cañal-Fernández, V., Obam-Eyang, P.N. (2018). Multi-criteria analysis of the GRI sustainability reports: an application to Socially Responsible Investment. Journal of the Operational Research Society, 69(10), 1576-1598.

Blanco, V., Salmerón, R., Gómez-Haro, S. (2018). A Multicriteria Selection System Based on Player Performance: Case Study—The Spanish ACB Basketball League. Group Decision and Negotiation, 27(6), 1029-1046.

Blot, A., Kessaci, M.-É., Jourdan, L. (2018). Survey and unification of local search techniques in metaheuristics for multi-objective combinatorial optimisation. Journal of Heuristic, 24(6), 853-877.

Bocewicz, G., Banaszak, Z., Nielsen, I. (2019). Multimodal processes prototyping subject to grid-like network and fuzzy operation time constraints. Annals of Operations Research, 273(1-2), 561-585.

Boland, N., Charkhgard, H., Savelsbergh, M. (2019). Preprocessing and cut generation techniques for multiobjective binary programming. European Journal of Operational Research, 274(3), 858-875.

Bonassa, A.C., Cunha, C.B., Isler, C.A. (2019). An exact formulation for the multi-period auto-carrier loading and transportation problem in Brazil. Computers & Industrial Engineering, 129, 144-155.

Boone, C.A., Hazen, B.T., Skipper, J.B., Overstreet, R.E. (2018). A framework for investigating optimization of service parts performance with big data. Annals of Operations Research, 270(1-2), 65-74.

Borgwardt, S., Frongillo, R.M. (2019). Power Diagram Detection with Applications to Information Elicitation. Journal of Optimization Theory and Applications, 181(1), 184-196.

Botte, M., Schöbel, A. (2019). Dominance for multiobjective robust optimization concepts. European Journal of Operational Research, 273(2), 430-440.

Boysen, N., Briskorn, D., Fedtke, S., Schmickerath, M. (2019). Automated sortation conveyors: A survey from an operational research perspective. European Journal of Operational Research, 276(3), 796-815.

Braat, J., Hamers, H., Klijn, F., Slikker, M. (2019). A selfish allocation heuristic in scheduling: Equilibrium and inefficiency bound analysis. European Journal of Operational Research, 273(2), 634-645.

Brandão, L.C., Soares de Mello, J.C.C.B. (2019). A multicriteria approach to the h-index. European Journal of Operational Research, 276(1), 357-363.

Brandt, F., Nickel, S. (2019). The air cargo load planning problem - a consolidated problem definition and literature review on related problems. European Journal of Operational Research, 275(2), 399-410.

Braud, A., Dolques, X., Huchard, M., Le Ber, F. (2018). Generalization effect of quantifiers in a classification based on relational concept analysis. Knowledge-Based Systems, 160, 119-135.

Bravo, M., Rojas, L.P., Parada, V. (2019). An evolutionary algorithm for the multi-objective pick-up and delivery pollution-routing problem. , 26(1), 302-317.

Brech, C.-H., Ernst, A., Kolisch, R. (2019). Scheduling medical residents' training at university hospitals. European Journal of Operational Research, 274(1), 253-366.

Breunig, U., Baldacci, R., Hartl, R.F., Vidal, T. (2019). The electric two-echelon vehicle routing problem. Computers and Operations Research, 103, 198-210.

Bruccoleri, M., Riccobono, F., Größler, A. (2019). Shared Leadership Regulates Operational Team Performance in the Presence of Extreme Decisional Consensus/Conflict: Evidences from Business Process Reengineering. Decision Sciences, 50(1), 46-83.

Brunelli, M., Fedrizzi, M. (2019). A general formulation for some inconsistency indices of pairwise comparisons. Annals of Operations Research, 274(1-2), 155-169.

Brunelli, M., Rezaei, J. (2019). A multiplicative best-worst method for multi-criteria decision making. Operations Research Letters, 47(1), 12-15.

Bruzda, J. (2019). Quantile smoothing in supply chain and logistics forecasting. International Journal of Production Economics, 208, 122-139.

Buchholz, P., Scheftelowitsch, D. (2019). Computation of weighted sums of rewards for concurrent MDPs. Mathematical Methods of Operations Research, 89(1).

Bugata, P., Drotár, P. (2019). Weighted nearest neighbors feature selection. Knowledge-Based Systems, 163, 749-761.

Buisman, M.E., Haijema, R., Akkerman, R., Bloemhof, J.M. (2019). Donation management for menu planning at soup kitchens. European Journal of Operational Research, 272(1), 324-338.

Bukata, L., Šůcha, P., Hanzálek, Z. (2019). Optimizing energy consumption of robotic cells by a Branch & Bound algorithm. Computers and Operations Research, 102, 52-66.

Burdett, R.L., Corry, P., Yarlagadda, P.K.D.V., Eustace, C., Smith, S. (2019). A flexible job shop scheduling approach with operators for coal export terminals. Computers and Operations Research, 104, 15-36.

Burgelman, J., Vanhoucke, M. (2019). Computing project makespan distributions: Markovian PERT networks revisited. Computers and Operations Research, 103, 123-133.

Büyüktahtakın, I.E., Haight, R.G. (2018). A review of operations research models in invasive species management: state of the art, challenges, and future directions. Annals of Operations Research, 271(2), 357-403.

Cabo, M., González-Velarde, J.L., Possani, E., Ríos Solís, Y.Á. (2018). Bi-objective scheduling on a restricted batching machine. Computers and Operations Research, 100, 201-210.

Cai, J., Hu, X., Chen, K., Tadikamalla, P.R., Shang, J. (2019). Supply chain coordination under production yield loss and downside risk aversion. Computers & Industrial Engineering, 127, 353-365.

Cai, M., Lang, G., Fujita, H., Li, Z., Yang, T. (2019). Incremental approaches to updating reducts under dynamic covering granularity. Knowledge-Based Systems, 172, 130-140.

Çalı, S., Balaman, Ş.Y. (2019). Improved decisions for marketing, supply and purchasing: Mining big data through an integration of sentiment analysis and intuitionistic fuzzy multi criteria assessment. Computers & Industrial Engineering, 129, 315-332. Callaghan, B., Salhi, S., Brimberg, J. (2019). Optimal solutions for the continuous p-centre problem and related - neighbour and conditional problems: A relaxation-based algorithm. Journal of the Operational Research Society, 70(2), 192-211.

Calvo, C., Ivorra, C., Liern, V. (2018). Controlling risk through diversification in portfolio selection with nonhistorical information. Journal of the Operational Research Society, 69(10), 1543-1548.

Cami, B.R., Hassanpour, H., Mashayekhi, H. (2019). User preferences modeling using dirichlet process mixture model for a content-based recommender system. Knowledge-Based Systems, 163, 644-655.

Campelo, F., Takahashi, F. (2019). Sample size estimation for power and accuracy in the experimental comparison of algorithms. Journal of Heuristic, 25(2), 305-338.

Candogan, O., Pekec, S. (2018). Efficient allocation and pricing of multifeatured items. Management Science, 64(12), 5521-5543.

Cannella, S., Dominguez, R., Ponte, B., Framinan, J.M. (2018). Capacity restrictions and supply chain performance: Modelling and analysing load-dependent lead times. International Journal of Production Economics, 204, 264-277.

Cánovas-Segura, B., Morales, A., Juarez, J.M., Campos, M., Palacios, F. (2019). A lightweight acquisition of expert rules for interoperable clinical decision support systems. Knowledge-Based Systems, 167, 98-113.

Cao, J.X., Xue, C.C., Jian, M.Y., Yao, X.R. (2019). Research on the station location problem for public bicycle systems under dynamic demand. Computers & Industrial Engineering, 127, 971-980.

Capelle, T., Cortés, C.E., Gendreau, M., Rey, P.A., Rousseau, L.-M. (2019). A column generation approach for location-routing problems with pickup and delivery. European Journal of Operational Research, 272(1), 121-131.

Caprari, E., Cerboni Baiardi, L., Molho, E. (2019). Primal worst and dual best in robust vector optimization. European Journal of Operational Research, 275(3), 830-838.

Cardoso-Grilo, T., Monteiro, M., Oliveira, M.D., Amorim-Lopes, M., Barbosa-Póvoa, A. (2019). From problem structuring to optimization: A multi-methodological framework to assist the planning of medical training. European Journal of Operational Research, 273(2), 662-683.

Çarman, F., Tuncer Şakar, C. (2019). An MCDM-integrated maximum coverage approach for positioning of military surveillance systems. Journal of the Operational Research Society, 70(1), 162-176.

Carrizosa, E., Guerrero, V., Romero Morales, D. (2019). Visualization of complex dynamic datasets by means of mathematical optimization. Omega, 86, 125-136.

Caserta, M., Voß, S. (2019). The robust multiple-choice multidimensional knapsack problem. Omega, 86, 16-27.

Castro, O.R., Fritsche, G.M., Pozo, A. (2018). Evaluating selection methods on hyper-heuristic multi-objective particle swarm optimization. Journal of Heuristic, 24(4), 581-616.

Catalano, G., Daraio, C., Diana, M., Gregori, M., Matteucci, G. (2019). Efficiency, effectiveness, and impacts assessment in the rail transport sector: a state-of-the-art critical analysis

of current research. International Transactions in Operational Research, 26(1), 5-40.

Cattaruzza, D., Absi, N., Feillet, D. (2018). Vehicle routing problems with multiple trips. Annals of Operations Research, 271(1), 127-159.

Cavdur, F., Sebatli, A., Kose-Kucuk, M., Rodoplu, C. (2019). A two-phase binary-goal programming-based approach for optimal project-team formation. Journal of the Operational Research Society, 70(4), 689-706.

Ceyhan, G., Köksalan, M., Lokman, B. (2019). Finding a representative nondominated set for multi-objective mixed integer programs. European Journal of Operational Research, 272(1), 61-77.

Chabane, B., Basseur, M., Hao, J.-K. (2019). Lorenz dominance based algorithms to solve a practical multiobjective problem. Computers and Operations Research, 104, 1-14.

Chan, C.K., Zhou, Y., Wong, K.H. (2019). An equilibrium model of the supply chain network under multi-attribute behaviors analysis. European Journal of Operational Research, 275(2), 514-535.

Chand, S., Teyarachakul Prime, S., Sethi, S. (2018). Production planning with multiple production lines: Forward algorithm and insights on process design for volume flexibility. Naval Research Logistics, 65(6-7), 535-549.

Chang, C.-T. (2018). A technique of the salient success and survival aspiration levels for multiple objective/criteria decision-making problems. Journal of the Operational Research Society, 69(12), 1957-1965.

Chang, J.C., Graves, S.C., Kirchain, R.E., Olivetti, E.A. (2019). Integrated planning for design and production in twostage recycling operations. European Journal of Operational Research, 273(2), 535-547.

Chang, K.-H. (2019). A novel supplier selection method that integrates the intuitionistic fuzzy weighted averaging method and a soft set with imprecise data. Annals of Operations Research, 272(1-2), 139-157.

Chang, L., Zhou, Z., Chen, Y., Xu, X., Sun, J., Liao, T., Tan, X. (2018). Akaike Information Criterion-based conjunctive belief rule base learning for complex system modeling. Knowledge-Based Systems, 161, 47-64.

Chang, Z., Ding, J.-Y., Song, S. (2019). Distributionally robust scheduling on parallel machines under moment uncertainty. European Journal of Operational Research, 272(3), 832-846.

Chao, C., Zhihui, T., Baozhen, Y. (2019). Optimization of two-stage location-routing-inventory problem with time-windows in food distribution network. Annals of Operations Research, 273(1-2), 111-134.

Chassein, A., Kinscherff, A. (2019). Complexity of strict robust integer minimum cost flow problems: An overview and further results. Computers and Operations Research, 104, 228-238.

Cheaitou, A., Cariou, P. (2019). Greening of maritime transportation: a multi-objective optimization approach. Annals of Operations Research, 273(1-2), 501-525.

Cheaitou, A., Cheaytou, R. (2019). A two-stage capacity reservation supply contract with risky supplier and forecast updating. International Journal of Production Economics, 209m 42-60.

Chekurov, S., Metsä-Kortelainen, S., Salmi, M., Roda, I., Jussila, A. (2018). The perceived value of additively manufactured digital spare parts in industry: An empirical investigation. International Journal of Production Economics, 205, 87-97.

Chen, B., Zhang, X. (2019). Scheduling with time-of-use costs. European Journal of Operational Research, 274(3), 900-908.

Chen, C., Li, M., Liu, X., Ye, Y. (2019). Extended ADMM and BCD for nonseparable convex minimization models with quadratic coupling terms: convergence analysis and insights. Mathematical Programming, 173(1-2), 37-77.

Chen, J., Köbis, E., Yao, J.-C. (2019). Optimality Conditions and Duality for Robust Nonsmooth Multiobjective Optimization Problems with Constraints. Journal of Optimization Theory and Applications, 181(2), 411-436.

Chen, K., Kou, G., Li, C. (2018). A linear programming model to reduce rank violations while eliciting preference from pairwise comparison matrix. Journal of the Operational Research Society, 69(9), 1512-1523.

Chen, K.-S., Wang, C.-H., Tan, K.-H. (2019). Developing a fuzzy green supplier selection model using six sigma quality indices. International Journal of Production Economics, 212, 1-7.

Chen, M.-C., Wu, P.-J., Hsu, Y.-H. (2019). An effective pricing model for the congestion alleviation of e-commerce logistics. Computers & Industrial Engineering, 129, 368-376. Chen, P.-C., Yu, M.-M., Shih, J.-C., Chang, C.-C., Hsu, S.-H. (2019). A reassessment of the Global Food Security Index by using a hierarchical data envelopment analysis approach. European Journal of Operational Research, 272(2), 687-698.

Chen, S.-B., Zhang, Y.-M., Ding, C.H.Q., Zhang, J., Luo, B. (2019). Extended adaptive Lasso for multi-class and multi-label feature selection. Knowledge-Based Systems, 173, 28-36.

Chen, T., Wang, L.-C., Chiu, M.-C. (2018). A multigranularity approach for estimating the sustainability of a factory simulation model: semiconductor packaging as an example. Operational Research, 18(3), 711-729.

Chen, T., Wang, Y.-C. (2018). A fuzzy collaborative intelligence approach for estimating future yield with DRAM as an example. Operational Research, 18(3), 671-688.

Chen, W., Goh, M. (2019). Mechanism for cooperative partner selection: Dual-factor theory perspective. Computers & Industrial Engineering, 128, 254-263.

Chen, W.-J., Li, C.-N., Shao, Y.-H., Zhang, J., Deng, N.-Y. (2019). 2DRLPP: Robust two-dimensional locality preserving projection with regularization. Knowledge-Based Systems, 169, 53-66.

Chen, X., Li, H., Tan, C. (2019). An intuitionstic fuzzy factorial analysis model for multi-attribute decision-making under random environment. Journal of the Operational Research Society, 70(1), 81-100.

Chen, X., Reinelt, G., Dai, G., Spitz, A. (2019). A mixed integer linear programming model for multi-satellite scheduling. European Journal of Operational Research, 275(2), 687-698.

Chen, Y., Ni, J., Yu, D. (2019). Application developers' product offering strategies in multi-platform markets. European Journal of Operational Research, 273(1), 320-333.

Chen, Y., Yang, L., Jiang, Y., Wahab, M.I.M., Yang, J. (2019). Joint replenishment decision considering shortages, partial demand substitution, and defective items. Computers & Industrial Engineering, 127, 420-435.

Chen, Z.-Y., Fan, Z.-P., Sun, M. (2019). Individual-level social influence identification in social media: A learning-simulation coordinated method. European Journal of Operational Research, 273(3), 1005-1015.

Cheng, C.-Y., Ying, K.-C., Li, S.-F., Hsieh, Y.-C. (2019). Minimizing makespan in mixed no-wait flowshops with sequence-dependent setup times. Computers & Industrial Engineering, 130, 338-347.

Cheng, F., Fu, G., Zhang, X., Qiu, J. (2019). Multi-objective evolutionary algorithm for optimizing the partial area under the ROC curve. Knowledge-Based Systems, 170, 61-69.

Cheng, J.R., Gen, M. (2019). Accelerating genetic algorithms with GPU computing: A selective overview. Computers & Industrial Engineering, 128, 514-525.

Cheng, R., Li, M., Li, K., Yao, X. (2018). Evolutionary Multiobjective Optimization-Based Multimodal Optimization: Fitness Landscape Approximation and Peak Detection. IEEE Transaction on Evolutionary Computation, 22(5), 692-706.

Cheng, Y., Farooq, S. (2018). The role of plants in manufacturing networks: A revisit and extension. International Journal of Production Economics, 206, 15-32.

Chernonog, T., Avinadav, T. (2019). Pricing and advertising in a supply chain of perishable products under asymmetric information. International Journal of Production Economics, 209, 249-264.

Chernonog, T., Avinadav, T., Ben-Zvi, T. (2019). How to set price and quality in a supply chain of virtual products under bi-criteria and risk consideration. International Journal of Production Economics, 209, 156-163.

Cherrafi, A., Garza-Reyes, J.A., Kumar, V., Mishra, N., Ghobadian, A., Elfezazi, S. (2018). Lean, green practices and process innovation: A model for green supply chain performance. International Journal of Production Economics, 206, 79-92.

Chi, Y., Tang, X., Lian, Y., Dong, X., Liu, Y. (2019). A supernetwork-based online post informative quality evaluation model. Knowledge-Based Systems, 168, 10-24.

Chica, M., Chiong, R., Kirley, M., Ishibuchi, H. (2018). A Networked-Player Trust Game and Its Evolutionary Dynamics. IEEE Transaction on Evolutionary Computation, 22(6), 866-878.

Chiou, S.-W. (2018). A data-driven bi-level program for knowledge-based signal control system under uncertainty. Knowledge-Based Systems, 160, 210-227.

Choi, B.-C., Park, M.-J. (2019). A linear time-cost tradeoff problem with multiple interim assessments within multiple projects in parallel. , 128, 651-658.

Choi, T.-M., Guo, S., Liu, N., Shi, X. (2019). Values of food leftover sharing platforms in the sharing economy. International Journal of Production Economics, 213, 23-31.

Choi, T.-M., Zhang, J., Cheng, T.C.E. (2018). Quick Response in Supply Chains with Stochastically Risk Sensitive Retailers*. Decision Sciences, 49(5), 932-957.

Choi, Y., Lee, H., Irani, Z. (2018). Big data-driven fuzzy cognitive map for prioritising IT service procurement in the

public sector. Annals of Operations Research, 270(1-2), 75-104.

Chraibi, A., Osman, I.H., Kharraja, S. (2019). Adaptive layout for operating theatre in hospitals: different mathematical models for optimal layouts. Annals of Operations Research, 272(1-2), 493-527.

Clempner, J.B. (2018). Computing multiobjective Markov chains handled by the extraproximal method. Annals of Operations Research, 271(2), 469-486.

Coelho, G.F., Pinto, L.R. (2018). Kriging-based simulation optimization: An emergency medical system application. Journal of the Operational Research Society, 69(12), 2006-2020.

Cook, W.D., Ramón, N., Ruiz, J.L., Sirvent, I., Zhu, J. (2019). DEA-based benchmarking for performance evaluation in pay-for-performance incentive plans. Omega, 84, 45-54.

Cordone, R., Hosteins, P. (2019). A bi-objective model for the single-machine scheduling problem with rejection cost and total tardiness minimization. Computers and Operations Research, 102, 130-140.

Corominas, A., García-Villoria, A., González, N.-A., Pastor, R. (2019). A multistage graph-based procedure for solving a just-in-time flexible job-shop scheduling problem with machine and time-dependent processing costs. Journal of the Operational Research Society, 70(4), 620-633.

Correcher, J.F., Van den Bossche, T., Alvarez-Valdes, R., Vanden Berghe, G. (2019). The berth allocation problem in terminals with irregular layouts. European Journal of Operational Research, 272(3), 1096-1108.

Corsten, H., Hopf, M., Kasper, B., Thielen, C. (2018). Assortment planning for multiple chain stores. OR Spectrum, 40(4), 875-912.

Corus, D., Oliveto, P.S. (2018). Standard Steady State Genetic Algorithms Can Hillclimb Faster Than Mutation-Only Evolutionary Algorithms. IEEE Transaction on Evolutionary Computation, 22(5), 720-732.

Crama, Y., Grabisch, M., Martello, S. (2018). Surveys in operations research. Annals of Operations Research, 271(1), 3-10.

Cruz, F.R.B., Duarte, A.R., Souza, G.L. (2018). Multiobjective performance improvements of general finite singleserver queueing networks. Journal of Heuristic, 24(5), 757-781.

Cruz, R., Bergsten Mendes, A., Bahiense, L., Wu, Y. (2019). Integrating berth allocation decisions in a fleet composition and periodic routing problem of platform supply vessels. European Journal of Operational Research, 275(1), 334-346.

Csató, L. (2018). Characterization of the Row Geometric Mean Ranking with a Group Consensus Axiom. Group Decision and Negotiation, 27(6), 1011-1027.

Cubitt, R., van de Kuilen, G., Mukerji, S. (2018). The strength of sensitivity to ambiguity. Theory and Decision, 85(3-4), 275-302.

Cui, H., Sošić, G. (2019). Recycling common materials: Effectiveness, optimal decisions, and coordination mechanisms. European Journal of Operational Research, 274(3), 1055-1068.

Cui, L., Song, M., Zhu, L. (2019). Economic evaluation of the trilateral FTA among China, Japan, and South Korea with

big data analytics. Computers & Industrial Engineering, 128, 1040-1051.

Cui, W., Li, L., Lu, Z. (2019). Energy-efficient scheduling for sustainable manufacturing systems with renewable energy resources. Naval Research Logistics, 66(2), 154-173.

Cui, X., Gao, J., Shi, Y., Zhu, S. (2019). Time-consistent and self-coordination strategies for multi-period mean-Conditional Value-at-Risk portfolio selection. European Journal of Operational Research, 276(2), 781-789.

Dal Sasso, V., Djeumou Fomeni, F., Lulli, G., Zografos, K.G. (2019). Planning efficient 4D trajectories in Air Traffic Flow Management. European Journal of Operational Research, 276(2), 676-687.

Damci-Kurt, P., Zhang, M., Marentay, B., Govind, N. (2019). Improving physician schedules by leveraging equalization: Cases from hospitals in U.S. Omega, 85, 182-193.

Damgacioglu, H., Celik, E., Celik, N. (2019). Estimating gene expression from high-dimensional DNA methylation levels in cancer data: A bimodal unsupervised dimension reduction algorithm. Computers & Industrial Engineering, 130, 348-357.

Dan, Y., Hu, B.Q., Qiao, J. (2019). Some results on the degree of symmetry of fuzzy relations. Fuzzy Sets and Systems, 360, 1-32.

Danaf, M., Becker, F., Song, X., Atasoy, B., Ben-Akiva, M. (2019). Online discrete choice models: Applications in personalized recommendations. Decision Support Systems, 119, 35-45.

Dang, Q.-V., Nguyen, C.T., Rudová, H. (2019). Scheduling of mobile robots for transportation and manufacturing tasks. Journal of Heuristic, 25(2), 175-213.

Danielson, M., Ekenberg, L. (2019). An improvement to swing techniques for elicitation in MCDM methods. Knowledge-Based Systems, 168, 70-79.

Danloup, N., Allaoui, H., Goncalves, G. (2018). A comparison of two meta-heuristics for the pickup and delivery problem with transshipment. Computers and Operations Research, 100, 155-171.

Darbari, J.D., Kannan, D., Agarwal, V., Jha, P.C. (2019). Fuzzy criteria programming approach for optimising the TBL performance of closed loop supply chain network design problem. Annals of Operations Research, 273(1-2), 693-738.

D'Ariano, A., Meng, L., Centulio, G., Corman, F. (2019). Integrated stochastic optimization approaches for tactical scheduling of trains and railway infrastructure maintenance. Computers & Industrial Engineering, 127, 1315-1335.

Das, M., Odom, P., Islam, M.R., (Jana) Doppa, J.R., Roth, D., Natarajan, S. (2019). Planning with actively eliciting preferences. Knowledge-Based Systems, 165, 219-227.

Davari, S. (2019). The incremental cooperative design of preventive healthcare networks. Annals of Operations Research, 272(1-2), 445-492.

Davoodi, M. (2019). k-Balanced Center Location problem: A new multi-objective facility location problem. Computers and Operations Research, 105, 68-84.

Davoodi, S.M.R., Goli, A. (2019). An integrated disaster relief model based on covering tour using hybrid Benders decomposition and variable neighborhood search: Application in the Iranian context. Computers & Industrial Engineering, 130, 370-380. De Giovanni, P., Zaccour, G. (2019). A selective survey of game-theoretic models of closed-loop supply chains. 4OR, 17(1).

de la Fuente, D., Vega-Rodríguez, M.A., Pérez, C.J. (2018). Automatic selection of a single solution from the Pareto front to identify key players in social networks. Knowledge-Based Systems, 160, 228-236.

de Matta, R. (2019). Product costing in the strategic formation of a supply chain. Annals of Operations Research, 272(1-2), 389-427.

Deb, K., Hussein, R., Roy, P.C., Toscano-Pulido, G. (2019). A Taxonomy for Metamodeling Frameworks for Evolutionary Multiobjective Optimization. IEEE Transaction on Evolutionary Computation, 23(1), 104-116.

Deb, K., Zhu, L., Kulkarni, S. (2018). Handling Multiple Scenarios in Evolutionary Multiobjective Numerical Optimization. IEEE Transaction on Evolutionary Computation, 22(6), 920-933.

Defryn, C., Sörensen, K., Dullaert, W. (2019). Integrating partner objectives in horizontal logistics optimisation models. Omega, 82, 1-12.

Delorme, X., Dolgui, A., Kovalev, S., Kovalyov, M.Y. (2019). Minimizing the number of workers in a paced mixed-model assembly line. European Journal of Operational Research, 272(1), 188-194.

Demesouka, O.E., Anagnostopoulos, K.P., Siskos, E. (2019). Spatial multicriteria decision support for robust land-use suitability: The case of landfill site selection in Northeastern Greece. European Journal of Operational Research, 272(2), 574-586.

Detti, P., Nicosia, G., Pacifici, A., Zabalo Manrique de Lara, G. (2019). Robust single machine scheduling with a flexible maintenance activity. Computers and Operations Research, 107, 19-31.

Dev, N.K., Shankar, R., Gupta, R., Dong, J. (2019). Multicriteria evaluation of real-time key performance indicators of supply chain with consideration of big data architecture. Computers & Industrial Engineering, 128, 1076-1087.

Dey, O. (2019). A fuzzy random integrated inventory model with imperfect production under optimal vendor investment. Operational Research, 19(1), 101-115.

Dhiman, G., Kumar, V. (2019). Emperor penguin optimizer: A bio-inspired algorithm for engineering problems. Knowledge-Based Systems, 159, 20-50.

Dhiman, G., Kumar, V. (2019). Seagull optimization algorithm: Theory and its applications for large-scale industrial engineering problems. Knowledge-Based Systems, 165, 169-196.

Diabat, A., Jabbarzadeh, A., Khosrojerdi, A. (2019). A perishable product supply chain network design problem with reliability and disruption considerations. International Journal of Production Economics, 212, 125-138.

Ding, H., Fu, Y., Zheng, L., Yan, Z. (2019). Determinants of the competitive advantage of dairy supply chains: Evidence from the Chinese dairy industry. International Journal of Production Economics, 209, 360-373.

Ding, J., Shen, L., Lü, Z., Peng, B. (2019). Parallel machine scheduling with completion-time-based criteria and sequence-dependent deterioration. Computers and Operations Research, 103, 35-45.

Ding, J., Yang, C., Jin, Y., Chai, T. (2019). Generalized Multitasking for Evolutionary Optimization of Expensive Problems. IEEE Transaction on Evolutionary Computation, 23(1), 44-58.

Ding, S. (2019). A novel discrete grey multivariable model and its application in forecasting the output value of China's high-tech industries. Computers & Industrial Engineering, 127, 749-760.

Ding, S., Cong, L., Hu, Q., Jia, H., Shi, Z. (2019). A multiway p-spectral clustering algorithm. Knowledge-Based Systems, 164, 371-377.

Djelassi, S., Diallo, M.F., Zielke, S. (2018). How self-service technology experience evaluation affects waiting time and customer satisfaction? A moderated mediation model. Decision Support Systems, 111, 38-47.

Djeumou Fomeni, F. (2018). A multi-objective optimization approach for the blending problem in the tea industry. International Journal of Production Economics, 205, 179-192.

do Castelo Gouveia, M., Duarte Neves, E., Cândido Dias, L., Henggeler Antunes, C. (2018). Performance evaluation of Portuguese mutual fund portfolios using the value-based DEA method. Journal of the Operational Research Society, 69(10), 1628-1639.

Doan, X.V., Shaw, D. (2019). Resource allocation when planning for simultaneous disasters. European Journal of Operational Research, 274(2), 687-709.

Dobos, I., Vörösmarty, G. (2019). Inventory-related costs in green supplier selection problems with Data Envelopment Analysis (DEA). International Journal of Production Economics, 209, 374-380.

Doerr, K.H., Ferrer, G. (2019). Fuel sharing in expeditionary operations. Computers & Industrial Engineering, 127, 286-296.

Dogru, A.K., Melouk, S.H. (2019). Adaptive appointment scheduling for patient-centered medical homes. Omega, 85, 166-181.

Dokeroglu, T., Sevinc, E. (2019). Evolutionary parallel extreme learning machines for the data classification problem. Computers & Industrial Engineering, 130, 237-249.

Dong, J., Wang, L., Liu, J., Gao, Y., Qi, L., Sun, X. (2019). A procedural texture generation framework based on semantic descriptions. Knowledge-Based Systems, 163, 898-906

Dong, N., Dai, C. (2019). An improvement decompositionbased multi-objective evolutionary algorithm using multisearch strategy. Knowledge-Based Systems, 163, 572-580.

Dong, X.L., Han, D., Dai, Z., Li, L., Zhu, J. (2018). An Accelerated Three-Term Conjugate Gradient Method with Sufficient Descent Condition and Conjugacy Condition. Journal of Optimization Theory and Applications, 179(3), 944-961.

Dong, Y., Zha, Q., Zhang, H., Kou, G., Fujita, H., Chiclana, F., Herrera-Viedma, E. (2018). Consensus reaching in social network group decision making: Research paradigms and challenges. Knowledge-Based Systems, 162, 3-13.

Doolittle, E.K., Kerivin, H.L.M., Wiecek, M.M. (2018). Robust multiobjective optimization with application to Internet routing. Annals of Operations Research, 271(2), 487-525. dos Santos, H.H., Máximo de Souza, R., Souza Aragão, A. (2018). Decision analysis in referrals of children and adolescent victims of violence: An ANP approach. Journal of the Operational Research Society, 69(9), 1483-1492.

Doumpos, M., Figueira, J.R. (2019). A multicriteria outranking approach for modeling corporate credit ratings: An application of the ELECTRE TRI-NC method. Omega, 82, 166-180.

Dowson, O., Philpott, A., Mason, A., Downward, A. (2019). A multi-stage stochastic optimization model of a pastoral dairy farm. European Journal of Operational Research, 274(3), 1077-1089.

Dranichak, G.M., Wiecek, M.M. (2018). On computing highly robust efficient solutions. Journal of Multi-Criteria Decision Analysis, 25(5-6), 177-188.

Dranichak, G.M., Wiecek, M.M. (2019). On highly robust efficient solutions to uncertain multiobjective linear programs. European Journal of Operational Research, 273(1), 20-30.

Drezner, T., Drezner, Z., Kalczynski, P. (2019). The planar multifacility collection depots location problem. Computers and Operations Research, 102, 121-129.

Du, F., Zhang, J., Hu, J., Fei, R. (2019). Discriminative multi-modal deep generative models. Knowledge-Based Systems, 173, 74-82.

Du, Y.-W., Yang, N., Ning, J. (2018). IFS/ER-based largescale multiattribute group decision-making method by considering expert knowledge structure. Knowledge-Based Systems, 162, 124-135.

Duan, L., Ventura, J.A. (2019). A Dynamic Supplier Selection and Inventory Management Model for a Serial Supply Chain with a Novel Supplier Price Break Scheme and Flexible Time Periods. European Journal of Operational Research, 272(3), 979-998.

Dubey, R., Gunasekaran, A., Childe, S.J., Roubaud, D., Fosso Wamba, S., Giannakis, M., Foropon, C. (2019). Big data analytics and organizational culture as complements to swift trust and collaborative performance in the humanitarian supply chain. International Journal of Production Economics, 210, 120-136.

Dukkanci, O., Kara, B.Y., Bektaş, T. (2019). The green location-routing problem. , 105, 187-202.

Dulebenets, M.A. (2019). A Delayed Start Parallel Evolutionary Algorithm for just-in-time truck scheduling at a cross-docking facility. International Journal of Production Economics, 212, 236-258.

Duma, D., Aringhieri, R. (2019). The management of nonelective patients: shared vs. dedicated policies. Omega, 83, 199-212.

Dundar, B., McGarvey, R.G., Aguilar, F.X. (2019). A robust optimisation approach for identifying multi-state collaborations to reduce CO2 emissions. Journal of the Operational Research Society, 70(4), 601-619.

Dunnett, S., Leigh, J., Jackson, L. (2019). Optimising police dispatch for incident response in real time. Journal of the Operational Research Society, 70(2), 269-279.

Durán, G., Durán, S., Marenco, J., Mascialino, F., Rey, P.A. (2019). Scheduling Argentina's professional basketball leagues: A variation on the Travelling Tournament Problem.

European Journal of Operational Research, 275(3), 1126-1138.

Durbach, I.N., Montibeller, G. (2019). Behavioural Analytics: Exploring judgments and choices in large data sets. Journal of the Operational Research Society, 70(2), 255-268.

Dursun, P., Taşkın, Z.C., Altınel, İ.K. (2019). The determination of optimal treatment plans for Volumetric Modulated Arc Therapy (VMAT). European Journal of Operational Research, 272(1), 372-388.

Dutta, G., Rao, H.V., Basu, S., Tiwari, M.K. (2019). Asset liability management model with decision support system for life insurance companies: Computational results. Computers & Industrial Engineering, 128, 985-998.

Džamić, D., Aloise, D., Mladenović, N. (2019). Ascent– descent variable neighborhood decomposition search for community detection by modularity maximization. Annals of Operations Research, 272(1-2), 273-287.

E, H., Cui, Y., Pedrycz, W., Li, Z. (2019). Enhancements of rule-based models through refinements of Fuzzy C-Means. Knowledge-Based Systems, 170, 43-60.

Ecker, G., Yuan, D., Koster, A.M.C.A., Schmeink, A. (2019). Accurate optimization models for interference constrained bandwidth allocation in cellular networks. Computers and Operations Research, 101, 1-12.

Eisenhandler, O., Tzur, M. (2019). The humanitarian pickup and distribution problem. Operations Research, 67(1), 10-32.

Eisenstadt, E., Moshaiov, A. (2018). Decision-making in non-cooperative games with conflicting self-objectives. Journal of Multi-Criteria Decision Analysis, 25(5-6), 130-141.

Ekici, A., Özener, O.Ö., Duran, S. (2019). Cyclic ordering policies from capacitated suppliers under limited cycle time. Computers & Industrial Engineering, 128, 336-345.

El Traboulsi, Y., Dornaika, F., Ruichek, Y. (2018). Semisupervised two phase test sample sparse representation classifier. Knowledge-Based Systems, 160, 16-27.

Elaziz, M.A., Mirjalili, S. (2019). A hyper-heuristic for improving the initial population of whale optimization algorithm. Knowledge-Based Systems, 172, 42-63.

Elaziz, M.A., Xiong, S., Jayasena, K.P.N., Li, L. (2019). Task scheduling in cloud computing based on hybrid moth search algorithm and differential evolution. Knowledge-Based Systems, 169, 39-52.

Elsadany, A.A., Awad, A.M. (2019). Dynamics and chaos control of a duopolistic Bertrand competitions under environmental taxes. Annals of Operations Research, 274(1-2), 211-240.

Enayati, S., Mayorga, M.E., Toro-Díaz, H., Albert, L.A. (2019). Identifying trade-offs in equity and efficiency for simultaneously optimizing location and multipriority dispatch of ambulances. International Transactions in Operational Research, 26(2), 415-438.

Ermis, G., Akkan, C. (2019). Search algorithms for improving the pareto front in a timetabling problem with a solution network-based robustness measure. Annals of Operations Research, 275(1), 101-121.

Ertogral, K., Öztürk, F.S. (2019). An integrated production scheduling and workforce capacity planning model for the

maintenance and repair operations in airline industry. Computers & Industrial Engineering, 127, 832-840.

Escudero, L.F., Monge, J.F., Morales, D.R. (2018). On the time-consistent stochastic dominance risk averse measure for tactical supply chain planning under uncertainty. Computers and Operations Research, 100, 270-286.

Esmaeili-Najafabadi, E., Fallah Nezhad, M.S., Pourmohammadi, H., Honarvar, M., Vahdatzad, M.A. (2019). A joint supplier selection and order allocation model with disruption risks in centralized supply chain. Computers & Industrial Engineering, 127, 734-748.

Estrada-Moreno, A., Savelsbergh, M., Juan, A.A., Panadero, J. (2019). Biased-randomized iterated local search for a multiperiod vehicle routing problem with price discounts for delivery flexibility. International Transactions in Operational Research, 26(4), 1293-1314.

Etebari, F. (2019). A column generation algorithm for the choice-based congested location-pricing problem. Computers & Industrial Engineering, 130, 687-698.

Eun, J., Kim, S.-P., Yih, Y., Tiwari, V. (2019). Scheduling elective surgery patients considering time-dependent health urgency: Modeling and solution approaches. Omega, 86, 137-153.

Ezugwu, A.E. (2019). Enhanced symbiotic organisms search algorithm for unrelated parallel machines manufacturing scheduling with setup times. Knowledge-Based Systems, 172, 15-32.

Fahmideh, M., Beydoun, G. (2019). Big data analytics architecture design—An application in manufacturing systems. Computers & Industrial Engineering, 128, 948-963.

Faiz, T.I., Vogiatzis, C., Noor-E-Alam, M. (2019). A column generation algorithm for vehicle scheduling and routing problems. Computers & Industrial Engineering, 130, 222-236.

Fan, N., Li, J., He, Z., Zhang, C., Li, X. (2019). Regionfiltering correlation tracking. Knowledge-Based Systems, 172, 95-103.

Fang, Y., Liu, Q., Li, M., Laili, Y., Pham, D.T. (2019). Evolutionary many-objective optimization for mixed-model disassembly line balancing with multi-robotic workstations. European Journal of Operational Research, 276(1), 160-174.

Fanjul-Peyro, L., Ruiz, R., Perea, F. (2019). Reformulations and an exact algorithm for unrelated parallel machine scheduling problems with setup times. Computers and Operations Research, 101, 173-182.

Farahani, R.Z., Fallah, S., Ruiz, R., Hosseini, S., Asgari, N. (2019). OR models in urban service facility location: A critical review of applications and future developments. European Journal of Operational Research, 276(1), 1-27.

Fares, M., Moufarrej, A., Jreij, E., Tekli, J., Grosky, W. (2019). Unsupervised word-level affect analysis and propagation in a lexical knowledge graph. Knowledge-Based Systems, 165, 432-459.

Fargnoli, M., Haber, N. (2019). A practical ANP-QFD methodology for dealing with requirements' inner dependency in PSS development. Computers & Industrial Engineering, 127, 536-548.

Fattahi, M., Govindan, K., Keyvanshokooh, E. (2018). A multi-stage stochastic program for supply chain network

redesign problem with price-dependent uncertain demands. Computers and Operations Research, 100, 314-332.

Federgruen, A., Guetta, C.D., Iyengar, G. (2018). Twoechelon distribution systems with random demands and storage constraints. Naval Research Logistics, 65(8), 594-618.

Fei, X., Branke, J., Gulpinar, N. (2019). New Sampling Strategies When Searching for Robust Solutions. IEEE Transaction on Evolutionary Computation, 23(2), 273-287.

Feizabadi, R., Bagherian, M., Moghadam, S.S. (2019). Issues on DEA network models of Färe & Grosskopf and Kao. Computers & Industrial Engineering, 128, 727-735.

Felfel, H., Yahia, W.B., Ayadi, O., Masmoudi, F. (2018). Stochastic multi-site supply chain planning in textile and apparel industry under demand and price uncertainties with risk aversion. Annals of Operations Research, 271(2), 551-574.

Fernández, E., Figueira, J.R., Navarro, J. (2019). An interval extension of the outranking approach and its application to multiple-criteria ordinal classification. Omega, 84, 189-198.

Fernández, J., G.- Tóth, B., L. Redondo, J., M. Ortigosa, P. (2019). The probabilistic customer's choice rule with a threshold attraction value: Effect on the location of competitive facilities in the plane. Computers and Operations Research, 101, 234-249.

Fernández-García, A.J., Iribarne, L., Corral, A., Criado, J., Wang, J.Z. (2019). A recommender system for componentbased applications using machine learning techniques. Knowledge-Based Systems, 164, 68-84.

Ferreira, K.J., Simchi-Levi, D., Wang, H. (2018). Online network revenue management using Thompson sampling. Operations Research, 66(6), 1586-1602.

Ferretti, V., Pluchinotta, I., Tsoukiàs, A. (2019). Studying the generation of alternatives in public policy making processes. European Journal of Operational Research, 273(1), 353-363.

Fichtinger, J., Chan, C.W.-C., Yates, N. (2019). A joint network design and multi-echelon inventory optimisation approach for supply chain segmentation. International Journal of Production Economics, 209, 103-111.

Figielska, E. (2018). Scheduling in a two-stage flowshop with parallel unrelated machines at each stage and shared resources. Computers & Industrial Engineering, 126, 435-450.

Filippi, C., Ogryczak, W., Speranza, M.G. (2019). Bridging k-sum and CVaR optimization in MILP. Computers and Operations Research, 105, 156-166.

Fonseca, G.B., Nogueira, T.H., Ravetti, M.G. (2019). A hybrid Lagrangian metaheuristic for the cross-docking flow shop scheduling problem. European Journal of Operational Research, 275(1), 139-154.

Fontem, B., Smith, J. (2019). Analysis of a chanceconstrained new product risk model with multiple customer classes. European Journal of Operational Research, 272(3), 999-1016.

Foroughi, A.A., Tavassoli, M.H. (2019). Discriminating extreme efficient decision making units in DEA using random weight vectors. Computers & Industrial Engineering, 128, 305-312.

Foulloy, L., Clivillé, V., Berrah, L. (2019). A fuzzy temporal approach to the Overall Equipment Effectiveness

measurement. Computers & Industrial Engineering, 127, 103-115.

Fralix, B. (2018). A new look at a smart polling model. Mathematical Methods of Operations Research, 88(3), 339-367.

Framinan, J.M., Perez-Gonzalez, P., Fernandez-Viagas, V. (2019). Deterministic assembly scheduling problems: A review and classification of concurrent-type scheduling models and solution procedures. European Journal of Operational Research, 273(2), 401-417.

Franz, A., Rieck, J., Zimmermann, J. (2019). Fix-andoptimize procedures for solving the long-term unit commitment problem with pumped storages. Annals of Operations Research, 274(1-2), 241-265.

French, S., Argyris, N. (2018). Decision analysis and political processes. Decision Analysis, 15(4), 208-222.

Fröhlich von Elmbach, A., Scholl, A., Walter, R. (2019). Minimizing the maximal ergonomic burden in intra-hospital patient transportation. European Journal of Operational Research, 276(3), 840-854.

Fu, C., Chang, W., Xu, D., Yang, S. (2019). An evidential reasoning approach based on criterion reliability and solution reliability. Computers & Industrial Engineering, 128, 401-417.

Fu, C., Chang, W., Xue, M., Yang, S. (2019). Multiple criteria group decision making with belief distributions and distributed preference relations. European Journal of Operational Research, 273(2), 623-633.

Fu, C., Lu, W., Pedrycz, W., Yang, J. (2019). Fuzzy granular classification based on the principle of justifiable granularity. Knowledge-Based Systems, 170, 89-101.

Gahm, C., Kanet, J.J., Tuma, A. (2019). On the flexibility of a decision theory-based heuristic for single machine scheduling. Computers and Operations Research, 101, 103-115.

Galagedera, D.U.A. (2019). Modelling social responsibility in mutual fund performance appraisal: A two-stage data envelopment analysis model with non-discretionary first stage output. European Journal of Operational Research, 273(1), 376-389.

Gambella, C., Maggioni, F., Vigo, D. (2019). A stochastic programming model for a tactical solid waste management problem. European Journal of Operational Research, 273(2), 684-694.

Gambella, C., Malaguti, E., Masini, F., Vigo, D. (2018). Optimizing relocation operations in electric car-sharing. Omega, 81, 234-245.

Gandomi, A.H., Kashani, A.R. (2018). Probabilistic evolutionary bound constraint handling for particle swarm optimization. Operational Research, 18(3), 801-823.

Gao, P., Ma, Y., Song, K., Li, C., Wang, F., Xiao, L., Zhang, Y. (2018). High performance visual tracking with circular and structural operators. Knowledge-Based Systems, 161, 240-253.

Gao, X., Lee, G.M. (2019). Moment-based rental prediction for bicycle-sharing transportation systems using a hybrid genetic algorithm and machine learning. Computers & Industrial Engineering, 128, 60-69. Gao, X., Sun, Q., Xu, H., Wei, D., Gao, J. (2019). Multimodel fusion metric learning for image set classification. Knowledge-Based Systems, 164, 253-264.

Gao, Y., Chang, D., Fang, T., Luo, T. (2019). Design and optimization of parking lot in an underground container logistics system. Computers & Industrial Engineering, 130, 327-337.

Gao, Y., Yuan, J., Ng, C.T., Cheng, T.C.E. (2019). A further study on two-agent parallel-batch scheduling with release dates and deteriorating jobs to minimize the makespan. European Journal of Operational Research, 273(1), 74-81.

Garcia, L.P.F., Lehmann, J., de Carvalho, A.C.P.L.F., Lorena, A.C. (2019). New label noise injection methods for the evaluation of noise filters. Knowledge-Based Systems, 163, 693-704.

García-Martínez, G., Guijarro, F., Poyatos, J.A. (2019). Measuring the social responsibility of European companies: a goal programming approach. International Transactions in Operational Research, 26(3), 1074-1095.

Garg, H., Arora, R. (2018). Bonferroni mean aggregation operators under intuitionistic fuzzy soft set environment and their applications to decision-making. Journal of the Operational Research Society, 69(11), 1711-1724.

Garg, H., Kumar, K. (2019). An extended technique for order preference by similarity to ideal solution group decisionmaking method with linguistic interval-valued intuitionistic fuzzy information. Journal of Multi-Criteria Decision Analysis, 26(1-2), 16-26.

Gautam, C., Balaji, R., Sudharsan, K., Tiwari, A., Ahuja, K. (2019). Localized Multiple Kernel learning for Anomaly Detection: One-class Classification. Knowledge-Based Systems, 165, 241-252.

Geiger, M.J., Huber, S., Langton, S., Leschik, M., Lindorf, C., Tüshaus, U. (2018). Multi-attribute assignment of trains to departures in rolling stock management: A contribution to the EURO/ROADEF 2014 Challenge. Annals of Operations Research, 271(2), 1131-1163.

Ghadimi, P., Wang, C., Lim, M.K., Heavey, C. (2019). Intelligent sustainable supplier selection using multi-agent technology: Theory and application for Industry 4.0 supply chains. Computers & Industrial Engineering, 127, 588-600.

Ghaffarinasab, N., Van Woensel, T., Minner, S. (2018). A continuous approximation approach to the planar hub location-routing problem: Modeling and solution algorithms. Computers and Operations Research, 100, 140-154.

Ghasemi Saghand, P., Charkhgard, H., Kwon, C. (2019). A Branch-and-Bound Algorithm for a Class of Mixed Integer Linear Maximum Multiplicative Programs: A Bi-objective Optimization Approach. Computers and Operations Research, 101, 263-274.

Ghassemi Tari, F., Hashemi, Z. (2018). Prioritized K-mean clustering hybrid GA for discounted fixed charge transportation problems. Computers & Industrial Engineering, 126, 63-74.

Ghimatgar, H., Kazemi, K., Helfroush, M.S., Aarabi, A. (2018). An improved feature selection algorithm based on graph clustering and ant colony optimization. Knowledge-Based Systems, 159, 270-285.

Ghodratnama, A., Arbabi, H.R., Azaron, A. (2019). Production planning in industrial townships modeled as hub location-allocation problems considering congestion in manufacturing plants. Computers & Industrial Engineering, 129, 479-501.

Giri, B.C., Dey, S.K. (2019). Game theoretic analysis of a closed-loop supply chain with backup supplier under dual channel recycling. Computers & Industrial Engineering, 129, 179-191.

Glaize, A., Duenas, A., Di Martinelly, C., Fagnot, I. (2018). Healthcare decision-making applications using multicriteria decision analysis: A scoping review. Journal of Multi-Criteria Decision Analysis, 26(1-2), 62-83.

Glock, C.H., Grosse, E.H., Abedinnia, H., Emde, S. (2019). An integrated model to improve ergonomic and economic performance in order picking by rotating pallets. European Journal of Operational Research, 273(2), 516-534.

Glock, C.H., Grosse, E.H., Kim, T., Neumann, W.P., Sobhani, A. (2019). An integrated cost and worker fatigue evaluation model of a packaging process. International Journal of Production Economics, 207, 107-124.

Gnägi, M., Rihm, T., Zimmermann, A., Trautmann, N. (2019). Two continuous-time assignment-based models for the multi-mode resource-constrained project scheduling problem. Computers & Industrial Engineering, 129, 346-353. Gomes, R.J., Guerreiro, A.P., Kuhn, T., Paquete, L. (2018). Implicit enumeration strategies for the hypervolume subset selection problem. Computers and Operations Research, 100, 244-253.

Gómez-Navarro, T., García-Melón, M., Guijarro, F., Preuss, M. (2018). Methodology to assess the market value of companies according to their financial and social responsibility aspects: An AHP approach. Journal of the Operational Research Society, 69(10), 1599-1608.

Gong, M., Li, H., Meng, D., Miao, Q., Liu, J. (2019). Decomposition-Based Evolutionary Multiobjective Optimization to Self-Paced Learning. IEEE Transaction on Evolutionary Computation, 23(2), 288-302.

Gong, M., Pan, K., Xie, Y. (2019). Differential privacy preservation in regression analysis based on relevance. Knowledge-Based Systems, 173, 140-149.

Gong, Z., Zhang, N., Chiclana, F. (2018). The optimization ordering model for intuitionistic fuzzy preference relations with utility functions. Knowledge-Based Systems, 162, 174-184.

González-Ortega, J., Ríos Insua, D., Cano, J. (2019). Adversarial risk analysis for bi-agent influence diagrams: An algorithmic approach. European Journal of Operational Research, 273(3), 1085-1096.

Gossler, T., Wakolbinger, T., Nagurney, A., Daniele, P. (2019). How to increase the impact of disaster relief: A study of transportation rates, framework agreements and product distribution. European Journal of Operational Research, 274(1), 126-141.

Gou, X., Xu, Z., Herrera, F. (2018). Consensus reaching process for large-scale group decision making with double hierarchy hesitant fuzzy linguistic preference relations. Knowledge-Based Systems, 157, 20-33.

Gou, X., Xu, Z., Liao, H., Herrera, F. (2018). Multiple criteria decision making based on distance and similarity measures under double hierarchy hesitant fuzzy linguistic

environment. Computers & Industrial Engineering, 126, 516-530.

Gouveia, L., Leitner, M., Ruthmair, M. (2019). Layered graph approaches for combinatorial optimization problems. Computers and Operations Research, 102, 22-38.

Govindan, K., Agarwal, V., Darbari, J.D., Jha, P.C. (2019). An integrated decision making model for the selection of sustainable forward and reverse logistic providers. Annals of Operations Research, 273(1-2), 607-650.

Govindan, K., Cheng, T.C.E. (2018). Advances in stochastic programming and robust optimization for supply chain planning. Computers and Operations Research, 100, 262-269. Govindan, K., Kadziński, M., Ehling, R., Miebs, G. (2019). Selection of a sustainable third-party reverse logistics provider based on the robustness analysis of an outranking graph kernel conducted with ELECTRE I and SMAA. Omega, 85, 1-15.

Grenouilleau, F., Legrain, A., Lahrichi, N., Rousseau, L.-M. (2019). A set partitioning heuristic for the home health care routing and scheduling problem. European Journal of Operational Research, 275(1), 295-303.

Griffiths, V., Scanlan, J.P., Eres, M.H., Martinez-Sykora, A., Chinchapatnam, P. (2019). Cost-driven build orientation and bin packing of parts in Selective Laser Melting (SLM). European Journal of Operational Research, 273(1), 334-352.

Grimm, V., Grübel, J., Schewe, L., Schmidt, M., Zöttl, G. (2019). Nonconvex equilibrium models for gas market analysis: Failure of standard techniques and alternative modeling approaches. European Journal of Operational Research, 273(3), 1097-1108.

Gubler, T., Larkin, I., Pierce, L. (2018). Doing well by making well: The impact of corporate wellness programs on employee productivity. Management Science, 64(11), 4967-4987.

Guo, J., He, L., Gen, M. (2019). Optimal strategies for the closed-loop supply chain with the consideration of supply disruption and subsidy policy. Computers & Industrial Engineering, 128, 886-893.

Guo, M., Chen, Y.-W., Wang, H., Yang, J.-B., Zhang, K. (2019). The single-period (newsvendor) problem under interval grade uncertainties. European Journal of Operational Research, 273(1), 198-216.

Guo, P. (2019). Focus theory of choice and its application to resolving the St. Petersburg, Allais, and Ellsberg paradoxes and other anomalies. European Journal of Operational Research, 276(3), 1034-1043.

Guo, Q., Tang, L. (2019). Modelling and discrete differential evolution algorithm for order rescheduling problem in steel industry. Computers & Industrial Engineering, 130, 586-596.

Gupta, S., Deep, K. (2019). Improved sine cosine algorithm with crossover scheme for global optimization. Knowledge-Based Systems, 165, 374-406.

Gupta, S.K., Gunasekaran, A., Antony, J., Gupta, S., Bag, S., Roubaud, D. (2019). Systematic literature review of project failures: Current trends and scope for future research. Computers & Industrial Engineering, 127, 274-285.

Gupta, V.K., Ting, Q.U., Tiwari, M.K. (2019). Multi-period price optimization problem for omnichannel retailers accounting for customer heterogeneity. International Journal of Production Economics, 212, 155-167. Haag, F., Lienert, J., Schuwirth, N., Reichert, P. (2019). Identifying non-additive multi-attribute value functions based on uncertain indifference statements. Omega, 85, 49-67.

Habibi, F., Barzinpour, F., Sadjadi, S.J. (2019). A mathematical model for project scheduling and material ordering problem with sustainability considerations: A case study in Iran. Computers & Industrial Engineering, 128, 690-710.

Hafezi, M., Zolfagharinia, H. (2018). Green product development and environmental performance: Investigating the role of government regulations. International Journal of Production Economics, 204, 395-410.

Hajian Heidary, M., Aghaie, A. (2019). Risk averse sourcing in a stochastic supply chain: A simulation-optimization approach. Computers & Industrial Engineering, 130, 62-74.

Halat, K., Hafezalkotob, A. (2019). Modeling carbon regulation policies in inventory decisions of a multi-stage green supply chain: A game theory approach. Computers & Industrial Engineering, 128, 807-830.

Hald, K.S., Mouritsen, J. (2018). The evolution of performance measurement systems in a supply chain: A longitudinal case study on the role of interorganisational factors. International Journal of Production Economics, 205, 256-271.

Haley, M.R. (2018). A moment-free nonparametric quantityof-quality approach to optimal portfolio selection: A role for endogenous shortfall and windfall boundaries?. , 69(10), 1678-1687.

Halman, N., Holzhauser, M., Krumke, S.O. (2018). An FPTAS for the knapsack problem with parametric weights. Operations Research Letters, 46(5), 487-491.

Hamdan, B., Diabat, A. (2019). A two-stage multi-echelon stochastic blood supply chain problem. Computers and Operations Research, 101, 130-143.

Hamel, A.H., Löhne, A. (2018). A set optimization approach to zero-sum matrix games with multi-dimensional payoffs. Mathematical Methods of Operations Research, 88(3), 369-397.

Han, S., Cao, B., Fu, Y., Luo, Z. (2018). A liner shipping competitive model with consideration of service quality management. Annals of Operations Research, 270(1-2), 155-177.

Hariga, M., Shamayleh, A., El-Wehedi, F. (2019). Integrated time-cost tradeoff and resources leveling problems with allowed activity splitting. International Transactions in Operational Research, 26(1), 80-99.

Harju, M., Liesiö, J., Virtanen, K. (2019). Spatial multiattribute decision analysis: Axiomatic foundations and incomplete preference information. European Journal of Operational Research, 275(1), 167-181.

Harju, M., Liesiö, J., Virtanen, K. (2019). Spatial multiattribute decision analysis: Axiomatic foundations and incomplete preference information. European Journal of Operational Research, 275(1), 167-181.

Harks, T., Schröder, M., Vermeulen, D. (2019). Toll caps in privatized road networks. European Journal of Operational Research, 276(3), 947-956.

Hartikainen, M., Miettinen, K., Klamroth, K. (2019). Interactive Nonconvex Pareto Navigator for multiobjective optimization. European Journal of Operational Research, 275(1), 238-251.

Hasan, M., Büyüktahtakın, İ.E., Elamin, E. (2019). A multicriteria ranking algorithm (MCRA) for determining breast cancer therapy. Omega, 82, 83-101.

Hasegawa, S., Kinoshita, Y., Yamada, T., Bracke, S. (2019). Life cycle option selection of disassembly parts for materialbased CO 2 saving rate and recovery cost: Analysis of different market value and labor cost for reused parts in German and Japanese cases. International Journal of Production Economics, 213, 229-242.

He, G., Chen, D., Liao, K., Sun, J., Nie, S. (2019). A methodology for the optimal design of gathering pipeline system in old oilfield during its phased development process. Computers & Industrial Engineering, 130, 14-34.

He, H., Tan, Y., Xing, J. (2019). Unsupervised classification of 12-lead ECG signals using wavelet tensor decomposition and two-dimensional Gaussian spectral clustering. Knowledge-Based Systems, 163, 392-403.

He, L., Chalil Madathil, S., Oberoi, A., Servis, G., Khasawneh, M.T. (2019). A systematic review of research design and modeling techniques in inpatient bed management. Computers & Industrial Engineering, 127, 451-466.

He, L., Liu, X., Laporte, G., Chen, Y., Chen, Y. (2018). An improved adaptive large neighborhood search algorithm for multiple agile satellites scheduling. Computers and Operations Research, 100, 12-25.

He, X., Zhou, Y., Chen, Z. (2019). An Evolution Path-Based Reproduction Operator for Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 23(1), 29-43.

He, X., Zhou, Y., Chen, Z. (2019). Evolutionary Bilevel Optimization Based on Covariance Matrix Adaptation. IEEE Transaction on Evolutionary Computation, 23(2), 258-272.

He, Y., Dyer, J.S., Butler, J.C. (2019). A decision-making model with utility from anticipation and disappointment. Journal of Multi-Criteria Decision Analysis, 26(1-2), 35-50.

He, Y., Liu, F., Cui, J., Han, X., Zhao, Y., Chen, Z., Zhou, D., Zhang, A. (2019). Reliability-oriented design of integrated model of preventive maintenance and quality control policy with time-between-events control chart. Computers & Industrial Engineering, 129, 228-238.

He, Z., Yen, G.G., Yi, Z. (2019). Robust Multiobjective Optimization via Evolutionary Algorithms. IEEE Transaction on Evolutionary Computation, 23(2), 316-330.

He, Z.-F., Yang, M., Gao, Y., Liu, H.-D., Yin, Y. (2019). Joint multi-label classification and label correlations with missing labels and feature selection. Knowledge-Based Systems, 163, 145-158.

Heider, S., Heins, J., Kanet, J.J. (2018). Applying operations research to scheduling work cells in a manufacturing environment. Interfaces, 48(6), 556-565.

Hejazi, T.-H., Badri, H., Yang, K. (2019). A Reliabilitybased Approach for Performance Optimization of Service Industries: An Application to Healthcare Systems. European Journal of Operational Research, 273(3), 1016-1025.

Henke, T., Speranza, M.G., Wäscher, G. (2019). A branchand-cut algorithm for the multi-compartment vehicle routing problem with flexible compartment sizes. Annals of Operations Research, 275(2), 321-338.

Hermelin, D., Kubitza, J.-M., Shabtay, D., Talmon, N., Woeginger, G.J. (2019). Scheduling two agents on a single machine: A parameterized analysis of NP-hard problems. Omega, 83, 275-286.

Hermelin, D., Pinedo, M., Shabtay, D., Talmon, N. (2019). On the parameterized tractability of single machine scheduling with rejection. European Journal of Operational Research, 273(1), 67-73.

Hernandez, F., Gendreau, M., Jabali, O., Rei, W. (2019). A local branching matheuristic for the multi-vehicle routing problem with stochastic demands. Journal of Heuristic, 25(2), 215-245.

Hesaraki, A.F., Dellaert, N.P., de Kok, T. (2019). Generating outpatient chemotherapy appointment templates with balanced flowtime and makespan. European Journal of Operational Research, 275(1), 304-318.

Heydari, J., Zaabi-Ahmadi, P., Choi, T.-M. (2018). Coordinating supply chains with stochastic demand by crashing lead times. Computers and Operations Research, 100, 394-403.

Hien, L.T.K., Nguyen, C.V., Xu, H., Lu, C., Feng, J. (2019). Accelerated Randomized Mirror Descent Algorithms for Composite Non-strongly Convex Optimization. Journal of Optimization Theory and Applications, 181(2), 541-566.

Hinojosa, S., Avalos, O., Oliva, D., Cuevas, E., Pajares, G., Zaldivar, D., Gálvez, J. (2018). Unassisted thresholding based on multi-objective evolutionary algorithms. Knowledge-Based Systems, 159, 221-232.

Hocaoğlu, M.F. (2019). Weapon target assignment optimization for land based multi-air defense systems: A goal programming approach. Computers & Industrial Engineering, 128, 681-689.

Holzmann, T., Smith, J.C. (2019). Shortest path interdiction problem with arc improvement recourse: A multiobjective approach. Naval Research Logistics, 66(3), 230-252.

Hong, I.-H., Chou, C.-C., Lee, P.-K. (2019). Admission control in queue-time loop production-mixed integer programming with Lagrangian relaxation (MIPLAR). Computers & Industrial Engineering, 129, 417-425.

Hong, J., Alzaman, C., Diabat, A., Bulgak, A. (2019). Sustainability dimensions and PM 2.5 in supply chain logistics. Annals of Operations Research, 275(2), 339-366.

Hong, J., Diabat, A., Panicker, V.V., Rajagopalan, S. (2018). A two-stage supply chain problem with fixed costs: An ant colony optimization approach. International Journal of Production Economics, 204, 214-226.

Hosseini, S., Morshedlou, N., Ivanov, D., Sarder, M.D., Barker, K., Khaled, A.A. (2019). Resilient supplier selection and optimal order allocation under disruption risks. International Journal of Production Economics, 213, 124-137.

Hou, F., Triantaphyllou, E. (2019). An iterative approach for achieving consensus when ranking a finite set of alternatives by a group of experts. European Journal of Operational Research, 275(2), 570-579.

Hsieh, C.-C., Putera, R.R. (2018). Mitigating supply disruption with ordering and supply restoration decisions. , 126, 681-690.

Hsu, W.-Y. (2018). A decision-making mechanism for assessing risk factor significance in cardiovascular diseases. Decision Support Systems, 115, 64-77.

Hu, H., Li, X., Zhang, Y., Shang, C., Zhang, S. (2019). Multi-objective location-routing model for hazardous material logistics with traffic restriction constraint in intercity roads. Computers & Industrial Engineering, 128, 861-876.

Hu, Q.-Y., Huang, L., Wang, C.-D., Chao, H.-Y. (2019). Item orientated recommendation by multi-view intact space learning with overlapping. Knowledge-Based Systems, 164, 358-370.

Hu, S., Dong, Z.S. (2019). Supplier selection and prepositioning strategy in humanitarian relief. Omega, 83, 287-298.

Hu, X., Zhu, W., An, B., Jin, P., Xia, W. (2019). A branch and price algorithm for EOS constellation imaging and downloading integrated scheduling problem. Computers and Operations Research, 104, 74-89.

Hu, Y.-C., Jiang, P., Lee, P.-C. (2019). Forecasting tourism demand by incorporating neural networks into Grey–Markov models. Journal of the Operational Research Society, 70(1), 12-20.

Hu, Y.-F., Hou, J.-L., Chien, C.-F. (2019). A UNISON framework for knowledge management of university–industry collaboration and an illustration. Computers & Industrial Engineering, 129, 31-43.

Hu, Z., Tian, J., Feng, G. (2019). A relief supplies purchasing model based on a put option contract. Computers & Industrial Engineering, 127, 253-262.

Hua, H., Hovestadt, L., Tang, P., Li, B. (2019). Integer programming for urban design. European Journal of Operational Research, 274(3), 1125-1137.

Huang, H., Li, Z., Xu, H. (2018). Wholesale Price Auctions for Dual Sourcing under Supply Risk. Decision Sciences, 49(4), 754-780.

Huang, K., Rafiei, R. (2019). Equitable last mile distribution in emergency response. Computers & Industrial Engineering, 127, 887-900.

Huang, M., Tu, J., Chao, X., Jin, D. (2019). Quality risk in logistics outsourcing: A fourth party logistics perspective. European Journal of Operational Research, 276(3), 855-879.

Huang, Y., Yang, L., Tang, T., Gao, Z., Cao, F., Li, K. (2018). Train speed profile optimization with on-board energy storage devices: A dynamic programming based approach. Computers & Industrial Engineering, 126, 149-164.

Huang, Y.-H., Blazquez, C.A., Huang, S.-H., Paredes-Belmar, G., Latorre-Nuñez, G. (2019). Solving the Feeder Vehicle Routing Problem using ant colony optimization. Computers & Industrial Engineering, 127, 520-535.

Hug, N., Prade, H., Richard, G., Serrurier, M. (2019). Analogical proportion-based methods for recommendation – First investigations. Fuzzy Sets and Systems, 110-132.

Husseinzadeh Kashan, A., Tavakkoli-Moghaddam, R., Gen, M. (2019). Find-Fix-Finish-Exploit-Analyze (F3EA) metaheuristic algorithm: An effective algorithm with new evolutionary operators for global optimization. Computers & Industrial Engineering, 128, 192-218. Huynh, Q.N., Chand, S., Singh, H.K., Ray, T. (2018). Genetic Programming With Mixed-Integer Linear Programming-Based Library Search. IEEE Transaction on Evolutionary Computation, 22(5), 733-747.

Hwang, I., Jang, Y.J., Choi, H. (2018). Overhead shuttle design for a flat panel display production line considering the contactless power supply capacity. Computers & Industrial Engineering, 126, 232-242.

Ijadi Maghsoodi, A., Mosavat, M., Hafezalkotob, A., Hafezalkotob, A. (2019). Hybrid hierarchical fuzzy group decision-making based on information axioms and BWM: Prototype design selection. Computers & Industrial Engineering, 127, 788-804.

Ingels, J., Maenhout, B. (2019). Optimised buffer allocation to construct stable personnel shift rosters. Omega, 82, 102-117.

Iosif, A., Gavrilut, A. (2019). A Gould type integral of fuzzy functions. Fuzzy Sets and Systems, 355, 26-41.

Irawan, C.A., Jones, D. (2019). Formulation and solution of a two-stage capacitated facility location problem with multilevel capacities. Annals of Operations Research, 272(1-2), 41-67.

Irawan, C.A., Luis, M., Salhi, S., Imran, A. (2019). The incorporation of fixed cost and multilevel capacities into the discrete and continuous single source capacitated facility location problem. Annals of Operations Research, 275(2), 367-392.

Ishibuchi, H., Imada, R., Setoguchi, Y., Nojima, Y. (2018). Reference Point Specification in Inverted Generational Distance for Triangular Linear Pareto Front. IEEE Transaction on Evolutionary Computation, 22(6), 961-975.

Izadikhah, M., Saen, R.F. (2018). Assessing sustainability of supply chains by chance-constrained two-stage DEA model in the presence of undesirable factors. Computers and Operations Research, 100, 343-367.

Jaggi, C.K., Gupta, M., Kausar, A., Tiwari, S. (2019). Inventory and credit decisions for deteriorating items with displayed stock dependent demand in two-echelon supply chain using Stackelberg and Nash equilibrium solution. Annals of Operations Research, 274(1-2), 309-329.

Jahani, H., Abbasi, B., Alavifard, F., Talluri, S. (2018). Supply chain network redesign with demand and price uncertainty. International Journal of Production Economics, 205, 287-312.

Jajja, M.S.S., Chatha, K.A., Farooq, S. (2018). Impact of supply chain risk on agility performance: Mediating role of supply chain integration. International Journal of Production Economics, 205, 118-138.

James, S., Lanham, E., Mak-Hau, V., Pan, L., Wilkin, T., Wood-Bradley, G. (2018). Identifying items for moderation in a peer assessment framework. Knowledge-Based Systems, 162, 211-219.

Jang, H., Hwang, K., Lee, T., Lee, T. (2019). Designing robust rollout plan for better rural perinatal care system in Korea. European Journal of Operational Research, 274(2), 730-742.

Jansen, S., Atan, Z., Adan, I., Kok, T.D. (2019). Setting optimal planned leadtimes in configure-to-order assembly systems. European Journal of Operational Research, 273(2), 585-595.

Jaszkiewicz, A., Lust, T. (2018). ND-Tree-Based Update: A Fast Algorithm for the Dynamic Nondominance Problem. IEEE Transaction on Evolutionary Computation, 22(5), 778-791.

Jena, S.K., Sarmah, S.P., Sarin, S.C. (2019). Price competition between high and low brand products considering coordination strategy. Computers & Industrial Engineering, 130, 500-511.

Jenkins, P.R., Robbins, M.J., Lunday, B.J. (2018). Examining military medical evacuation dispatching policies utilizing a Markov decision process model of a controlled queueing system. Annals of Operations Research, 271(2), 641-678.

Jha, S.B., Jha, J.K., Tiwari, M.K. (2019). A multi-objective meta-heuristic approach for transit network design and frequency setting problem in a bus transit system. Computers & Industrial Engineering, 130, 166-186.

Jia, Z.-H., Zhuo, X.-X., Leung, J.Y.-T., Li, K. (2019). Integrated production and transportation on parallel batch machines to minimize total weighted delivery time. Computers and Operations Research, 102, 39-51.

Jiang, B., Tang, J., Yan, C. (2019). A stochastic programming model for outpatient appointment scheduling considering unpunctuality. Omega, 82, 70-82.

Jiang, H., Dong, Y. (2019). Structural regularization in quadratic logistic regression model. Knowledge-Based Systems, 163, 842-857.

Jiang, P., Li, C., Li, R., Yang, H. (2019). An innovative hybrid air pollution early-warning system based on pollutants forecasting and Extenics evaluation. Knowledge-Based Systems, 164, 174-192.

Jiang, R. (2019). Risk-sensitive cost models of age replacement policy: Comments and proposals. Journal of the Operational Research Society, 70(4), 548-554.

Jiang, Y.-P., Fan, Z.-P., Liang, H.-M., Sun, M. (2019). An optimization approach for existing home seller-buyer matching. Journal of the Operational Research Society, 70(2), 237-254.

Jiang, Z., Gu, J., Fan, W., Liu, W., Zhu, B. (2019). Qlearning approach to coordinated optimization of passenger inflow control with train skip-stopping on a urban rail transit line. Computers & Industrial Engineering, 127, 1131-1142.

John, R.S., Tóth, S.F., Zabinsky, Z.B. (2018). Optimizing the geometry of wildlife corridors in conservation reserve design. Operations Research, 66(6), 1471-1485.

Johnson, B.L., Porter, A.T., King, J.C., Newman, A.M. (2019). Optimally configuring a measurement system to detect diversions from a nuclear fuel cycle. Annals of Operations Research, 275(2), 393-420.

Jonkman, J., Barbosa-Póvoa, A.P., Bloemhof, J.M. (2019). Integrating harvesting decisions in the design of agro-food supply chains. European Journal of Operational Research, 276(1), 247-258.

Joshi, A.D., Gupta, S.M. (2019). Evaluation of design alternatives of End-Of-Life products using internet of things. International Journal of Production Economics, 208, 281-293.

Jovanovic, R., Tuba, M., Voß, S. (2019). An efficient ant colony optimization algorithm for the blocks relocation problem. European Journal of Operational Research, 274(1), 78-90.

Junqueira, R.D.Á.R., Morabito, R. (2019). Modeling and solving a sugarcane harvest front scheduling problem. International Journal of Production Economics, 213, 150-160.

Kalczynski, P., Drezner, Z. (2019). Locating multiple facilities using the max-sum objective. Computers & Industrial Engineering, 129, 136-143.

Kamis, N.H., Chiclana, F., Levesley, J. (2018). Geo-uninorm consistency control module for preference similarity network hierarchical clustering based consensus model. Knowledge-Based Systems, 162, 103-114.

Kamran, M.A., Karimi, B., Dellaert, N. (2018). Uncertainty in advance scheduling problem in operating room planning. Computers & Industrial Engineering, 126, 252-268.

Kang, Y., Albey, E., Uzsoy, R. (2018). Rounding heuristics for multiple product dynamic lot-sizing in the presence of queueing behavior. Computers and Operations Research, 100, 54-65.

Karatas, M., Onggo, B.S. (2019). Optimising the barrier coverage of a wireless sensor network with hub-and-spoke topology using mathematical and simulation models. Computers and Operations Research, 106, 36-48.

Karatas, M., Yakıcı, E. (2019). An analysis of p-median location problem: Effects of backup service level and demand assignment policy. European Journal of Operational Research, 272(1), 207-218.

Karhi, S. (2018). Semi-online scheduling of two job types on a set of multipurpose machines. Journal of the Operational Research Society, 69(9), 1445-1455.

Karimi Dastjerd, N., Ertogral, K. (2019). A fix-and-optimize heuristic for the integrated fleet sizing and replenishment planning problem with predetermined delivery frequencies. Computers & Industrial Engineering, 127, 778-787.

Karimi, M., Niknamfar, A.H., Niaki, S.T.A. (2019). An application of fuzzy-logic and grey-relational ANP-based SWOT in the ceramic and tile industry. Knowledge-Based Systems, 163, 581-594.

Karsu, Ö., Azizoglu, M. (2019). An exact algorithm for the minimum squared load assignment problem. Computers and Operations Research, 106, 76-90.

Kashef, M., Safari, H., Maleki, M., Cruz-Machado, V. (2018). Solving MCDM problems based on combination of PACMAN and LINMAP. Journal of Multi-Criteria Decision Analysis, 25(5-6), 169-176.

Katsikopoulos, K.V., Durbach, I.N., Stewart, T.J. (2018). When should we use simple decision models? A synthesis of various research strands. Omega, 81, 17-25.

Kaur, H., Singh, S.P. (2019). Flexible dynamic sustainable procurement model. Annals of Operations Research, 273(1-2), 651-691.

Kavikumar, R., Sakthivel, R., Kaviarasan, B., Kwon, O.M., Marshal Anthoni, S. (2019). Non-fragile control design for interval-valued fuzzy systems against nonlinear actuator faults. Fuzzy Sets and Systems, 365, 40-59.

Kaynar, N., Karsu, Ö. (2018). Equitable decision making approaches over allocations of multiple benefits to multiple entities. Omega, 81, 85-98.

Kazemi Tutunchi, G., Fathi, Y. (2019). Effective methods for solving the Bi-criteria p-Center and p-Dispersion problem. Computers and Operations Research, 101, 43-54.

Keenan, P.B., Jankowski, P. (2019). Spatial Decision Support Systems: Three decades on. Decision Support Systems, 116, 64-76.

Kelle, P., Song, J., Jin, M., Schneider, H., Claypool, C. (2019). Evaluation of operational and environmental sustainability tradeoffs in multimodal freight transportation planning. International Journal of Production Economics, 209, 411-420.

Kellner, F., Lienland, B., Utz, S. (2019). An a posteriori decision support methodology for solving the multi-criteria supplier selection problem. European Journal of Operational Research, 272(2), 505-522.

Kenan, N., Jebali, A., Diabat, A. (2018). An integrated flight scheduling and fleet assignment problem under uncertainty. Computers and Operations Research, 100, 333-343.

Kendy Arakaki, R., Luiz Usberti, F. (2019). An efficiencybased path-scanning heuristic for the capacitated arc routing problem. Computers and Operations Research, 103, 288-295. Kerstens, K., Sadeghi, J., Van de Woestyne, I. (2019). Convex and nonconvex input-oriented technical and economic capacity measures: An empirical comparison.

European Journal of Operational Research, 276(2), 699-709. Keskin, M., Çatay, B. (2018). A matheuristic method for the electric vehicle routing problem with time windows and fast chargers. Computers and Operations Research, 100, 172-188. Khalilpourazari, S., Pasandideh, S.H.R. (2019). Modeling and optimization of multi-item multi-constrained EOQ model for growing items. Knowledge-Based Systems, 164, 150-162. Khan, M.H.A., Jain, R., Thakur, L., Kumar, S.K., Tiwari, M.K. (2019). Exploiting co-existence and co-evolution of mutualistic communities: A stable algorithm based on the plant-pollinator interactions. Computers & Industrial Engineering, 128, 637-650.

Khodayifar, S., Raayatpanah, M.A., Pardalos, P.M. (2019). A polynomial time algorithm for the minimum flow problem in time-varying networks. Annals of Operations Research, 272(1-2), 29-39.

Kiatsupaibul, S., Smith, R.L., Zabinsky, Z.B. (2018). Single observation adaptive search for continuous simulation optimization. Operations Research, 66(6), 1713-1727.

Kim, H.-J., Lee, J.-H. (2019). Three-machine flow shop scheduling with overlapping waiting time constraints. Computers and Operations Research, 101, 93-102.

Kınay, Ö.B., Saldanha-da-Gama, F., Kara, B.Y. (2019). On multi-criteria chance-constrained capacitated single-source discrete facility location problems. Omega, 83, 107-122.

King, B., Newman, A. (2018). Optimizing the cutoff grade for an operational underground mine. Interfaces, 48(4), 357-371.

Kitjacharoenchai, P., Ventresca, M., Moshref-Javadi, M., Lee, S., Tanchoco, J.M.A., Brunese, P.A. (2019). Multiple traveling salesman problem with drones: Mathematical model and heuristic approach. Computers & Industrial Engineering, 129, 14-30.

Kline, A., Ahner, D., Hill, R. (2019). The Weapon-Target Assignment Problem. Computers and Operations Research, 105, 226-236.

Knust, F., Xie, L. (2019). Simulated annealing approach to nurse rostering benchmark and real-world instances. Annals of Operations Research, 272(1-2), 187-216.

Koç, Ç., Jabali, O., Mendoza, J.E., Laporte, G. (2019). The electric vehicle routing problem with shared charging stations. International Transactions in Operational Research, 26(4), 1211-1243.

Koch, H., Bortfeldt, A., Wäscher, G. (2018). A hybrid algorithm for the vehicle routing problem with backhauls, time windows and three-dimensional loading constraints. OR Spectrum, 40(4), 1029-1075.

Kokkala, J., Berg, K., Virtanen, K., Poropudas, J. (2019). Rationalizable strategies in games with incomplete preferences. Theory and Decision, 86(2), 185-204.

Kong, G., Jiang, L., Yin, X., Wang, T., Xu, D.-L., Yang, J.-B., Hu, Y. (2018). Combining principal component analysis and the evidential reasoning approach for healthcare quality assessment. Annals of Operations Research, 271(2), 679-699. Kong, T., Seong, K., Song, K., Lee, K. (2018). Two-mode

modularity clustering of parts and activities for cell formation problems. Computers and Operations Research, 100, 77-88.

Konur, D., Geunes, J. (2019). Integrated districting, fleet composition, and inventory planning for a multi-retailer distribution system. Annals of Operations Research, 273(1-2), 527-559.

Kourentzes, N., Barrow, D., Petropoulos, F. (2019). Another look at forecast selection and combination: Evidence from forecast pooling. International Journal of Production Economics, 209, 226-235.

Kovacs, G., Moshtari, M. (2019). A roadmap for higher research quality in humanitarian operations: A methodological perspective. European Journal of Operational Research, 276(2), 395-408.

Kovalyov, M.Y., Kress, D., Meiswinkel, S., Pesch, E. (2019). A parallel machine schedule updating game with compensations and clients averse to uncertain loss. Computers and Operations Research, 103, 148-157.

Koza, D.F. (2019). Liner shipping service scheduling and cargo allocation. European Journal of Operational Research, 275(3), 897-915.

Kraul, S., Fügener, A., Brunner, J.O., Blobner, M. (2019). A robust framework for task-related resident scheduling. European Journal of Operational Research, 276(2), 656-675.

Kress, D., Müller, D., Nossack, J. (2019). A worker constrained flexible job shop scheduling problem with sequence-dependent setup times. OR Spectrum, 41(1), 179-217.

Kritikos, M.N., Ioannou, G. (2019). Two heuristics for the capacitated minimum spanning tree problem with time windows. Journal of the Operational Research Society, 70(4), 555-567.

Kubler, S., Derigent, W., Voisin, A., Robert, J., Le Traon, Y., Viedma, E.H. (2018). Measuring inconsistency and deriving priorities from fuzzy pairwise comparison matrices using the knowledge-based consistency index. Knowledge-Based Systems, 162, 147-160.

Kucukkoc, I. (2019). MILP models to minimise makespan in additive manufacturing machine scheduling problems. Computers and Operations Research, 105, 58-67.

Kucukkoc, I., Li, Z., Karaoglan, A.D., Zhang, D.Z. (2018). Balancing of mixed-model two-sided assembly lines with underground workstations: A mathematical model and ant colony optimization algorithm. International Journal of Production Economics, 205, 228-243.

Kumari, M., Kulkarni, M.S. (2019). Single-measure and multi-measure approach of predictive manufacturing control: A comparative study. Computers & Industrial Engineering, 127, 182-195.

Kundakcı, N. (2019). An integrated method using MACBETH and EDAS methods for evaluating steam boiler alternatives. Journal of Multi-Criteria Decision Analysis, 26(1-2), 27-34.

Kuzmicz, K.A., Pesch, E. (2019). Approaches to empty container repositioning problems in the context of Eurasian intermodal transportation. Omega, 85, 194-213.

Kuzu, K., Soyer, R. (2018). Bayesian modeling of abandonments in ticket queues. Naval Research Logistics, 65(6-7), 499-521.

Kuzyutin, D., Gromova, E., Pankratova, Y. (2018). Sustainable cooperation in multicriteria multistage games. Operations Research Letters, 46(6), 557-562.

Labreuche, C. (2018). An axiomatization of the Choquet integral in the context of multiple criteria decision making without any commensurability assumption. Annals of Operations Research, 271(2), 701-735.

Lagravinese, R., Liberati, P., Resce, G. (2019). Exploring health outcomes by stochastic multicriteria acceptability analysis: An application to Italian regions. European Journal of Operational Research, 274(3), 1168-1179.

Laha, D., Gupta, J.N.D. (2018). An improved cuckoo search algorithm for scheduling jobs on identical parallel machines. Computers & Industrial Engineering, 126, 348-360.

Lai, T.-C., Sotskov, Y.N., Dolgui, A. (2019). The stability radius of an optimal line balance with maximum efficiency for a simple assembly line. European Journal of Operational Research, 274(2), 466-481.

Lamba, K., Singh, S.P., Mishra, N. (2019). Integrated decisions for supplier selection and lot-sizing considering different carbon emission regulations in Big Data environment. Computers & Industrial Engineering, 128, 1052-1062.

Landa, R., Lárraga, G., Toscano, G. (2019). Use of a goalconstraint-based approach for finding the region of interest in multi-objective problems. Journal of Heuristic, 25(1), 107-139.

Lane, D., Husemann, E., Holland, D., Khaled, A. (2019). Understanding foodborne transmission mechanisms for Norovirus: A study for the UK's Food Standards Agency. European Journal of Operational Research, 275(2), 721-736.

Layeb, S.B., Jaoua, A., Jbira, A., Makhlouf, Y. (2018). A simulation-optimization approach for scheduling in stochastic freight transportation. Computers & Industrial Engineering, 126, 99-110.

Ledzewicz, U., Maurer, H., Schättler, H. (2019). Optimal Combined Radio- and Anti-Angiogenic Cancer Therapy. Journal of Optimization Theory and Applications, 180(1), 321-340.

Lee, H., Lim, J., Lee, K., Kim, C.O. (2019). Agent simulation-based ordinal optimisation for new product design. Journal of the Operational Research Society, 70(3), 502-515.

Lee, V.-H., Ooi, K.-B., Chong, A.Y.-L., Sohal, A. (2018). The effects of supply chain management on technological innovation: The mediating role of guanxi. International Journal of Production Economics, 205, 15-29.

Legros, B. (2019). Dynamic repositioning strategy in a bikesharing system; how to prioritize and how to rebalance a bike station. European Journal of Operational Research, 272(2), 740-753.

Legros, B., Jouini, O. (2019). On the scheduling of operations in a chat contact center. European Journal of Operational Research, 274(1), 303-316.

Lejeune, M., Lozin, V., Lozina, I., Ragab, A., Yacout, S. (2019). Recent advances in the theory and practice of Logical Analysis of Data. European Journal of Operational Research, 275(1), 1-15.

Leonor Plá, M., Casasús, T., Liern, V., Carlos Pérez, J. (2018). On the importance of perspective and flexibility for efficiency measurement: effects on the ranking of decision-making units. Journal of the Operational Research Society, 69(10), 1640-1652.

Li, A.-D., He, Z., Wang, Q., Zhang, Y. (2019). Key quality characteristics selection for imbalanced production data using a two-phase bi-objective feature selection method. European Journal of Operational Research, 274(3), 978-989.

Li, B., Xuan, H., Yang, X., Wang, X. (2019). A novel parameterised approximation approach based on bi-level programming for integration transport scheduling problem. Journal of the Operational Research Society, 70(2), 212-225.

Li, C.-L., Hall, N.G. (2019). Work package sizing and project performance. Operations Research, 67(1), 123-142.

Li, C.R., Sarker, B.R., Cui, G., Chen, X.L., Luo, W.L. (2019). An optimal procurement policy for multiple consumable accessories with different lifespan distributions. Computers & Industrial Engineering, 127, 143-157.

Li, D., Nagurney, A., Yu, M. (2018). Consumer learning of product quality with time delay: Insights from spatial price equilibrium models with differentiated products. Omega, 81, 150-168.

Li, F., Zhu, Q., Chen, Z. (2019). Allocating a fixed cost across the decision making units with two-stage network structures. Omega, 83, 139-154.

Li, F., Zhu, Q., Liang, L. (2019). A new data envelopment analysis based approach for fixed cost allocation. Annals of Operations Research, 274(1-2), 347-372.

Li, G., Li, N., Sambandam, N., Sethi, S.P., Zhang, F. (2018). Flow shop scheduling with jobs arriving at different times. International Journal of Production Economics, 206, 250-260.

Li, J., Chen, X., Zhu, Z., Yang, C., Chu, C. (2019). A branch, bound, and remember algorithm for the simple disassembly line balancing problem. Computers and Operations Research, 105, 47-57.

Li, J., Wang, J.-Q., Hu, J.-H. (2019). Consensus building for hesitant fuzzy preference relations with multiplicative consistency. Computers & Industrial Engineering, 128, 387-400.

Li, K., Chen, R., Fu, G., Yao, X. (2019). Two-Archive Evolutionary Algorithm for Constrained Multiobjective Optimization. IEEE Transaction on Evolutionary Computation, 23(2), 303-315. Li, K., Deb, K., Yao, X. (2018). R-Metric: Evaluating the Performance of Preference-Based Evolutionary Multiobjective Optimization Using Reference Points. IEEE Transaction on Evolutionary Computation, 22(6), 821-835.

Li, L., Qin, L., Qu, X., Zhang, J., Wang, Y., Ran, B. (2019). Day-ahead traffic flow forecasting based on a deep belief network optimized by the multi-objective particle swarm algorithm. Knowledge-Based Systems, 172, 1-14.

Li, N., Stanford, D.A., Sharif, A.B., Caron, R.J., Pardhan, A. (2019). Optimising key performance indicator adherence with application to emergency department congestion. European Journal of Operational Research, 272(1), 313-323.

Li, W., Nault, B.R., Ye, H. (2019). Trade-off balancing in scheduling for flow shop production and perioperative processes. European Journal of Operational Research, 273(3), 817-830.

Li, W., Özcan, E., John, R. (2019). A Learning Automata-Based Multiobjective Hyper-Heuristic. IEEE Transaction on Evolutionary Computation, 23(1), 59-73.

Li, W., Wang, S., Rehbock, V. (2019). Numerical Solution of Fractional Optimal Control. Journal of Optimization Theory and Applications, 180(2), 556-573.

Li, X., Li, Y. (2018). On the loss-averse dual-sourcing problem under supply disruption. Computers and Operations Research, 100, 301-313.

Li, X., Li, Y., Huang, Y. (2019). Heuristics and lower bound for minimizing maximum lateness on a batch processing machine with incompatible job families. Computers and Operations Research, 106, 91-101.

Li, X., Liu, Q., Fan, N., He, Z., Wang, H. (2019). Hierarchical spatial-aware Siamese network for thermal infrared object tracking. Knowledge-Based Systems, 166, 71-81.

Li, Y., Abtahi, A.-R., Seyedan, M. (2019). Supply chain performance evaluation using fuzzy network data envelopment analysis: a case study in automotive industry. Annals of Operations Research, 275(2), 461-484.

Li, Y., Guo, H., Zhang, Q., Gu, M., Yang, J. (2018). Imbalanced text sentiment classification using universal and domain-specific knowledge. Knowledge-Based Systems, 160, 1-15.

Li, Y., Li, F., Emrouznejad, A., Liang, L., Xie, Q. (2019). Allocating the fixed cost: an approach based on data envelopment analysis and cooperative game. Annals of Operations Research, 274(1-2), 373-394.

Li, Y., Xie, J., Kim, A.M., El-Basyouny, K. (2019). Investigating trade-offs between optimal mobile photo enforcement programme plans. Journal of Multi-Criteria Decision Analysis, 26(1-2), 51-61.

Li, Y.-H., Cevher, V. (2019). Convergence of the Exponentiated Gradient Method with Armijo Line Search. , 181(2), 588-607.

Li, Y.-M., Liou, J.-H., Ni, C.-Y. (2019). Diffusing mobile coupons with social endorsing mechanism. Decision Support Systems, 117, 87-99.

Li, Z., Hai, J. (2019). Inventory management for one warehouse multi-retailer systems with carbon emission costs. Computers & Industrial Engineering, 130, 565-574.

Li, Z., Zhang, Q., Liao, H. (2019). Efficient-equitableecological evaluation of regional water resource coordination considering both visible and virtual water. Omega, 83, 223-235.

Li, Z.C., Qian, B., Hu, R., Chang, L.L., Yang, J.B. (2019). An elitist nondominated sorting hybrid algorithm for multiobjective flexible job-shop scheduling problem with sequence-dependent setups. Knowledge-Based Systems, 173, 83-112.

Liagkouras, K. (2019). A new three-dimensional encoding multiobjective evolutionary algorithm with application to the portfolio optimization problem. Knowledge-Based Systems, 163, 186-203.

Liagkouras, K., Metaxiotis, K. (2018). Handling the complexities of the multi-constrained portfolio optimization problem with the support of a novel MOEA. Journal of the Operational Research Society, 69(10), 1609-1627.

Liagkouras, K., Metaxiotis, K. (2019). Improving the performance of evolutionary algorithms: a new approach utilizing information from the evolutionary process and its application to the fuzzy portfolio optimization problem. Annals of Operations Research, 272(1-2), 119-137.

Liang, J., Ma, M., Sadiq, M., Yeung, K.-H. (2019). A filter model for intrusion detection system in Vehicle Ad Hoc Networks: A hidden Markov methodology. Knowledge-Based Systems, 163, 611-623.

Liang, Y., Cui, N., Wang, T., Demeulemeester, E. (2019). Robust resource-constrained max-NPV project scheduling with stochastic activity duration. OR Spectrum, 41(1), 219-254.

Liao, Q., Fan, Q.-Q., Li, J.-J. (2019). Translation control of an immersed tunnel element using a multi-objective differential evolution algorithm. Computers & Industrial Engineering, 130, 158-165.

Liberati, C., Camillo, F. (2018). Personal values and credit scoring: new insights in the financial prediction. Journal of the Operational Research Society, 69(12), 1994-2005.

Lima-Junior, F.R., Carpinetti, L.C.R. (2019). Predicting supply chain performance based on SCOR ® metrics and multilayer perceptron neural networks. International Journal of Production Economics, 212, 19-38.

Lin, J., Zhu, L., Wang, Z.-J. (2019). A hybrid multi-verse optimization for the fuzzy flexible job-shop scheduling problem. Computers & Industrial Engineering, 127, 1089-1100.

Lin, S.-W., Ying, K.-C. (2019). Makespan optimization in a no-wait flowline manufacturing cell with sequence-dependent family setup times. Computers & Industrial Engineering, 128, 1-7.

Lin, Y.-C., Chen, T., Wang, L.-C. (2018). Integer nonlinear programming and optimized weighted-average approach for mobile hotel recommendation by considering travelers' unknown preferences. Operational Research, 18(3), 625-643.

Lindahl, M., Stidsen, T., Sørensen, M. (2019). Quality recovering of university timetables. European Journal of Operational Research, 276(2), 422-435.

Linhares, A., Swamy, C. (2018). Approximating min-cost chain-constrained spanning trees: a reduction from weighted to unweighted problems. Mathematical Programming, 172(1-2), 17-34.

Liu, B., Zhou, Q., Ding, R.-X., Palomares, I., Herrera, F. (2019). Large-scale group decision making model based on

social network analysis: Trust relationship-based conflict detection and elimination. European Journal of Operational Research, 275(2), 737-754.

Liu, C., Du, Y. (2019). A membrane algorithm based on chemical reaction optimization for many-objective optimization problems. Knowledge-Based Systems, 165, 306-320.

Liu, C., Zhao, Q., Yan, B., Elsayed, S., Ray, T., Sarker, R. (2019). Adaptive Sorting-Based Evolutionary Algorithm for Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 23(2), 247-257.

Liu, C.-L., Chen, Y.-C. (2018). Background music recommendation based on latent factors and moods. Knowledge-Based Systems, 159, 158-170.

Liu, H., Cai, J., Ong, Y.-S., Wang, Y. (2019). Understanding and comparing scalable Gaussian process regression for big data. Knowledge-Based Systems, 164, 324-335.

Liu, H., Lin, H., Jiang, X., Mao, X., Liu, Q., Li, B. (2019). Estimation of mass matrix in machine tool's weak components research by using symbolic regression. Computers & Industrial Engineering, 127, 998-1011.

Liu, H., Qiao, H., Wang, S., Li, Y. (2019). Platform Competition in Peer-to-Peer Lending Considering Risk Control Ability. European Journal of Operational Research, 274(1), 280-290.

Liu, H.-C., You, J.-X., Duan, C.-Y. (2019). An integrated approach for failure mode and effect analysis under intervalvalued intuitionistic fuzzy environment. International Journal of Production Economics, 207, 163-172.

Liu, H.-H., Song, Y.-Y., Yang, G.-L. (2019). Crossefficiency evaluation in data envelopment analysis based on prospect theory. European Journal of Operational Research, 273(1), 364-375.

Liu, J., Liao, X., Huang, W., Liao, X. (2019). Market segmentation: A multiple criteria approach combining preference analysis and segmentation decision. Omega, 83, 1-13.

Liu, J., Liao, X., Kadziński, M., Słowiński, R. (2019). Preference disaggregation within the regularization framework for sorting problems with multiple potentially non-monotonic criteria. European Journal of Operational Research, 276(3), 1071-1089.

Liu, J., Nie, J., Yuan, H. (2019). To expand or not to expand: A strategic analysis of the recycler's waste treatment capacity. Computers & Industrial Engineering, 130, 731-744.

Liu, K., Yang, X., Yu, H., Mi, J., Wang, P., Chen, X. (2019). Rough set based semi-supervised feature selection via ensemble selector. Knowledge-Based Systems, 165, 282-296. Liu, L. (2019). Outsourcing and rescheduling for a twomachine flow shop with the disruption of new arriving jobs: A hybrid variable neighborhood search algorithm. Computers & Industrial Engineering, 130, 198-221.

Liu, L., Dessouky, M. (2019). Stochastic passenger train timetabling using a branch and bound approach. Computers & Industrial Engineering, 127, 1223-1240.

Liu, M., Xu, X., Zhang, D. (2019). Integrated optimization model for distribution network design: a case study of the clothing industry. International Transactions in Operational Research, 26(4), 1269-1292.

Liu, P., Wang, Y. (2019). Intuitionistic Fuzzy Interaction Hamy Mean Operators and Their Application to Multiattribute Group Decision Making. Group Decision and Negotiation, 28(1), 197-232.

Liu, P., You, X. (2019). Bidirectional projection measure of linguistic neutrosophic numbers and their application to multi-criteria group decision making. Computers & Industrial Engineering, 128, 447-457.

Liu, W., Zhang, H., Chen, X., Yu, S. (2018). Managing consensus and self-confidence in multiplicative preference relations in group decision making. Knowledge-Based Systems, 162, 72-73.

Liu, Y., Eckert, C., Yannou-Le Bris, G., Petit, G. (2019). A fuzzy decision tool to evaluate the sustainable performance of suppliers in an agrifood value chain. Computers & Industrial Engineering, 127, 196-212.

Liu, Z., Guo, S., Wang, L., Du, B., Pang, S. (2019). A multiobjective service composition recommendation method for individualized customer: Hybrid MPA-GSO-DNN model. Computers & Industrial Engineering, 128, 122-134.

Liu, Z., Wang, J. (2019). Supply chain network equilibrium with strategic financial hedging using futures. European Journal of Operational Research, 272(3), 962-978.

Llamazares, B. (2019). SUOWA operators: An analysis of their conjunctive/disjunctive character. Fuzzy Sets and Systems, 357, 117-134.

Lo, A., Tang, Z. (2019). Pareto-optimal reinsurance policies in the presence of individual risk constraints. Annals of Operations Research, 274(1-2), 395-423.

Long, H.V., Ali, M., Son, L.H., Khan, M., Tu, D.N. (2019). A novel approach for fuzzy clustering based on neutrosophic association matrix. Computers & Industrial Engineering, 127, 687-697.

Long, J., Szeto, W.Y. (2019). Link-based system optimum dynamic traffic assignment problems in general networks. Operations Research, 67(1), 167-182.

Long, W., Lu, Z., Cui, L. (2019). Deep learning-based feature engineering for stock price movement prediction. Knowledge-Based Systems, 164, 163-173.

Lopes, R. (2018). Integrated model of quality inspection, preventive maintenance and buffer stock in an imperfect production system. Computers & Industrial Engineering, 126, 650-656.

Lozano, S., Calzada-Infante, L. (2018). Efficiency assessment using network analysis tools. Journal of the Operational Research Society, 69(119; 1803-1818.

Lozano, S., Hinojosa, M.A., Mármol, A.M. (2019). Extending the bargaining approach to DEA target setting. Omega, 85, 94-102.

Lu, G., Zhou, X., Mahmoudi, M., Shi, T., Peng, Q. (2019). Optimizing resource recharging location-routing plans: A resource-space-time network modeling framework for railway locomotive refueling applications. Computers & Industrial Engineering, 127, 1241-1258.

Lunday, B.J., Robbins, M.J. (2019). Collaborativelydeveloped vaccine pricing and stable profit sharing mechanisms. Omega, 84, 102-113.

Lv, B., Qi, X. (2019). Research on partner combination selection of the supply chain collaborative product innovation

based on product innovative resources. Computers & Industrial Engineering, 128, 245-253.

Lv, B., Yang, B., Zhu, X., Li, J. (2019). Operational optimization of transit consolidation in multimodal transport. Computers & Industrial Engineering, 129, 454-464.

M, B., Mathew, S., Mordeson, J.N. (2019). Connectivity index of a fuzzy graph and its application to human trafficking. Fuzzy Sets and Systems, 360, 117-136.

Ma, H.L., Chung, S.H., Chan, H.K., Cui, L. (2019). An integrated model for berth and yard planning in container terminals with multi-continuous berth layout. Annals of Operations Research, 273(1-2), 409-431.

Ma, X., Ho, W., Ji, P., Talluri, S. (2018). Contract Design with Information Asymmetry in a Supply Chain under an Emissions Trading Mechanism. Decision Sciences, 49(1), 121-153.

Maciel, L., Ballini, R. (2019). A fuzzy inference system modeling approach for interval-valued symbolic data forecasting. Knowledge-Based Systems, 164, 139-149.

Macrina, G., Di Puglia Pugliese, L., Guerriero, F., Laporte, G. (2019). The green mixed fleet vehicle routing problem with partial battery recharging and time windows. Computers and Operations Research, 101, 183-199.

Mafarja, M., Aljarah, I., Heidari, A.A., Faris, H., Fournier-Viger, P., Li, X., Mirjalili, S. (2018). Binary dragonfly optimization for feature selection using time-varying transfer functions. Knowledge-Based Systems, 161, 185-204.

Maghri, M.E., Elboulqe, Y. (2018). Reduced Jacobian Method. Journal of Optimization Theory and Applications, 179(3), 917-943.

Mahdiloo, M., Jafarzadeh, A.H., Saen, R.F., Wu, Y., Rice, J. (2018). Modelling undesirable outputs in multiple objective data envelopment analysis. Journal of the Operational Research Society, 69(12), 1903-1919.

Mahdiloo, M., Ngwenyama, O., Scheepers, R., Tamaddoni, A. (2018). Managing emissions allowances of electricity producers to maximize CO 2 abatement: DEA models for analyzing emissions and allocating emissions allowances. International Journal of Production Economics, 205, 244-255.

Mai, F., Tian, S., Lee, C., Ma, L. (2019). Deep learning models for bankruptcy prediction using textual disclosures. European Journal of Operational Research, 274(2), 743-758.

Majumder, A., Laha, D., Suganthan, P.N. (2019). Bacterial foraging optimization algorithm in robotic cells with sequence-dependent setup times. Knowledge-Based Systems, 172, 104-122.

Malaguti, E., Monaci, M., Paronuzzi, P., Pferschy, U. (2019). Integer optimization with penalized fractional values: The Knapsack case. European Journal of Operational Research, 273(3), 874-888.

Malekzadeh Hamedani, E., Kaedi, M. (2019). Recommending the long tail items through personalized diversification. Knowledge-Based Systems, 164, 348-357.

Malik, M.M., Abdallah, S., Ala'raj, M. (2018). Data mining and predictive analytics applications for the delivery of healthcare services: a systematic literature review. Annals of Operations Research, 270(1-2), 287-312.

Malinowski, E., Karwan, M.H., Sun, L., Pinto, J.M. (2018). Packaged gas supply chain planning with network-wide SKU rationalization. International Journal of Production Economics, 204, 346-357.

Manavalan, E., Jayakrishna, K. (2019). A review of Internet of Things (IoT) embedded sustainable supply chain for industry 4.0 requirements. Computers & Industrial Engineering, 127, 925-953.

Manerba, D., Perboli, G. (2019). New solution approaches for the capacitated supplier selection problem with total quantity discount and activation costs under demand uncertainty. Computers and Operations Research, 101, 29-42. Mansouri, N., Mohammad Hasani Zade, B., Javidi, M.M. (2019). Hybrid task scheduling strategy for cloud computing by modified particle swarm optimization and fuzzy theory. Computers & Industrial Engineering, 130, 597-633.

Margolis, J.T., Sullivan, K.M., Mason, S.J., Magagnotti, M. (2018). A multi-objective optimization model for designing resilient supply chain networks. International Journal of Production Economics, 204, 174-185.

Martínez, K.P., Morabito, R., Toso, E.A.V. (2018). A coupled process configuration, lot-sizing and scheduling model for production planning in the molded pulp industry. International Journal of Production Economics, 204, 227-243.

Martins, S., Ostermeier, M., Amorim, P., Hübner, A., Almada-Lobo, B. (2019). Product-oriented time window assignment for a multi-compartment vehicle routing problem. European Journal of Operational Research, 276(3), 893-909.

Marynissen, J., Demeulemeester, E. (2019). Literature review on multi-appointment scheduling problems in hospitals. European Journal of Operational Research, 272(2), 407-419.

Masri, H. (2018). A Shariah-compliant portfolio selection model. Journal of the Operational Research Society, 69(10), 1568-1575.

Masri, H., Krichen, S., Guitouni, A. (2019). Metaheuristics for solving the biobjective single-path multicommodity communication flow problem. International Transactions in Operational Research, 26(2), 589-614.

Massanet, S., Pradera, A., Ruiz-Aguilera, D., Torrens, J. (2019). Equivalence and characterization of probabilistic and survival implications. Fuzzy Sets and Systems, 359, 63-79.

Massanet, S., Recasens, J., Torrens, J. (2019). Some characterizations of T-power based implications. Fuzzy Sets and Systems, 359, 42-62.

Matthews, J., Visagie, S.E. (2019). SKU arrangement on a unidirectional picking line. International Transactions in Operational Research, 26(1), 100-130.

Mazzola, E., Bruccoleri, M., Perrone, G. (2019). The curvilinear effect of manufacturing outsourcing and captive-offshoring on firms' innovation: The role of temporal endurance. International Journal of Production Economics, 211, 197-210.

McGarry, K., Graham, Y., McDonald, S., Rashid, A. (2018). RESKO: Repositioning drugs by using side effects and knowledge from ontologies. Knowledge-Based Systems, 160, 34-48.

Megahed, A., Goetschalckx, M. (2018). Tactical supply chain planning under uncertainty with an application in the wind turbines industry. Computers and Operations Research, 100, 287-300.

Meinard, Y., Tsoukiàs, A. (2019). On the rationality of decision aiding processes. European Journal of Operational Research, 273(3), 1074-1084.

Mejias, R.J., Reinig, B.A., Dennis, A.R., MacKenzie, S.B. (2018). Observation versus Perception in the Conceptualization and Measurement of Participation Equality in Computer-Mediated Communication. Decision Sciences, 49(4), 593-624.

Mencarelli, L., D'Ambrosio, C. (2019). Complex portfolio selection via convex mixed-integer quadratic programming: a survey. International Transactions in Operational Research, 26(2), 389-414.

Méndez-Vázquez, Y.M., Nembhard, D.A. (2019). Workercell assignment: The impact of organizational factors on performance in cellular manufacturing systems. Computers & Industrial Engineering, 127, 1101-1114.

Meng, F., Chu, D., Li, K., Zhou, X. (2019). Multiple-class multidimensional knapsack optimisation problem and its solution approaches. Knowledge-Based Systems, 166, 1-17.

Meng, F., Tang, J. (2019). New ranking order for linguistic hesitant fuzzy sets. Journal of the Operational Research Society, 70(4), 531-540.

Meng, Y.-P. (2019). The optimization and coordination of multi-layer recruitment network for social emergency resources. Computers & Industrial Engineering, 130, 50-61.

Meng, Z., Pan, J.-S., Tseng, K.-K. (2019). PaDE: An enhanced Differential Evolution algorithm with novel control parameter adaptation schemes for numerical optimization. Knowledge-Based Systems, 168, 80-99.

M'Hallah, R., Visintin, F. (2019). A stochastic model for scheduling elective surgeries in a cyclic Master Surgical Schedule. Computers & Industrial Engineering, 129, 156-168.

Miao, F., Zhou, Y., Luo, Q. (2019). A modified symbiotic organisms search algorithm for unmanned combat aerial vehicle route planning problem. Journal of the Operational Research Society, 70(1), 21-52.

Michalak, K. (2019). Low-Dimensional Euclidean Embedding for Visualization of Search Spaces in Combinatorial Optimization. IEEE Transaction on Evolutionary Computation, 23(2), 232-246.

Micheli, G.J.L., Mantella, F. (2018). Modelling an environmentally-extended inventory routing problem with demand uncertainty and a heterogeneous fleet under carbon control policies. International Journal of Production Economics, 204, 316-327.

Miguel Antonio, L., Coello Coello, C.A. (2018). Coevolutionary Multiobjective Evolutionary Algorithms: Survey of the State-of-the-Art. IEEE Transaction on Evolutionary Computation, 22(6), 851-865.

Millstein, M.A., Campbell, J.F. (2018). Total Hockey optimizes omnichannel facility locations. Interfaces, 48(4), 340-356.

Min, A.T.W., Ong, Y.-S., Gupta, A., Goh, C.-K. (2019). Multiproblem Surrogates: Transfer Evolutionary Multiobjective Optimization of Computationally Expensive Problems. IEEE Transaction on Evolutionary Computation, 23(1), 15-28.

Mirzapour Al-e-hashem, S.M.J., Rekik, Y., Mohammadi Hoseinhajlou, E. (2019). A hybrid L-shaped method to solve

a bi-objective stochastic transshipment-enabled inventory routing problem. International Journal of Production Economics, 381-398.

Mishra, A.R., Rani, P. (2018). Interval-Valued Intuitionistic Fuzzy WASPAS Method: Application in Reservoir Flood Control Management Policy. Group Decision and Negotiation, 27(6), 1047-1078.

Mishra, N., Singh, A. (2018). Use of twitter data for waste minimisation in beef supply chain. Annals of Operations Research, 270(1-2), 337-359.

Mohamadi, A., Yaghoubi, S., Pishvaee, M.S. (2019). Fuzzy multi-objective stochastic programming model for disaster relief logistics considering telecommunication infrastructures: a case study. Operational Research, 19(1), 59-99.

Mohammed, A., Harris, I., Soroka, A., Nujoom, R. (2019). A hybrid MCDM-fuzzy multi-objective programming approach for a G-resilient supply chain network design. Computers & Industrial Engineering, 127, 297-312.

Moheb-Alizadeh, H., Handfield, R. (2019). Sustainable supplier selection and order allocation: A novel multiobjective programming model with a hybrid solution approach. Computers & Industrial Engineering, 129, 192-209.

Mokhtar, H., Krishnamoorthy, M., Ernst, A.T. (2019). The 2allocation p-hub median problem and a modified Benders decomposition method for solving hub location problems. Computers and Operations Research, 104, 375-393.

Moktadir, M.A., Ali, S.M., Paul, S.K., Shukla, N. (2019). Barriers to big data analytics in manufacturing supply chains: A case study from Bangladesh. Computers & Industrial Engineering, 128, 1063-1075.

Mondal, T., Bhattacharya, I., Pramanik, P., Boral, N., Roy, J., Saha, S., Saha, S. (2018). A multi-criteria evaluation approach in navigation technique for micro-jet for damage & need assessment in disaster response scenarios. Knowledge-Based Systems, 162, 220-237.

Moons, K., Waeyenbergh, G., Pintelon, L. (2019). Measuring the logistics performance of internal hospital supply chains – A literature study. Omega, 82, 205-217.

Mor, B., Mosheiov, G. (2018). A note: minimizing total absolute deviation of job completion times on unrelated machines with general position-dependent processing times and job-rejection. Annals of Operations Research, 271(2), 1079-1085.

Moradi Afrapoli, A., Tabesh, M., Askari-Nasab, H. (2019). A multiple objective transportation problem approach to dynamic truck dispatching in surface mines. European Journal of Operational Research, 276(1), 331-342.

Morais, V., Gendron, B., Mateus, G.R. (2019). The parborescence star problem: Formulations and exact solution approaches. Computers and Operations Research, 102, 91-101.

Morais, V., Mateus, G.R. (2019). Configuration-based approach for topological problems in the design of wireless sensor networks. International Transactions in Operational Research, 26(3), 836-855.

Morente-Molinera, J.A., Kou, G., Samuylov, K., Ureña, R., Herrera-Viedma, E. (2019). Carrying out consensual Group Decision Making processes under social networks using sentiment analysis over comparative expressions. Knowledge-Based Systems, 165, 335-345.

Morovati, V., Pourkarimi, L. (2019). Extension of Zoutendijk method for solving constrained multiobjective optimization problems. European Journal of Operational Research, 273(1), 44-57.

Mosa, M.A., Anwar, A.S., Hamouda, A. (2019). A survey of multiple types of text summarization with their satellite contents based on swarm intelligence optimization algorithms. Knowledge-Based Systems, 163, 518-532.

Moscoso-López, J.A., Turias, I., Jiménez-Come, M.J., Ruiz-Aguilar, J.J., Cerbán, M.D.M. (2019). A two-stage forecasting approach for short-term intermodal freight prediction. International Transactions in Operational Research, 26(2), 642-666.

Mosquera, F., Smet, P., Vanden Berghe, G. (2019). Flexible home care scheduling. Omega, 83, 80-95.

Mota-López, D.R., Sánchez-Ramírez, C., Alor-Hernández, G., García-Alcaraz, J.L., Rodríguez-Pérez, S.I. (2019). Evaluation of the impact of water supply disruptions in bioethanol production. Computers & Industrial Engineering, 127, 1068-1088.

Mousavi, M.M., Ouenniche, J. (2018). Multi-criteria ranking of corporate distress prediction models: empirical evaluation and methodological contributions. Annals of Operations Research, 271(2), 853-886.

Mousavi, S.M., Pardalos, P.M., Niaki, S.T.A., Fügenschuh, A., Fathi, M. (2019). Solving a continuous periodic review inventory-location allocation problem in vendor-buyer supply chain under uncertainty. Computers & Industrial Engineering, 128, 541-552.

Mullor, R., Mulero, J., Trottini, M. (2019). A modelling approach to optimal imperfect maintenance of repairable equipment with multiple failure modes. Computers & Industrial Engineering, 128, 24-31.

Na, H.S., Banerjee, A. (2019). Agent-based discrete-event simulation model for no-notice natural disaster evacuation planning. Computers & Industrial Engineering, 129, 44-55.

Nagurney, A., Dutta, P. (2019). Competition for blood donations. Omega, 85, 103-114.

Nagurney, A., Salarpour, M., Daniele, P. (2019). An integrated financial and logistical game theory model for humanitarian organizations with purchasing costs, multiple freight service providers, and budget, capacity, and demand constraints. International Journal of Production Economics, 212, 212-226.

Nawaz, F., Asadabadi, M.R., Janjua, N.K., Hussain, O.K., Chang, E., Saberi, M. (2018). An MCDM method for cloud service selection using a Markov chain and the best-worst method. Knowledge-Based Systems, 159, 120-131.

Nearchou, A.C. (2018). Multicriteria scheduling optimization using an elitist multiobjective population heuristic: the h-NSDE algorithm. Journal of Heuristic, 24(6), 817-851.

Nedashkovskaya, N.I. (2018). Investigation of methods for improving consistency of a pairwise comparison matrix. Journal of the Operational Research Society, 69(12), 1947-1956.

Nezami, F.G., Heydar, M. (2019). Energy-aware Economic Production Quantity model with variable energy pricing. Operational Research, 19(1), 201-218.

Ng, C.T., Cheng, T.C.E., Tsadikovich, D., Levner, E., Elalouf, A., Hovav, S. (2018). A multi-criterion approach to optimal vaccination planning: Method and solution. Computers & Industrial Engineering, 126, 637-649.

Nguyen, D., Luo, W., Phung, D., Venkatesh, S. (2018). LTARM: A novel temporal association rule mining method to understand toxicities in a routine cancer treatment. Knowledge-Based Systems, 161, 313-328.

Nguyen, W.P.V., Nof, S.Y. (2019). Collaborative response to disruption propagation (CRDP) in cyber-physical systems and complex networks. Decision Support Systems, 117, 1-13. Ni, Y., Sandal, L.K. (2019). Seasonality matters: A multiseason, multi-state dynamic optimization in fisheries. European Journal of Operational Research, 275(2), 648-658. Nidhi, M.B., Madhusudanan Pillai, V. (2019). Product disposal penalty: Analysing carbon sensitive sustainable supply chains. Computers & Industrial Engineering, 128, 8-23.

Nie, R.-X., Tian, Z.-P., Wang, X.-K., Wang, J.-Q., Wang, T.-L. (2018). Risk evaluation by FMEA of supercritical water gasification system using multi-granular linguistic distribution assessment. Knowledge-Based Systems, 162, 185-201.

Nikolopoulou, A.I., Repoussis, P.P., Tarantilis, C.D., Zachariadis, E.E. (2019). Adaptive memory programming for the many-to-many vehicle routing problem with cross-docking. Operational Research, 19(1).

Nikzad, E., Bashiri, M., Oliveira, F. (2019). Two-stage stochastic programming approach for the medical drug inventory routing problem under uncertainty. Computers & Industrial Engineering, 128, 358-370.

Ning, Y., Xu, S.X., Yan, M., Huang, G.Q. (2018). Digital pricing with piracy and variety seeking. International Journal of Production Economics, 206, 184-195.

Nitisiri, K., Gen, M., Ohwada, H. (2019). A parallel multiobjective genetic algorithm with learning based mutation for railway scheduling. Computers & Industrial Engineering, 130, 381-394.

Niu, P., Niu, S., liu, N., Chang, L. (2019). The defect of the Grey Wolf optimization algorithm and its verification method. Knowledge-Based Systems, 171, 37-43.

Niu, S., Song, S., Ding, J.-Y., Zhang, Y., Chiong, R. (2019). Distributionally robust single machine scheduling with the total tardiness criterion. Computers and Operations Research, 101, 13-28.

Noori-Daryan, M., Taleizadeh, A.A., Jolai, F. (2019). Analyzing pricing, promised delivery lead time, supplierselection, and ordering decisions of a multi-national supply chain under uncertain environment. International Journal of Production Economics, 209, 236-248.

Nouiehed, M., Pang, J.-S., Razaviyayn, M. (2019). On the pervasiveness of difference-convexity in optimization and statistics. Mathematical Programming, 174(1-2), 195-222.

Novais, L., Maqueira, J.M., Ortiz-Bas, Á. (2019). A systematic literature review of cloud computing use in supply chain integration. Computers & Industrial Engineering, 129, 296-314.

Novotny, A.A., Sokołowski, J., Żochowski, A. (2019). Topological Derivatives of Shape Functionals. Part II: FirstOrder Method and Applications. Journal of Optimization Theory and Applications, 180(3), 683-710.

Ochs, P., Fadili, J., Brox, T. (2019). Non-smooth Nonconvex Bregman Minimization: Unification and New Algorithms. Journal of Optimization Theory and Applications, 181(1), 244-278.

Okoro, U., Kolios, A. (2018). Multicriteria risk assessment framework for components' risk ranking: Case study of a complex oil and gas support structure. Journal of Multi-Criteria Decision Analysis, 25(5-6), 113-129.

Okoshi, C.Y., Pinheiro de Lima, E., Gouvea Da Costa, S.E. (2019). Performance cause and effect studies: Analyzing high performance manufacturing companies. International Journal of Production Economics, 210, 27-41.

Olender, P., Ogryczak, W. (2019). A revised Variable Neighborhood Search for the Discrete Ordered Median Problem. European Journal of Operational Research, 274(2), 445-465.

Oliveira, B.B., Carravilla, M.A., Oliveira, J.F., Costa, A.M. (2019). A co-evolutionary matheuristic for the car rental capacity-pricing stochastic problem. European Journal of Operational Research, 276(2), 637-655.

Oliveira, G.A., Tan, K.H., Guedes, B.T. (2018). Lean and green approach: An evaluation tool for new product development focused on small and medium enterprises. International Journal of Production Economics, 205, 62-73.

Omrani, H., Shafaat, K., Alizadeh, A. (2019). Integrated data envelopment analysis and cooperative game for evaluating energy efficiency of transportation sector: a case of Iran. Annals of Operations Research, 274(1-2), 471-499.

Ormerod, R.J. (2018). The logic and methods of OR consulting practice: towards a foundational view. Journal of the Operational Research Society, 69(9), 1357-1378.

Osuna-Gómez, R., Chalco-Cano, Y., Hernández-Jiménez, B., Aguirre-Cipe, I. (2019). Optimality conditions for fuzzy constrained programming problems. Fuzzy Sets and Systems, 362, 35-54.

Otrodi, F., Ghasemy Yaghin, R., Torabi, S.A. (2019). Joint pricing and lot-sizing for a perishable item under two-level trade credit with multiple demand classes. Computers & Industrial Engineering, 127, 761-777.

Oude Vrielink, R.A., Jansen, E.A., Hans, E.W., van Hillegersberg, J. (2019). Practices in timetabling in higher education institutions: a systematic review. Annals of Operations Research, 275(1), 145-160.

Ouenniche, J., Bouslah, K., Cabello, J.M., Ruiz, F. (2018). A new classifier based on the reference point method with application in bankruptcy prediction. Journal of the Operational Research Society, 69(10), 1653-1660.

Ozbay, E., Çavuş, Ö., Kara, B.Y. (2019). Shelter site location under multi-hazard scenarios. Computers and Operations Research, 106, 102-118.

Özcan, U. (2019). Balancing and scheduling tasks in parallel assembly lines with sequence-dependent setup times. International Journal of Production Economics, 213, 81-96.

Ozdemir, Y., Gul, M. (2019). Measuring development levels of NUTS-2 regions in Turkey based on capabilities approach and multi-criteria decision-making. Computers & Industrial Engineering, 128, 150-169. Özener, O., Ekici, A., Çoban, E. (2019). Improving blood products supply through donation tailoring. Computers and Operations Research, 102, 10-21.

Palomo-Martínez, P.J., Salazar-Aguilar, M.A. (2019). The biobjective traveling purchaser problem with deliveries. European Journal of Operational Research, 273(2), 608-622.

Pamucar, D., Chatterjee, K., Zavadskas, E.K. (2019). Assessment of third-party logistics provider using multicriteria decision-making approach based on interval rough numbers. Computers & Industrial Engineering, 127, 383-407. Pamulapati, T., Mallipeddi, R., Suganthan, P.N. (2019). ISDE +An Indicator for Multi and Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 23(2), 346-352.

Pan, L., He, C., Tian, Y., Wang, H., Zhang, X., Jin, Y. (2019). A Classification-Based Surrogate-Assisted Evolutionary Algorithm for Expensive Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 23(1), 74-88.

Panagopoulos, O.P., Xanthopoulos, P., Razzaghi, T., Şeref, O. (2019). Relaxed support vector regression. Annals of Operations Research, 276(1-2), 191-210.

Papadopoulos, C.T., Li, J., O'Kelly, M.E.J. (2019). A classification and review of timed Markov models of manufacturing systems. Computers & Industrial Engineering, 128, 219-244.

Papouskova, M., Hajek, P. (2019). Two-stage consumer credit risk modelling using heterogeneous ensemble learning. Decision Support Systems, 118, 33-45.

Park, S., Ok, C., Ha, C. (2018). A stochastic simulation-based holistic evaluation approach with DEA for vendor selection. Computers and Operations Research, 100, 368-378.

Parreiras, R.O., Kokshenev, I., Carvalho, M.O.M., Willer, A.C.M., Dellezzopolles, C.F.Jr., Nacif, D.B., Santana, J.A. (2019). A flexible multicriteria decision-making methodology to support the strategic management of Science, Technology and Innovation research funding programs. European Journal of Operational Research, 272(2), 725-739.

Patané, A., Jansen, G., Conca, P., Carapezza, G., Costanza, J., Nicosia, G. (2019). Multi-objective optimization of genome-scale metabolic models: the case of ethanol production. Annals of Operations Research, 276(1-2), 211-227.

Patra, P., Kumar, U.D., Nowicki, D.R., Randall, W.S. (2019). Effective management of performance-based contracts for sustainment dominant systems. International Journal of Production Economics, 208, 369-382.

Paul, J.A., Zhang, M. (2019). Supply location and transportation planning for hurricanes: A two-stage stochastic programming framework. European Journal of Operational Research, 274(1), 108-125.

Pawlak, T.P., Krawiec, K. (2019). Synthesis of Constraints for Mathematical Programming with One-Class Genetic Programming. IEEE Transaction on Evolutionary Computation, 23(1), 117-129.

Pei, J., Cheng, B., Liu, X., Pardalos, P.M., Kong, M. (2019). Single-machine and parallel-machine serial-batching scheduling problems with position-based learning effect and linear setup time. Annals of Operations Research, 272(1-2), 217-241. Pei, J., Liu, X., Fan, W., Pardalos, P.M., Lu, S. (2019). A hybrid BA-VNS algorithm for coordinated serial-batching scheduling with deteriorating jobs, financial budget, and resource constraint in multiple manufacturers. Omega, 82, 55-69.

Peláez, J.I., Cabrera, F.E., Vargas, L.G. (2018). Estimating the importance of consumer purchasing criteria in digital ecosystems. Knowledge-Based Systems, 162, 252-264.

Peláez, J.I., Martínez, E.A., Vargas, L.G. (2019). Decision making in social media with consistent data. Knowledge-Based Systems, 172, 33-41.

Pelissari, R., Oliveira, M.C., Ben Amor, S., Abackerli, A.J. (2019). A new FlowSort-based method to deal with information imperfections in sorting decision-making problems. European Journal of Operational Research, 276(1), 235-246.

Peng, Y., Fang, Y., Xie, Z., Zhou, G. (2019). Topic-enhanced emotional conversation generation with attention mechanism. Knowledge-Based Systems, 163, 429-437.

Penna, P.H.V., Subramanian, A., Ochi, L.S., Vidal, T., Prins, C. (2019). A hybrid heuristic for a broad class of vehicle routing problems with heterogeneous fleet. Annals of Operations Research, 273(1-2), 5-74.

Percy, D.F. (2019). A comparison of Olympic and Paralympic performances. Journal of the Operational Research Society, 70(3), 446-458.

Pereira Coutinho, W., Fliege, J., Battarra, M. (2019). Glider Routing and Trajectory Optimisation in disaster assessment. European Journal of Operational Research, 274(3), 1138-1154.

Pérez, J., Maldonado, S., González-Ramírez, R. (2018). Decision support for fleet allocation and contract renegotiation in contracted open-pit mine blasting operations. International Journal of Production Economics, 204, 59-69.

Pérez-Rodríguez, R., Hernández-Aguirre, A. (2019). A hybrid estimation of distribution algorithm for the vehicle routing problem with time windows. Computers & Industrial Engineering, 130, 75-96.

Pérez-Rodríguez, R., Hernández-Aguirre, A. (2019). A hybrid estimation of distribution algorithm for the vehicle routing problem with time windows. Computers & Industrial Engineering, 130, 75-96.

Petering, M.E.H., Chen, X., Hsieh, W.-H. (2019). Inventory control with flexible demand: Cyclic case with multiple batch supply and demand processes. International Journal of Production Economics, 212, 60-77.

Petronijevic, J., Etienne, A., Dantan, J.-Y. (2019). Human factors under uncertainty: A manufacturing systems design using simulation-optimisation approach. Computers & Industrial Engineering, 127, 665-676.

Petronijevic, J., Etienne, A., Dantan, J.-Y. (2019). Human factors under uncertainty: A manufacturing systems design using simulation-optimisation approach. Computers & Industrial Engineering, 127, 665-676.

Petrovic, S. (2019). "You have to get wet to learn how to swim" applied to bridging the gap between research into personnel scheduling and its implementation in practice. Annals of Operations Research, 275(1), 161-179.

Pierre, C., Francesco, P., Theo, N. (2019). Towards low carbon global supply chains: A multi-trade analysis of CO2

emission reductions in container shipping. International Journal of Production Economics, 208, 17-28.

Pinheiro, R.B.N.M., Lage, G.G., da Costa, G.R.M. (2019). A primal-dual integrated nonlinear rescaling approach applied to the optimal reactive dispatch problem. European Journal of Operational Research, 276(3), 1137-1153.

Pinto, L.L., Fernandes, K.C.C., Cardoso, K.V., Maculan, N. (2019). An exact and polynomial approach for a bi-objective integer programming problem regarding network flow routing. Computers and Operations Research, 106, 28-35.

Piot-Lepetit, I., Nzongang, J. (2019). Performance assessment and definition of improvement paths for microfinance institutions: an application to a network of village banks in Cameroon. International Transactions in Operational Research, 26(4), 1188-1210.

Pishchulov, G., Trautrims, A., Chesney, T., Gold, S., Schwab, L. (2019). The Voting Analytic Hierarchy Process revisited: A revised method with application to sustainable supplier selection. International Journal of Production Economics, 211, 166-179.

Plaza, M., Zębala, W., Matras, A. (2019). Decision system supporting optimization of machining strategy. Computers & Industrial Engineering, 127, 21-38.

Plaza, M., Zębala, W., Matras, A. (2019). Decision system supporting optimization of machining strategy. Computers & Industrial Engineering, 127, 21-38.

Pluchinotta, I., Kazakçi, A.O., Giordano, R., Tsoukiàs, A. (2019). Design Theory for Generating Alternatives in Public Decision Making Processes. , 28(2), 341-375.

Poo, M.C.-P., Yip, T.L. (2019). An optimization model for container inventory management. Annals of Operations Research, 273(1-2), 433-453.

Postek, K., Romeijnders, W., den Hertog, D., van der Vlerk, M.H. (2019). An approximation framework for two-stage ambiguous stochastic integer programs under mean-MAD information. European Journal of Operational Research, 274(2), 432-444.

Poudel, S.R., Quddus, M.A., Marufuzzaman, M., Bian, L., Burch V, R.F. (2019). Managing congestion in a multi-modal transportation network under biomass supply uncertainty. Annals of Operations Research, 273(1-2), 739-781.

Pournader, M., Kach, A., Fahimnia, B., Sarkis, J. (2019). Outsourcing performance quality assessment using data envelopment analytics. International Journal of Production Economics, 207, 173-182.

Powell, W.B. (2019). A unified framework for stochastic optimization. European Journal of Operational Research, 275(3), 795-821.

Pradera, A., Massanet, S., Ruiz-Aguilera, D., Torrens, J. (2019). The non-contradiction principle related to natural negations of fuzzy implication functions. Fuzzy Sets and Systems, 359, 3-21.

Priore, P., Ponte, B., Puente, J., Gómez, A. (2018). Learningbased scheduling of flexible manufacturing systems using ensemble methods. Computers & Industrial Engineering, 126, 282-291.

Pu, H., Zhang, H., Li, W., Xiong, J., Hu, J., Wang, J. (2019). Concurrent optimization of mountain railway alignment and station locations using a distance transform algorithm. Computers & Industrial Engineering, 127, 1297-1314. Puerta, C., Urrutia, A. (2019). Stability properties of aggregation functions under inversion of scales. Some characterisations. Fuzzy Sets and Systems, 357, 135-150.

Pyrko, I., Eden, C., Howick, S. (2019). Knowledge Acquisition Using Group Support Systems. Group Decision and Negotiation, 28(2), 233-253.

Qi, J., Yang, L., Gao, Y., Di, Z. (2019). Service-oriented train timetabling problem with consideration of women-only passenger cars. Computers & Industrial Engineering, 127, 1164-1182.

Qiao, J., Hu, B.Q. (2019). On homogeneous, quasihomogeneous and pseudo-homogeneous overlap and grouping functions. Fuzzy Sets and Systems, 357, 58-90.

Qin, H., Fan, P., Tang, H., Huang, P., Fang, B., Pan, S. (2019). An effective hybrid discrete grey wolf optimizer for the casting production scheduling problem with multi-objective and multi-constraint. Computers & Industrial Engineering, 128, 458-476.

Qiu, Y., Qiao, J., Pardalos, P.M. (2019). Optimal production, replenishment, delivery, routing and inventory management policies for products with perishable inventory. Omega, 82, 193-204.

Quintero-Araujo, C.L., Gruler, A., Juan, A.A., Faulin, J. (2019). Using horizontal cooperation concepts in integrated routing and facility-location decisions. International Transactions in Operational Research, 26(2), 551-576.

Raap, M., Preuß, M., Meyer-Nieberg, S. (2019). Moving target search optimization – A literature review. Computers and Operations Research, 105, 132-140.

Rabbani, M., Heidari, R., Yazdanparast, R. (2019). A stochastic multi-period industrial hazardous waste location-routing problem: Integrating NSGA-II and Monte Carlo simulation. European Journal of Operational Research, 272(3), 945-961.

Rachih, H., Mhada, F.Z., Chiheb, R. (2019). Meta-heuristics for reverse logistics: A literature review and perspectives. Computers & Industrial Engineering, 127, 45-62.

Rahimi, M., Ghezavati, V., Asadi, F. (2019). A stochastic risk-averse sustainable supply chain network design problem with quantity discount considering multiple sources of uncertainty. Computers & Industrial Engineering, 130, 430-449.

Rahimi-Ghahroodi, S., Al Hanbali, A., Vliegen, I.M.H., Cohen, M.A. (2019). Joint optimization of spare parts inventory and service engineers staffing with full backlogging. International Journal of Production Economics, 212, 39-50.

Rahmani, K., Yavari, M. (2019). Pricing policies for a dualchannel green supply chain under demand disruptions. Computers & Industrial Engineering, 127, 493-510.

Rajendran, S., Ravi Ravindran, A. (2019). Inventory management of platelets along blood supply chain to minimize wastage and shortage. Computers & Industrial Engineering, 130, 714-730.

Ramezanian, R. (2019). Estimation of the profiles in posteriori ELECTRE TRI: A mathematical programming model. Computers & Industrial Engineering, 128, 47-59.

Ramezankhani, M.J., Torabi, S.A., Vahidi, F. (2018). Supply chain performance measurement and evaluation: A mixed

sustainability and resilience approach. Computers & Industrial Engineering, 126, 531-548.

Range, T.M., Kozlowski, D., Petersen, N.C. (2019). Dynamic job assignment: A column generation approach with an application to surgery allocation. European Journal of Operational Research, 272(1), 78-93.

Range, T.M., Østerdal, L.P. (2019). First-order dominance: stronger characterization and a bivariate checking algorithm. Mathematical Programming, 173(1-2), 193-219.

Rauchecker, G., Schryen, G. (2019). An exact branch-andprice algorithm for scheduling rescue units during disaster response. European Journal of Operational Research, 272(1), 352-363.

Rauchecker, G., Schryen, G. (2019). Using high performance computing for unrelated parallel machine scheduling with sequence-dependent setup times: Development and computational evaluation of a parallel branch-and-price algorithm. Computers and Operations Research, 104, 338-357.

Rawat, M., Lad, B.K. (2018). Novel approach for machine tool maintenance modelling and optimization using fleet system architecture. Computers & Industrial Engineering, 126, 47-62.

Raza, S.A., Abdullakutty, F.C., Rathinam, S., Govindaluri, S.M. (2019). Multi-objective framework for process mean selection and price differentiation with leakage effects under price-dependent stochastic demand. Computers & Industrial Engineering, 127, 698-708.

Ren, Z., Xu, Z., Wang, H. (2018). Normal wiggly hesitant fuzzy sets and their application to environmental quality evaluation. Knowledge-Based Systems, 159, 286-297.

Resat, H.G., Turkay, M. (2019). A discrete-continuous optimization approach for the design and operation of synchromodal transportation networks. Computers & Industrial Engineering, 130, 512-525.

Rezapour, S., Naderi, N., Morshedlou, N., Rezapourbehnagh, S. (2018). Optimal deployment of emergency resources in sudden onset disasters. International Journal of Production Economics, 204, 365-382.

Rezgui, D., Chaouachi Siala, J., Aggoune-Mtalaa, W., Bouziri, H. (2019). Application of a variable neighborhood search algorithm to a fleet size and mix vehicle routing problem with electric modular vehicles. Computers & Industrial Engineering, 130, 537-550.

Rocha, H., Dias, J.M., Ventura, T., Ferreira, B.D.C., Lopes, M.D.C. (2019). Beam angle optimization in IMRT: are we really optimizing what matters? International Transactions in Operational Research, 26(3), 908-928.

Rodrigues, A.C., Martins, R.S., Wanke, P.F., Siegler, J. (2018). Efficiency of specialized 3PL providers in an emerging economy. International Journal of Production Economics, 205, 163-178.

Rodríguez, R.M., Labella, Á., Tré, G.D., Martínez, L. (2018). A large scale consensus reaching process managing group hesitation. Knowledge-Based Systems, 159, 86-97.

Rodríguez-Espíndola, O., Albores, P., Brewster, C. (2018). Dynamic formulation for humanitarian response operations incorporating multiple organisations. International Journal of Production Economics, 204, 83-98. Rodríguez-Martín, I., Salazar-González, J.-J., Yaman, H. (2019). The periodic vehicle routing problem with driver consistency. European Journal of Operational Research, 273(2), 575-584.

Rodriguez-Tello, E., Lardeux, F., Duarte, A., Narvaez-Teran, V. (2019). Alternative evaluation functions for the cyclic bandwidth sum problem. European Journal of Operational Research, 273(3), 904-919.

Rohmer, S.U.K., Gerdessen, J.C., Claassen, G.D.H. (2019). Sustainable supply chain design in the food system with dietary considerations: A multi-objective analysis. European Journal of Operational Research, 273(3), 1149-1164.

Roldán López de Hierro, A.F., Roldán, C., Herrera, F. (2018). On a new methodology for ranking fuzzy numbers and its application to real economic data. Fuzzy Sets and Systems, 353, 86-110.

Román, S., Villegas, A.M., Villegas, J.G. (2018). An evolutionary strategy for multiobjective reinsurance optimization. Journal of the Operational Research Society, 69(10), 1661-1677.

Roseline, S., Paramasivam, V., Anandhakrishnan, R., Lakshminarayanan, P.R. (2019). Numerical evaluation of zirconium reinforced aluminium matrix composites for sustainable environment. Annals of Operations Research, 275(2), 653-667.

Rossi, R., Tomasella, M., Martin-Barragan, B., Embley, T., Walsh, C., Langston, M. (2019). The Dynamic Bowser Routing Problem. European Journal of Operational Research, 275(1), 108-126.

Rossit, D.G., Vigo, D., Tohmé, F., Frutos, M. (2019). Visual attractiveness in routing problems: A review. Computers and Operations Research, 103, 13-34.

Rubaiee, S., Yildirim, M.B. (2019). An energy-aware multiobjective ant colony algorithm to minimize total completion time and energy cost on a single-machine preemptive scheduling. Computers & Industrial Engineering, 127, 240-252.

Rubio-Largo, A., Vanneschi, L., Castelli, M., Vega-Rodríguez, M.A. (2019). Multiobjective Metaheuristic to Design RNA Sequences. IEEE Transaction on Evolutionary Computation, 23(1), 156-169.

Ruiz, R., Pan, Q.-K., Naderi, B. (2019). Iterated Greedy methods for the distributed permutation flowshop scheduling problem. Omega, 83, 213-222.

Ruiz-Hernández, D., Menezes, M.B.C., Amrani, A. (2019). An information-content based measure of proliferation as a proxi for structural complexity. International Journal of Production Economics, 212, 78-91.

Ruiz-Torres, A.J., Ablanedo-Rosas, J.H., Mukhopadhyay, S., Paletta, G. (2019). Scheduling workers: A multi-criteria model considering their satisfaction. Computers & Industrial Engineering, 128, 747-754.

Russell, A., Taghipour, S. (2019). Multi-objective optimization of complex scheduling problems in low-volume low-variety production systems. International Journal of Production Economics, 208, 1-16.

Sabouhi, F., Pishvaee, M.S., Jabalameli, M.S. (2018). Resilient supply chain design under operational and disruption risks considering quantity discount: A case study of pharmaceutical supply chain. Computers & Industrial Engineering, 126, 657-672.

Safarzadeh, S., Khansefid, S., Rasti-Barzoki, M. (2018). A group multi-criteria decision-making based on best-worst method. Computers & Industrial Engineering, 126, 111-121.

Saha, I., Sarkar, J.P., Maulik, U. (2019). Integrated Rough Fuzzy Clustering for Categorical data Analysis. Fuzzy Sets and Systems, 361, 1-32.

Sahling, F., Hahn, G.J. (2019). Dynamic lot sizing in biopharmaceutical manufacturing. International Journal of Production Economics, 207, 96-106.

Saini, N., Saha, S., Jangra, A., Bhattacharyya, P. (2019). Extractive single document summarization using multiobjective optimization: Exploring self-organized differential evolution, grey wolf optimizer and water cycle algorithm. Knowledge-Based Systems, 164, 45-67.

Salamati-Hormozi, H., Zhang, Z.-H., Zarei, O., Ramezanian, R. (2018). Trade-off between the costs and the fairness for a collaborative production planning problem in make-to-order manufacturing. Computers & Industrial Engineering, 126, 421-434.

Salas-Molina, F. (2019). Selecting the best risk measure in multiobjective cash management. International Transactions in Operational Research, 26(3), 929-945.

Salemi, P.L., Song, E., Nelson, B.L., Staum, J. (2019). Gaussian markov random fields for discrete optimization via simulation: Framework and algorithms. Operations Research, 67(1), 250-266.

Salhi, A., Alsoufi, G., Yang, X. (2019). An evolutionary approach to a combined mixed integer programming model of seaside operations as arise in container ports. Annals of Operations Research, 272(1-2), 69-98.

Salih, M.M., Zaidan, B.B., Zaidan, A.A., Ahmed, M.A. (2019). Survey on fuzzy TOPSIS state-of-the-art between 2007 and 2017. Computers and Operations Research, 104, 207-227.

Salles, R., Belloze, K., Porto, F., Gonzalez, P.H., Ogasawara, E. (2019). Nonstationary time series transformation methods: An experimental review. Knowledge-Based Systems, 164, 274-291.

Salmani, Y., Partovi, F.Y., Banerjee, A. (2018). Customerdriven investment decisions in existing multiple sales channels: A downstream supply chain analysis. International Journal of Production Economics, 204, 44-58.

Salmeron, J.L., Mansouri, T., Moghadam, M.R.S., Mardani, A. (2019). Learning Fuzzy Cognitive Maps with modified asexual reproduction optimisation algorithm. Knowledge-Based Systems, 163, 723-735.

Samani, M.R.G., Hosseini-Motlagh, S.-M., Ghannadpour, S.F. (2019). A multilateral perspective towards blood network design in an uncertain environment: Methodology and implementation. Computers & Industrial Engineering, 130, 450-471.

Sanchez-Gomez, J.M., Vega-Rodríguez, M.A., Pérez, C.J. (2018). Extractive multi-document text summarization using a multi-objective artificial bee colony optimization approach. Knowledge-Based Systems, 159, 1-8.

San-José, L.A., Sicilia, J., Cárdenas-Barrón, L.E., Gutiérrez, J.M. (2019). Optimal price and quantity under power demand

pattern and non-linear holding cost. Computers & Industrial Engineering, 129, 426-434.

Santander-Jimenez, S., Vega-Rodriguez, M.A., Sousa, L. (2018). Multiobjective Frog-Leaping Optimization for the Study of Ancestral Relationships in Protein Data. IEEE Transaction on Evolutionary Computation, 22(6), 879-893.

Santini, A., Ropke, S., Hvattum, L.M. (2018). A comparison of acceptance criteria for the adaptive large neighbourhood search metaheuristic. Journal of Heuristic, 24(5), 783-815.

Santos, H.G., Toffolo, T.A.M., Silva, C.L.T.F., Vanden Berghe, G. (2019). Analysis of stochastic local search methods for the unrelated parallel machine scheduling problem. International Transactions in Operational Research, 26(2), 707-724.

Santos, R.S., Matias, J.C.O., Abreu, A., Reis, F. (2018). Evolutionary algorithms on reducing energy consumption in buildings: An approach to provide smart and efficiency choices, considering the rebound effect. Computers & Industrial Engineering, 126, 729-755.

Sarabando, P., Dias, L.C., Vetschera, R. (2019). Group decision making with incomplete information: a dominance and quasi-optimality volume-based approach using Monte-Carlo simulation. International Transactions in Operational Research, 26(1), 318-339.

Saragih, N.I., Bahagia, S.N., Suprayogi, Syabri, I. (2019). A heuristic method for location-inventory-routing problem in a three-echelon supply chain system. Computers & Industrial Engineering, 127, 875-886.

Sawik, T. (2019). Disruption mitigation and recovery in supply chains using portfolio approach. Omega, 84, 232-248.

Schätter, F., Hansen, O., Wiens, M., Schultmann, F. (2019). A decision support methodology for a disaster-caused business continuity management. Decision Support Systems, 118, 10-20.

Schiewe, A., Schiewe, P., Schmidt, M. (2019). The line planning routing game. European Journal of Operational Research, 274(2), 560-573.

Schlosser, R., Boissier, M. (2018). Dealing with the dimensionality curse in dynamic pricing competition: Using frequent repricing to compensate imperfect market anticipations. Computers and Operations Research, 100, 26-42.

Schmidt, M., Schöbel, A., Thom, L. (2019). Min-ordering and max-ordering scalarization methods for multi-objective robust optimization. European Journal of Operational Research, 275(2), 446-459.

Schneider, K., Nurre, S.G. (2019). A multi-criteria vehicle routing approach to improve the compliance audit schedule for food banks. Omega, 84, 127-140.

Schnepper, T., Klamroth, K., Stiglmayr, M., Puerto, J. (2019). Exact algorithms for handling outliers in center location problems on networks using k-max functions. European Journal of Operational Research, 273(2), 441-451.

Schubert, D., Scholz, A., Wäscher, G. (2018). Integrated order picking and vehicle routing with due dates. OR Spectrum, 40(4), 1109-1139.

Schuster Puga, M., Minner, S., Tancrez, J.-S. (2019). Twostage supply chain design with safety stock placement decisions. International Journal of Production Economics, 209, 183-193. Schütze, O., Hernández, C., Talbi, E.-G., Sun, J.Q., Naranjani, Y., Xiong, F.-R. (2019). Archivers for the representation of the set of approximate solutions for MOPs. Journal of Heuristic, 25(1), 71-105.

Schweitzer, D., Medal, H. (2019). Wireless LAN transmitter location under the threat of jamming attacks. Computers and Operations Research, 106, 14-27.

Sedeño-noda, A., Colebrook, M. (2019). A biobjective Dijkstra algorithm. European Journal of Operational Research, 276(1), 106-118.

Seiti, H., Hafezalkotob, A. (2019). Developing the R-TOPSIS methodology for risk-based preventive maintenance planning: A case study in rolling mill company. Computers & Industrial Engineering, 128, 622-636.

Sen, A., Al Kawam, A., Datta, A. (2019). Emergence of DSS efforts in genomics: Past contributions and challenges. Decision Support Systems, 116, 77-90.

Sesma-Sara, M., Lafuente, J., Roldán, A., Mesiar, R., Bustince, H. (2019). Strengthened ordered directionally monotone functions. Links between the different notions of monotonicity. Fuzzy Sets and Systems, 357, 151-172.

Shaban, I.A., Wang, Z.X., Chan, F.T.S., Chung, S.H., Qu, T. (2019). An extra-baggage service price setting with reference to cargo prices using multi-item newsvendor model. Computers & Industrial Engineering, 128, 877-885.

Shang, L., T'Kindt, V. (2019). A Sort & Search method for multicriteria optimization problems with applications to scheduling theory. Journal of Multi-Criteria Decision Analysis, 26(1-2), 84-90.

Shang, Z., Zhao, S., Hao, J.-K., Yang, X., Ma, F. (2019). Multiple phase tabu search for bipartite boolean quadratic programming with partitioned variables. Computers and Operations Research, 102, 141-149.

Shao, B.B.M., Shi, Z.M., Choi, T.Y., Chae, S. (2018). A data-analytics approach to identifying hidden critical suppliers in supply networks: Development of nexus supplier index. Decision Support Systems, 114, 37-48.

Shao, Z., Pi, D., Shao, W. (2019). A novel multi-objective discrete water wave optimization for solving multi-objective blocking flow-shop scheduling problem. Knowledge-Based Systems, 165, 110-131.

Sharafali, M., Tarakci, H., Kulkarni, S., Razack Shahul Hameed, R.A. (2019). Optimal delivery due date for a supplier with an unreliable machine under outsourced maintenance. International Journal of Production Economics, 208, 53-68.

Shen, J., Cui, L., Ma, Y. (2019). Availability and optimal maintenance policy for systems degrading in dynamic environments. European Journal of Operational Research, 276(1), 133-143.

Shen, K.-W., Wang, X.-K., Wang, J.-Q. (2019). Multicriteria decision-making method based on Smallest Enclosing Circle in incompletely reliable information environment. Computers & Industrial Engineering, 130, 1-13.

Shi, H., Liu, Y., Petruzzi, N.C. (2019). Informative advertising in a distribution channel. European Journal of Operational Research, 274(2), 773-787.

Shi, Q., Wang, C., Chen, J., Feng, Y., Chen, C. (2019). Location driven influence maximization: Online spread via offline deployment. Knowledge-Based Systems, 166, 30-41. Shi, W., Chen, X. (2018). Efficient budget allocation strategies for elementary effects method in stochastic simulation. Naval Research Logistics, 65(3), 218-241.

Shi, Y., Guo, X., Peng, T. (2018). Sizing the pool of online users: a dynamic pricing model for online travel agencies. Journal of the Operational Research Society, 69(9), 1456-1467.

Shin, D., Broadie, M., Zeevi, A. (2018). Tractable sampling strategies for ordinal optimization. Operations Research, 66(6), 1693-1712.

Shishodia, A., Verma, P., Dixit, V. (2019). Supplier evaluation for resilient project driven supply chain. Computers & Industrial Engineering, 129, 465-478.

Shishvan, M.S., Benndorf, J. (2019). Simulation-based optimization approach for material dispatching in continuous mining systems. European Journal of Operational Research, 275(3), 1108-1125.

Shiu, J.-Y., Lu, S.-T., Chang, D.-S., Wu, K.-W. (2019). Fuzzy multicriteria decision-making tools for selecting a professional property management company. International Transactions in Operational Research, 26(4), 1527-1557.

Shojaei, P., Haeri, S.A.S. (2019). Development of supply chain risk management approaches for construction projects: A grounded theory approach. Computers & Industrial Engineering, 128, 837-850.

Shojaeizadeh, M., Djamasbi, S., Paffenroth, R.C., Trapp, A.C. (2019). Detecting task demand via an eye tracking machine learning system. Decision Support Systems, 116, 91-101.

Shone, R., Glazebrook, K., Zografos, K.G. (2019). Resource allocation in congested queueing systems with time-varying demand: An application to airport operations. European Journal of Operational Research, 276(2), 566-581.

Shu, W., Qian, W., Xie, Y. (2019). Incremental approaches for feature selection from dynamic data with the variation of multiple objects. Knowledge-Based Systems, 163, 320-331.

Shuib, A., Kamarudin, F.I. (2019). Solving shift scheduling problem with days-off preference for power station workers using binary integer goal programming model. Annals of Operations Research, 272(1-2), 355-372.

Shukla, M., Mattar, L. (2019). Next generation smart sustainable auditing systems using Big Data Analytics: Understanding the interaction of critical barriers. Computers & Industrial Engineering, 128, 1015-1026.

Shukla, N., Tiwari, M.K., Beydoun, G. (2019). Next generation smart manufacturing and service systems using big data analytics. Computers & Industrial Engineering, 128, 905-910.

Siddiqui, A.W., Raza, S.A., Tariq, Z.M. (2018). A web-based group decision support system for academic term preparation. Decision Support Systems, 114, 1-17.

Sikora, M., Wróbel, Gudyś, A. (2019). GuideR: A guided separate-and-conquer rule learning in classification, regression, and survival settings. Knowledge-Based Systems, 173, 1-14.

Sinoara, R.A., Camacho-Collados, J., Rossi, R.G., Navigli, R., Rezende, S.O. (2019). Knowledge-enhanced document embeddings for text classification. Knowledge-Based Systems, 163, 955-971. Sivaprasad, S., MacKenziea, C.A. (2018). The hurwicz decision rule's relationship to decision making with the triangle and beta distributions and exponential utility. Decision Analysis, 15(3), 139-153.

Sleptchenko, A., Turan, H.H., Pokharel, S., ElMekkawy, T.Y. (2019). Cross-training policies for repair shops with spare part inventories. International Journal of Production Economics, 209, 334-345.

Smeulders, B., Crama, Y., Spieksma, F.C.R. (2019). Revealed preference theory: An algorithmic outlook. European Journal of Operational Research, 272(3), 803-815.

Śmieja, M., Struski, Ł., Tabor, J., Marzec, M. (2019). Generalized RBF kernel for incomplete data. Knowledge-Based Systems, 173, 150-162.

Smith, C.M., Shaw, D. (2019). The characteristics of problem structuring methods: A literature review. European Journal of Operational Research, 274(2), 403-416.

Soheilirad, S., Govindan, K., Mardani, A., Zavadskas, E.K., Nilashi, M., Zakuan, N. (2018). Application of data envelopment analysis models in supply chain management: a systematic review and meta-analysis. Annals of Operations Research, 271(2), 915-969.

Sohrabi, M.K., Azgomi, H. (2019). Evolutionary game theory approach to materialized view selection in data warehouses. Knowledge-Based Systems, 163, 558-571.

Song, S., Zhou, H., Song, W. (2019). Sustainable shelter-site selection under uncertainty: A rough QUALIFLEX method. Computers & Industrial Engineering, 128, 371-386.

Song, Y., Hu, Q.V., He, L. (2019). P-CNN: Enhancing text matching with positional convolutional neural network. Knowledge-Based Systems, 169, 67-79.

Song, Y., Teng, C. (2019). Optimal decision model and improved genetic algorithm for disposition of hierarchical facilities under hybrid service availability. Computers & Industrial Engineering, 130, 420-429.

Souza, J.C.O. (2018). Proximal Point Methods for Lipschitz Functions on Hadamard Manifolds: Scalar and Vectorial Cases. Journal of Optimization Theory and Applications, 179(3), 745-760.

Spathis, D., Passalis, N., Tefas, A. (2019). Interactive dimensionality reduction using similarity projections. Knowledge-Based Systems, 165, 77-91.

Spencer, K.Y., Tsvetkov, P.V., Jarrell, J.J. (2019). A greedy memetic algorithm for a multiobjective dynamic bin packing problem for storing cooling objects. Journal of Heuristic, 25(1).

Spizzichino, F.L. (2019). On the probabilistic meaning of copula-based extensions of fuzzy measures. Applications to target-based utilities and multi-state reliability systems. Fuzzy Sets and Systems, 354, 1-19.

Srinivas, S., Rajendran, S. (2019). Topic-based knowledge mining of online student reviews for strategic planning in universities. Computers & Industrial Engineering, 128, 974-984.

Stavropoulou, F., Repoussis, P.P., Tarantilis, C.D. (2019). The Vehicle Routing Problem with Profits and consistency constraints. European Journal of Operational Research, 274(1), 340-356.

Stefanini, L., Arana-Jiménez, M. (2019). Karush-Kuhn-Tucker conditions for interval and fuzzy optimization in several variables under total and directional generalized differentiability. Fuzzy Sets and Systems, 362, 1-34.

Stroobant, P., Audenaert, P., Colle, D., Pickavet, M. (2018). Generating constrained length personalized bicycle tours. 4OR, 16(4), 411-439.

Strub, O., Trautmann, N. (2019). A two-stage approach to the UCITS-constrained index-tracking problem. Computers and Operations Research, 103, 167-183.

Su, Y., Li, J., Li, Y. (2019). Optimality of admission control in a repairable queue. Operations Research Letters, 47(3), 202-207.

Su, Y., Zong, W., Drygaś, P. (2019). Properties of uninorms with the underlying operations given as ordinal sums. Fuzzy Sets and Systems, 357, 47-57.

Sun, B., Ma, W., Chen, X. (2019). Variable precision multigranulation rough fuzzy set approach to multiple attribute group decision-making based on λ -similarity relation. Computers & Industrial Engineering, 127, 326-343.

Sun, H., Yang, J., Yang, C. (2019). A robust optimization approach to multi-interval location-inventory and recharging planning for electric vehicles. Omega, 86, 59-75.

Sun, L., Lin, L., Li, H., Gen, M. (2019). Large scale flexible scheduling optimization by a distributed evolutionary algorithm. Computers & Industrial Engineering, 128, 894-904.

Sun, Y., Yen, G.G., Yi, Z. (2018). Improved Regularity Model-Based EDA for Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 22(5), 662-678.

Sun, Y., Yen, G.G., Yi, Z. (2019). Evolving Unsupervised Deep Neural Networks for Learning Meaningful Representations. IEEE Transaction on Evolutionary Computation, 23(1), 89-103.

Sun, Y., Yen, G.G., Yi, Z. (2019). IGD Indicator-Based Evolutionary Algorithm for Many-Objective Optimization Problems. IEEE Transaction on Evolutionary Computation, 23(2), 173-187.

Szász, L., Rácz, B.-G., Scherrer, M., Deflorin, P. (2019). Disseminative capabilities and manufacturing plant roles in the knowledge network of MNCs. International Journal of Production Economics, 208, 294-304.

Taal, A., Makkes, M.X., Kaat, M., Grosso, P. (2019). A multiple attribute relative quality measure based on the harmonic and arithmetic mean. Operational Research, 19(1), 117-134.

Taleizadeh, A.A., Rabiei, N., Noori-Daryan, M. (2019). Coordination of a two-echelon supply chain in presence of market segmentation, credit payment, and quantity discount policies. International Transactions in Operational Research, 26(4), 1576-1605.

Tamannaei, M., Rasti-Barzoki, M. (2019). Mathematical programming and solution approaches for minimizing tardiness and transportation costs in the supply chain scheduling problem. Computers & Industrial Engineering, 127, 643-656.

Tang, J., Meng, F. (2018). Ranking objects from group decision making with interval-valued hesitant fuzzy preference relations in view of additive consistency and consensus. Knowledge-Based Systems, 162, 46-61.

Tang, J., Zhang, R., Yao, Y., Zhao, Z., Wang, P., Li, H., Yuan, J. (2018). Maximizing the spread of influence via the collective intelligence of discrete bat algorithm. Knowledge-Based Systems, 160, 88-103.

Tang, L., Jin, Z., Qin, X., Jing, K. (2019). Supply chain scheduling in a collaborative manufacturing mode: model construction and algorithm design. Annals of Operations Research, 275(2), 685-714.

Tang, R., Fong, S., Deb, S., Wong, R. (2018). Dynamic group search algorithm for solving an engineering problem. Operational Research, 18(3), 781-799.

Tao, X., Wang, R., Chang, R., Li, C. (2019). Densitysensitive fuzzy kernel maximum entropy clustering algorithm. Knowledge-Based Systems, 166, 42-57.

Tao, X., Wang, R., Chang, R., Li, C., Liu, R., Zou, J. (2019). Spectral clustering algorithm using density-sensitive distance measure with global and local consistencies. Knowledge-Based Systems, 170, 26-42.

Tasdemir, C., Hiziroglu, S. (2019). Achieving cost efficiency through increased inventory leanness: Evidences from oriented strand board (OSB) industry. International Journal of Production Economics, 208, 412-433.

Tavakoli, A.R., Seifi, A.R., Arefi, M.M. (2019). Designing a self-constructing fuzzy neural network controller for damping power system oscillations. Fuzzy Sets and Systems, 356, 63-76.

Tayal, A., Singh, S.P. (2018). Integrating big data analytic and hybrid firefly-chaotic simulated annealing approach for facility layout problem. Annals of Operations Research, 270(1-2), 489-514.

Teixeira, J.C., Bigotte, J.F., Repolho, H.M., Antunes, A.P. (2019). Location of courts of justice: The making of the new judiciary map of Portugal. European Journal of Operational Research, 272(2), 608-620.

Tejani, G.G., Pholdee, N., Bureerat, S., Prayogo, D. (2018). Multiobjective adaptive symbiotic organisms search for truss optimization problems. Knowledge-Based Systems, 161, 398-414.

Teoh, B.E., Ponnambalam, S.G., Subramanian, N. (2018). Data driven safe vehicle routing analytics: a differential evolution algorithm to reduce CO2 emissions and hazardous risks. Annals of Operations Research, 270(1-2), 515-538.

Tewari, S., Dwivedi, U.D. (2019). Ensemble-based big data analytics of lithofacies for automatic development of petroleum reservoirs. Computers & Industrial Engineering, 128, 937-947.

Thies, C., Kieckhäfer, K., Spengler, T.S., Sodhi, M.S. (2019). Operations research for sustainability assessment of products: A review. European Journal of Operational Research, 274(1), 1-21.

Thomas Schneider, A.J., Luuk Besselink, P., Zonderland, M.E., Boucherie, R.J., Van Den Hout, W.B., Kievit, J., Bilars, P., Jaap Fogteloo, A., Rabelink, T.J. (2018). Allocating emergency beds improves the emergency admission flow. Interfaces, 48(4), 384-393.

Tian, J., Hao, X., Gen, M. (2019). A hybrid multi-objective EDA for robust resource constraint project scheduling with uncertainty. Computers & Industrial Engineering, 130, 317-326.

Tian, X., Niu, H. (2019). A bi-objective model with sequential search algorithm for optimizing network-wide

train timetables. Computers & Industrial Engineering, 127, 1259-1272.

Tian, X., Xu, Z., Fujita, H. (2018). Sequential funding the venture project or not? A prospect consensus process with probabilistic hesitant fuzzy preference information. Knowledge-Based Systems, 161, 172-184.

Tian, X., Zhang, Z.-H. (2019). Capacitated disassembly scheduling and pricing of returned products with price-dependent yield. Omega, 84, 160-174.

Tian, Y., Cheng, R., Zhang, X., Su, Y., Jin, Y. (2019). A Strengthened Dominance Relation Considering Convergence and Diversity for Evolutionary Many-Objective Optimization. IEEE Transaction on Evolutionary Computation, 23(2), 331-345.

Tian, Z., Fong, S., Deb, S., Tang, R., Wong, R. (2018). Vitality-based elephant search algorithm. Operational Research, 18(3), 841-863.

Tian, Z.-P., Nie, R.-X., Wang, J.-Q., Zhang, H.-Y. (2018). A two-fold feedback mechanism to support consensus-reaching in social network group decision-making. Knowledge-Based Systems, 162, 74-91.

Timajchi, A., Mirzapour Al-e-Hashem, S.M.J., Rekik, Y. (2019). Inventory routing problem for hazardous and deteriorating items in the presence of accident risk with transshipment option. International Journal of Production Economics, 209, 302-315.

Tinós, R., Zhao, L., Chicano, F., Whitley, D. (2018). NK Hybrid Genetic Algorithm for Clustering. IEEE Transaction on Evolutionary Computation, 22(5), 748-761.

Tliche, Y., Taghipour, A., Canel-Depitre, B. (2019). Downstream Demand Inference in decentralized supply chains. European Journal of Operational Research, 274(1), 65-77.

Toffolo, T.A.M., Vidal, T., Wauters, T. (2019). Heuristics for vehicle routing problems: Sequence or set optimization? Computers and Operations Research, 105, 118-131.

Tohidi, G., Hassasi, H. (2018). Adjacency-based local topdown search method for finding maximal efficient faces in multiple objective linear programming. Naval Research Logistics, 65(3), 203-217.

Tohidi, M., Kazemi Zanjani, M., Contreras, I. (2019). Integrated physician and clinic scheduling in ambulatory polyclinics. Journal of the Operational Research Society, 70(2), 177-191.

Tong, X., Chen, J., Zhu, Q., Cheng, T.C.E. (2018). Technical assistance, inspection regime, and corporate social responsibility performance: A behavioural perspective. International Journal of Production Economics, 206, 59-69.

Tong, X., Ge, W., Gao, X., Li, Y. (2019). Optimization of Combining Fiber Orientation and Topology for Constant-Stiffness Composite Laminated Plates. Journal of Optimization Theory and Applications, 181(2), 653-670.

Toth, W., Vacik, H. (2018). A comprehensive uncertainty analysis of the analytic hierarchy process methodology applied in the context of environmental decision making. Journal of Multi-Criteria Decision Analysis, 25(5-6), 142-161.

Treacy, R., Humphreys, P., McIvor, R., Lo, C. (2019). ISO14001 certification and operating performance: A

practice-based view. International Journal of Production Economics, 208, 319-328.

Trigueiro de Sousa Junior, W., Barra Montevechi, J.A., de Carvalho Miranda, R., Teberga Campos, A. (2019). Discrete simulation-based optimization methods for industrial engineering problems: A systematic literature review. Computers & Industrial Engineering, 128, 526-540.

Tsai, S.C., Ho, I.-Y. (2019). Sample average approximation for a two-echelon inventory system with service-level constraints. Journal of the Operational Research Society, 70(4), 675-688.

Tseng, M.-L., Wu, K.-J., Hu, J., Wang, C.-H. (2018). Decision-making model for sustainable supply chain finance under uncertainties. International Journal of Production Economics, 205, 30-36.

Tsionas, M.G. (2019). Multi-objective optimization using statistical models. European Journal of Operational Research, 276(1), 364-378.

Tsotsolas, N., Spyridakos, A., Siskos, E., Salmon, I. (2019). Criteria weights assessment through prioritizations (WAP) using linear programming techniques and visualizations. Operational Research, 19(1), 135-150.

Tuo, Q., Zhao, H., Hu, Q. (2019). Hierarchical feature selection with subtree based graph regularization. Knowledge-Based Systems, 163, 996-1008.

Umpfenbach, E.L., Dalkiran, E., Chinnam, R.B., Murat, A.E. (2018). Optimization of strategic planning processes for configurable products. Journal of the Operational Research Society, 69(11), 1834-1853.

Usanov, D., Guido Legemaate, G.A., van de Ven, P.M., van der Mei, R.D. (2019). Fire truck relocation during major incidents. Naval Research Logistics, 66(2), 105-122.

Vafaei, N., Ribeiro, R.A., Camarinha-Matos, L.M. (2019). Fuzzy early warning systems for condition based maintenance. Computers & Industrial Engineering, 128, 736-746.

Vafashoar, R., Meybodi, M.R. (2019). Reinforcement learning in learning automata and cellular learning automata via multiple reinforcement signals. Knowledge-Based Systems, 169, 1-27.

Vahdani, B., Mansour, F., Soltani, M., Veysmoradi, D. (2019). Bi-objective optimization for integrating quay crane and internal truck assignment with challenges of trucks sharing. Knowledge-Based Systems, 163, 675-692.

Vali-Siar, M.M., Gholami, S., Ramezanian, R. (2018). Multiperiod and multi-resource operating room scheduling under uncertainty: A case study. Computers & Industrial Engineering, 126, 549-568.

van Ackooij, W., Danti Lopez, I., Frangioni, A., Lacalandra, F., Tahanan, M. (2018). Large-scale unit commitment under uncertainty: an updated literature survey. Annals of Operations Research, 271(1), 11-85.

Van Den Eeckhout, M., Maenhout, B., Vanhoucke, M. (2019). A heuristic procedure to solve the project staffing problem with discrete time/resource trade-offs and personnel scheduling constraints. Computers and Operations Research, 101, 144-161.

Vandenberghe, M., De Vuyst, S., Aghezzaf, E.-H., Bruneel, H. (2019). Surgery sequencing to minimize the expected

maximum waiting time of emergent patients. European Journal of Operational Research, 275(3), 971-982.

Vega-Mejía, C.A., Montoya-Torres, J.R., Islam, S.M.N. (2019). A nonlinear optimization model for the balanced vehicle routing problem with loading constraints. International Transactions in Operational Research, 26(3), 794-835.

Vega-Mejía, C.A., Montoya-Torres, J.R., Islam, S.M.N. (2019). Consideration of triple bottom line objectives for sustainability in the optimization of vehicle routing and loading operations: a systematic literature review. Annals of Operations Research, 273(1-2), 311-375.

Venkatachalam, S., Narayanan, A. (2019). Two-stage absolute semi-deviation mean-risk stochastic programming: An application to the supply chain replenishment problem. Computers and Operations Research, 106, 62-75.

Verbiest, F., Cornelissens, T., Springael, J. (2019). A matheuristic approach for the design of multiproduct batch plants with parallel production lines. European Journal of Operational Research, 273(3), 933-947.

Verhulst, M.J., Rutkowski, A.-F. (2018). Decision-Making in the Police Work Force: Affordances Explained in Practice. Group Decision and Negotiation, 27(5), 827-852.

Vetschera, R. (2018). Zeuthen–Hicks Bargaining in Electronic Negotiations. Group Decision and Negotiation, 28(2), 255-274.

Vieira, D.A.G., Lisboa, A.C. (2019). A cutting-plane method to nonsmooth multiobjective optimization problems. European Journal of Operational Research, 275(3), 822-829.

Vieira, M., Pinto-Varela, T., Barbosa-Póvoa, A.P. (2019). A model-based decision support framework for the optimisation of production planning in the biopharmaceutical industry. Computers & Industrial Engineering, 129, 354-367.

Wagner, S.M., Grosse-Ruyken, P.T., Erhun, F. (2018). Determinants of sourcing flexibility and its impact on performance. International Journal of Production Economics, 205, 329-341.

Wakiru, J.M., Pintelon, L., Muchiri, P.N., Chemweno, P.K. (2019). A simulation-based optimization approach evaluating maintenance and spare parts demand interaction effects. International Journal of Production Economics, 208, 329-342.

Waltho, C., Elhedhli, S., Gzara, F. (2019). Green supply chain network design: A review focused on policy adoption and emission quantification. International Journal of Production Economics, 208, 305-318.

Wan, S., Niu, Z. (2018). An e-learning recommendation approach based on the self-organization of learning resource. Knowledge-Based Systems, 160, 71-87.

Wan, X., Dresner, M.E., Evers, P.T. (2018). How Do Delivery Variety Decisions Contribute to Sales? An Empirical Study on Demand and Supply Integration. Decision Sciences, 49(6), 1024-1060.

Wang, C., Schmidt, G., van der Rhee, B. (2018). Stage-Gate Contracts to Screen Agents with Inside Information. Decision Sciences, 49(6), 1156-1186.

Wang, D., Yin, Y., Cheng, T.C.E. (2018). Parallel-machine rescheduling with job unavailability and rejection. Omega, 81, 246-260.

Wang, D., Zhu, J., Wei, X., Cheng, T.C.E., Yin, Y., Wang, Y. (2019). Integrated production and multiple trips vehicle routing with time windows and uncertain travel times. Computers and Operations Research, 103, 1-12.

Wang, F., Chen, B., Sun, Y., Lin, C. (2019). Finite time control of switched stochastic nonlinear systems. Fuzzy Sets and Systems, 365, 140-152.

Wang, G., Ben-Ameur, W., Ouorou, A. (2019). A Lagrange decomposition based branch and bound algorithm for the optimal mapping of cloud virtual machines. European Journal of Operational Research, 276(1), 28-39.

Wang, G., Gunasekaran, A., Ngai, E.W.T. (2018). Distribution network design with big data: model and analysis. Annals of Operations Research, 270(1-2), 539-551.

Wang, G.-G., Deb, S., Zhao, X., Cui, Z. (2018). A new monarch butterfly optimization with an improved crossover operator. Operational Research, 18(3), 731-755.

Wang, H., Alidaee, B. (2019). Effective heuristic for largescale unrelated parallel machines scheduling problems. Omega, 83, 261-274.

Wang, H., Jin, Y., Doherty, J. (2018). A Generic Test Suite for Evolutionary Multifidelity Optimization. IEEE Transaction on Evolutionary Computation, 22(6), 836-850.

Wang, H., Jin, Y., Sun, C., Doherty, J. (2019). Offline Data-Driven Evolutionary Optimization Using Selective Surrogate Ensembles. IEEE Transaction on Evolutionary Computation, 23(2), 203-216.

Wang, J., Sun, X., Li, J., Chen, J., Liu, C. (2018). Has China's oil-import portfolio been optimized from 2005 to 2014? A perspective of cost-risk tradeoff. Computers & Industrial Engineering, 126, 451-464.

Wang, J.-B., Liu, F., Wang, J.-J. (2019). Research on mmachine flow shop scheduling with truncated learning effects. International Transactions in Operational Research, 26(3), 1135-1151.

Wang, K., Li, X., Gao, L. (2019). A multi-objective discrete flower pollination algorithm for stochastic two-sided partial disassembly line balancing problem. Computers & Industrial Engineering, 130, 634-649.

Wang, P., Goverde, R.M.P. (2019). Multi-train trajectory optimization for energy-efficient timetabling. European Journal of Operational Research, 272(2), 621-635.

Wang, P., Sun, L., Niraj, R., Chung, J., Su, M. (2019). Incorporating reference products into modeling consumer choice decision: A mixtures-of-experts model. Decision Support Systems, 119, 85-95.

Wang, W., Xu, J., Wang, M. (2018). Effects of recommendation neutrality and sponsorship disclosure on trust vs. distrust in online recommendation agents: Moderating role of explanations for organic recommendations. Management Science, 64(11), 5198-5219.

Wang, X., Meng, Q. (2019). Optimal price decisions for joint ventures between port operators and shipping lines under the congestion effect. European Journal of Operational Research, 273(2), 695-707.

Wang, Y., Singgih, M., Wang, J., Rit, M. (2019). Making sense of blockchain technology: How will it transform supply chains? International Journal of Production Economics, 211, 221-236.

Wang, Y., Zhang, J., Assogba, K., Liu, Y., Xu, M., Wang, Y. (2018). Collaboration and transportation resource sharing in multiple centers vehicle routing optimization with delivery and pickup. Knowledge-Based Systems, 160, 296-310.

Wang, Y., Zhang, Y., Tang, J. (2019). A distributionally robust optimization approach for surgery block allocation. European Journal of Operational Research, 273(2), 740-753.

Wang, Y.-R., Jin, Q., Sun, G.-D., Sun, C.-F. (2019). Planetary gearbox fault feature learning using conditional variational neural networks under noise environment. Knowledge-Based Systems, 163, 438-449.

Wang, Z., Ong, Y.-S., Ishibuchi, H. (2019). On Scalable Multiobjective Test Problems with Hardly Dominated Boundaries. IEEE Transaction on Evolutionary Computation, 23(2), 217-231.

Wang, Z., Pang, C.K., Ng, T.S. (2018). Data-driven scheduling optimization under uncertainty using Renyi entropy and skewness criterion. Computers & Industrial Engineering, 126, 410-420.

Wang, Z., Qi, Y., Cui, H., Zhang, J. (2019). A hybrid algorithm for order acceptance and scheduling problem in make-to-stock/make-to-order industries. Computers & Industrial Engineering, 127, 841-852.

Wang, Z.-J., Liu, F., Lin, J. (2019). A goal programming based heuristic method to obtaining interval weights in analytic form from interval multiplicative comparison matrices. Computers & Industrial Engineering, 128, 313-324.

Wang, Z.-J., Zhan, Z.-H., Lin, Y., Yu, W.-J., Yuan, H.-Q., Gu, T.-L., Kwong, S., Zhang, J. (2018). Dual-Strategy Differential Evolution with Affinity Propagation Clustering for Multimodal Optimization Problems. IEEE Transaction on Evolutionary Computation, 22(6), 894-908.

Wątróbski, J., Jankowski, J., Ziemba, P., Karczmarczyk, A., Zioło, M. (2019). Generalised framework for multi-criteria method selection. Omega, 86, 107-124.

Wei, H., Dong, M. (2019). Import-export freight organization and optimization in the dry-port-based cross-border logistics network under the Belt and Road Initiative. Computers & Industrial Engineering, 130, 472-484.

Wen, X., Choi, T.-M., Chung, S.-H. (2019). Fashion retail supply chain management: A review of operational models. International Journal of Production Economics, 207, 34-55.

Weskamp, C., Koberstein, A., Schwartz, F., Suhl, L., Voß, S. (2019). A two-stage stochastic programming approach for identifying optimal postponement strategies in supply chains with uncertain demand. Omega, 83, 123-138.

Wickert, T.I., Smet, P., Vanden Berghe, G. (2019). The nurse rerostering problem: Strategies for reconstructing disrupted schedules. Computers and Operations Research, 104, 319-337.

Williams, C., Fang, L. (2019). A Value-Focused Multiple Participant-Multiple Criteria (MPMC) Decision Support Approach for Public Policy Formulation. Group Decision and Negotiation, 28(1), 99-126.

Wirth, M., Emde, S. (2018). Scheduling trucks on factory premises. Computers & Industrial Engineering, 126, 175-186. Woo, Y.-B., Kim, B.S. (2019). A genetic algorithm-based matheuristic for hydrogen supply chain network problem with two transportation modes and replenishment cycles. Computers & Industrial Engineering, 127, 981-997.

Wu, C.-C., Chen, J.-Y., Lin, W.-C., Lai, K., Bai, D., Lai, S.-Y. (2019). A two-stage three-machine assembly scheduling flowshop problem with both two-agent and learning phenomenon. Computers & Industrial Engineering, 130, 485-499.

Wu, C.-C., Lin, W.-C., Zhang, X., Chung, I.-H., Yang, T.-H., Lai, K. (2019). Tardiness minimisation for a customer order scheduling problem with sum-of-processing-time-based learning effect. Journal of the Operational Research Society, 70(3), 487-501.

Wu, J., Chang, J., Cao, Q., Liang, C. (2019). A trust propagation and collaborative filtering based method for incomplete information in social network group decision making with type-2 linguistic trust. Computers & Industrial Engineering, 127, 853-864.

Wu, J., Sun, Q., Fujita, H., Chiclana, F. (2019). An attitudinal consensus degree to control the feedback mechanism in group decision making with different adjustment cost. Knowledge-Based Systems, 164, 265-273.

Wu, Q., Lin, W., Zhou, L., Chen, Y., Chen, H. (2019). Enhancing multiple attribute group decision making flexibility based on information fusion technique and hesitant Pythagorean fuzzy sets. Computers & Industrial Engineering, 127, 954-970.

Wu, T., Zhang, K., Liu, X., Cao, C. (2019). A two-stage social trust network partition model for large-scale group decision-making problems. Knowledge-Based Systems, 163, 632-643.

Wu, W., Kou, G., Peng, Y. (2018). A consensus facilitation model based on experts' weights for investment strategy selection. Journal of the Operational Research Society, 69(9), 1435-1444.

Wu, X., Che, A. (2019). A memetic differential evolution algorithm for energy-efficient parallel machine scheduling. Omega, 82, 155-165.

Wu, X., Liao, H. (2019). A consensus-based probabilistic linguistic gained and lost dominance score method. European Journal of Operational Research, 272(3), 1017-1027.

Wu, Y., Dong, J. (2019). Tracking control for non-Gaussian stochastic distribution sampled-data fuzzy systems. Fuzzy Sets and Systems, 356, 1-27.

Wu, Y., Li, Y., Xu, Y. (2019). Dual pattern-enhanced representations model for query-focused multi-document summarisation. Knowledge-Based Systems, 163, 736-748.

Wu, Z., Huang, S., Xu, J. (2019). Multi-stage optimization models for individual consistency and group consensus with preference relations. European Journal of Operational Research, 275(1), 182-194.

Xiang, X., Liu, C., Miao, L. (2018). Reactive strategy for discrete berth allocation and quay crane assignment problems under uncertainty. Computers & Industrial Engineering, 126, 196-216.

Xiao, Y., Deng, H., Lu, X., Wu, J. (2019). Optimal ballotlength in approval balloting-based multi-winner elections. Decision Support Systems, 118, 1-9.

Xiao, Z., Sun, J., Shu, W., Wang, T. (2019). Locationallocation problem of reverse logistics for end-of-life vehicles based on the measurement of carbon emissions. Computers & Industrial Engineering, 127, 169-181. Xie, A. (2018). On the extension of nullnorms and uninorms to fuzzy truth values. Fuzzy Sets and Systems, 352, 92-118.

Xie, C., Wu, X., Boyles, S. (2019). Traffic equilibrium with a continuously distributed bound on travel weights: the rise of range anxiety and mental account. Annals of Operations Research, 273(1-2), 279-310.

Xie, W., Ren, Z., Xu, Z., Wang, H. (2018). The consensus of probabilistic uncertain linguistic preference relations and the application on the virtual reality industry. Knowledge-Based Systems, 162, 14-28.

Xiong, S.-H., Chen, Z.-S., Chang, J.-P., Chin, K.-S. (2019). On extended power average operators for decision-making: A case study in emergency response plan selection of civil aviation. Computers & Industrial Engineering, 130, 258-271.

Xiong, Y., Du, G., Jiao, R.J. (2018). Modular product platforming with supply chain postponement decisions by leader-follower interactive optimization. International Journal of Production Economics, 205, 272-286.

Xu, W., Huang, S., Li, J. (2019). A novel consensus reaching framework for heterogeneous group decision making based on cumulative prospect theory. Computers & Industrial Engineering, 128, 325-335.

Xu, X., Jackson, J.E. (2019). Examining customer channel selection intention in the omni-channel retail environment. International Journal of Production Economics, 208, 434-445.

Xu, X., Li, K., Lu, X. (2019). Simultaneous locomotive assignment and train scheduling on a single-track railway line: A simulation-based optimization approach. Computers & Industrial Engineering, 127, 1336-1351.

Xu, X., Yin, X., Chen, X. (2019). A large-group emergency risk decision method based on data mining of public attribute preferences. Knowledge-Based Systems, 163, 495-509.

Xu, Y., Ma, F., Herrera, F. (2019). Revisiting inconsistent judgments for incomplete fuzzy linguistic preference relations: Algorithms to identify and rectify ordinal inconsistencies. Knowledge-Based Systems, 163, 305-319.

Xue, M., Fu, C., Feng, N.-P., Lu, G.-Y., Chang, W.-J., Yang, S.-L. (2018). Evaluation of supplier performance of high-speed train based on multi-stage multi-criteria decision-making method. Knowledge-Based Systems, 162, 238-251.

Xue, Y., Caliskan-Demirag, O., Chen, Y.F., Yu, Y. (2018). Supporting customers to sell used goods: Profitability and environmental implications. International Journal of Production Economics, 206, 220-232.

Yadav, M.L., Roychoudhury, B. (2018). Handling missing values: A study of popular imputation packages in R. Knowledge-Based Systems, 160, 104-118.

Yadav, S., Ekbal, A., Saha, S., Kumar, A., Bhattacharyya, P. (2019). Feature assisted stacked attentive shortest dependency path based Bi-LSTM model for protein–protein interaction. Knowledge-Based Systems, 166, 18-29.

Yadegari, E., Alem-Tabriz, A., Zandieh, M. (2019). A memetic algorithm with a novel neighborhood search and modified solution representation for closed-loop supply chain network design. Computers & Industrial Engineering, 128, 418-436.

Yager, R.R. (2018). Interval valued entropies for Dempster– Shafer structures. Knowledge-Based Systems, 161, 390-397. Yahyatabar, A., Najafi, A.A. (2018). Condition based maintenance policy for series-parallel systems through Proportional Hazards Model: A multi-stage stochastic programming approach. Computers & Industrial Engineering, 126, 30-46.

Yang, A., Li, W., Yang, X. (2019). Short-term electricity load forecasting based on feature selection and Least Squares Support Vector Machines. Knowledge-Based Systems, 163, 159-173.

Yang, J., Wang, G., Zhang, Q., Chen, Y., Xu, T. (2019). Optimal granularity selection based on cost-sensitive sequential three-way decisions with rough fuzzy sets. Knowledge-Based Systems, 163, 131-144.

Yang, L., Ye, Z.-S., Lee, C.-G., Yang, S.-F., Peng, R. (2019). A two-phase preventive maintenance policy considering imperfect repair and postponed replacement. European Journal of Operational Research, 274(3), 966-977.

Yang, Q., Du, P.-A., Wang, Y., Liang, B. (2018). Developing a rough set based approach for group decision making based on determining weights of decision makers with interval numbers. Operational Research, 18(3), 757-779.

Yang, S., Wu, J., Yang, X., Liao, F., Li, D., Wei, Y. (2019). Analysis of energy consumption reduction in metro systems using rolling stop-skipping patterns. Computers & Industrial Engineering, 127, 129-142.

Yang, Y., Xu, D.-L., Yang, J.-B., Chen, Y.-W. (2018). An evidential reasoning-based decision support system for handling customer complaints in mobile telecommunications. Knowledge-Based Systems, 162, 202-210.

Yang, Z., Li, K., Guo, Y., Ma, H., Zheng, M. (2018). Compact real-valued teaching-learning based optimization with the applications to neural network training. Knowledge-Based Systems, 159, 51-62.

Yang, Z., Wang, C., Zhang, Z., Li, J. (2019). Mini-batch algorithms with online step size. Knowledge-Based Systems, 165, 228-240.

Yao, M.X. (2019). Granularity measures and complexity measures of partition-based granular structures. Knowledge-Based Systems, 163, 885-897.

Yao, X., Li, J., Sun, X., Wu, D. (2018). Insights into tolerability constraints in multi-criteria decision making: Description and modeling. Knowledge-Based Systems, 162, 136-146.

Yao, Y., Li, X., Ye, Y., Liu, F., Ng, M.K., Huang, Z., Zhang, Y. (2019). Low-resolution image categorization via heterogeneous domain adaptation. Knowledge-Based Systems, 163, 656-665.

Yasari, P., Ranjbar, M., Jamili, N., Shaelaie, M.-H. (2019). A two-stage stochastic programming approach for a multiobjective course timetabling problem with courses cancelation risk. Computers & Industrial Engineering, 130, 650-660.

Yazdani, D., Nguyen, T.T., Branke, J. (2019). Robust Optimization over Time by Learning Problem Space Characteristics. IEEE Transaction on Evolutionary Computation, 23(1), 143-155.

Ye, F., Lu, M., Li, Y. (2019). Optimal overbooking decision for a "Hotel + OTA" dual-channel supply chain. International Transactions in Operational Research, 26(3), 999-1024. Ye, W., Wang, H., Yan, S., Li, T., Yang, Y. (2019). Nonnegative matrix factorization for clustering ensemble based on dark knowledge. Knowledge-Based Systems, 163, 624-631.

Yener, F., Yazgan, H.R. (2019). Optimal warehouse design: Literature review and case study application. Computers & Industrial Engineering, 129, 1-13.

Yeni, F.B., Özçelik, G. (2019). Interval-Valued Atanassov Intuitionistic Fuzzy CODAS Method for Multi Criteria Group Decision Making Problems. Group Decision and Negotiation, 28(2), 433-452.

Yenipazarli, A. (2019). Incentives for environmental research and development: Consumer preferences, competitive pressure and emissions taxation. European Journal of Operational Research, 276(2), 757-769.

Yi, H., Cui, L., Shen, J. (2019). Modeling and analysis for time redundant systems with a given mission window. Computers & Industrial Engineering, 127, 480-492.

Yi, J., Gao, L., Li, X., Shoemaker, C.A., Lu, C. (2019). An on-line variable-fidelity surrogate-assisted harmony search algorithm with multi-level screening strategy for expensive engineering design optimization. Knowledge-Based Systems, 170, 1-19.

Yin, Y., Yang, Y., Wang, D., Cheng, T.C.E., Wu, C.-C. (2018). Integrated production, inventory, and batch delivery scheduling with due date assignment and two competing agents. Naval Research Logistics, 65(5), 393-409.

Yoon, M., Bekker, J. (2019). Considering sample means in Rinott's procedure with a Bayesian approach. European Journal of Operational Research, 273(1), 249-258.

You, W., Yang, Z., Guo, G., Wan, X.-F., Ji, G. (2019). Prediction of DNA-binding proteins by interaction fusion feature representation and selective ensemble. Knowledge-Based Systems, 163, 598-610.

Yu, B., Cai, M., Li, Q. (2019). A λ -rough set model and its applications with TOPSIS method to decision making. Knowledge-Based Systems, 165, 420-431.

Yu, C., Semeraro, Q., Matta, A. (2018). A genetic algorithm for the hybrid flow shop scheduling with unrelated machines and machine eligibility. Computers and Operations Research, 100, 211-229.

Yu, H., Tan, Y., Sun, C., Zeng, J. (2019). A generation-based optimal restart strategy for surrogate-assisted social learning particle swarm optimization. Knowledge-Based Systems, 163, 14-25.

Yu, J.-R., Chiou, W.-J.P., Lee, W.-Y., Chuang, T.-Y. (2019). Realized performance of robust portfolios: Worst-case Omega vs. CVaR-related models. Computers and Operations Research, 104, 239-255.

Yu, K., Cao, Q., Zhou, L. (2019). Study on qualitative simulation technology of group safety behaviors and the related software platform. Computers & Industrial Engineering, 127, 1037-1055.

Yu, M., Nagarajan, V., Shen, S. (2018). An approximation algorithm for vehicle routing with compatibility constraints. Operations Research Letters, 46(6), 579-584.

Yu, M., Wu, C., Wang, Z., Tsung, F. (2018). A robust CUSUM scheme with a weighted likelihood ratio to monitor an overdispersed counting process. Computers & Industrial Engineering, 126, 165-174.

Yu, Q., Fang, K., Zhu, N., Ma, S. (2019). A matheuristic approach to the orienteering problem with service time dependent profits. European Journal of Operational Research, 273(2), 488-503.

Yu, V.F., Jewpanya, P., Lin, S.-W., Redi, A.A.N.P. (2019). Team orienteering problem with time windows and timedependent scores. Computers & Industrial Engineering, 127, 213-224.

Yu, Y., Wu, Y., Wang, J. (2019). Bi-objective green ridesharing problem: Model and exact method. International Journal of Production Economics, 208, 472-482.

Yuan, J., Hou, X., Xiao, Y., Cao, D., Guan, W., Nie, L. (2019). Multi-criteria active deep learning for image classification. Knowledge-Based Systems, 172, 86-94.

Yue, C., Qu, B., Liang, J. (2018). A Multiobjective Particle Swarm Optimizer Using Ring Topology for Solving Multimodal Multiobjective Problems. IEEE Transaction on Evolutionary Computation, 22(5), 805-817.

Yue, L., Guan, Z., Zhang, L., Ullah, S., Cui, Y. (2019). Multi objective lotsizing and scheduling with material constraints in flexible parallel lines using a Pareto based guided artificial bee colony algorithm. Computers & Industrial Engineering, 128, 659-680.

Zahid, T., Agha, M.H., Schmidt, T. (2019). Investigation of surrogate measures of robustness for project scheduling problems. Computers & Industrial Engineering, 129, 220-227.

Zanda, S., Zuddas, P., Seatzu, C. (2018). Long term nurse scheduling via a decision support system based on linear integer programming: A case study at the University Hospital in Cagliari. Computers & Industrial Engineering, 126, 337-347.

Zapata, A., Mármol, A.M., Monroy, L., Caraballo, M.A. (2019). A Maxmin Approach for the Equilibria of Vector-Valued Games. Group Decision and Negotiation, 28(2), 415-432.

Zapotecas-Martínez, S., Coello Coello, C.A., Aguirre, H.E., Tanaka, K. (2019). A Review of Features and Limitations of Existing Scalable Multiobjective Test Suites. IEEE Transaction on Evolutionary Computation, 23(1), 130-142.

Zervos, M., Oliveira, C., Duckworth, K. (2018). An investment model with switching costs and the option to abandon. Mathematical Methods of Operations Research, 88(3), 417-443.

Zhang, B., Liang, H., Gao, Y., Zhang, G. (2018). The optimization-based aggregation and consensus with minimum-cost in group decision making under incomplete linguistic distribution context. Knowledge-Based Systems, 162, 92-102.

Zhang, H., Dong, Y., Chiclana, F., Yu, S. (2019). Consensus efficiency in group decision making: A comprehensive comparative study and its optimal design. European Journal of Operational Research, 275(2), 580-598.

Zhang, H., Palomares, I., Dong, Y., Wang, W. (2018). Managing non-cooperative behaviors in consensus-based multiple attribute group decision making: An approach based on social network analysis. Knowledge-Based Systems, 162, 29-45.

Zhang, H., Rusmevichientong, P., Topaloglu, H. (2018). Multiproduct pricing under the generalized extreme value models with homogeneous price sensitivity parameters. Operations Research, 66(6), 1559-1570.

Zhang, H., Xie, J., Ge, J., Zhang, Z., Zong, B. (2019). A hybrid adaptively genetic algorithm for task scheduling problem in the phased array radar. European Journal of Operational Research, 272(3), 868-878.

Zhang, J., Li, C., Cao, D., Lin, Y., Su, S., Dai, L., Li, S. (2018). Multi-label learning with label-specific features by resolving label correlations. Knowledge-Based Systems, 159, 148-157.

Zhang, J., Luo, X., Zhou, Y., Ruan, W., Jiang, Y., Hao, Z. (2018). Two-way negotiation for intelligent hotel reservation based on multiagent: The model and system. Knowledge-Based Systems, 161, 78-89.

Zhang, J., Xiang, J., Cheng, T.C.E., Hua, G., Chen, C. (2019). An optimal efficient multi-attribute auction for transportation procurement with carriers having multi-unit supplies. Omega, 83, 249-260.

Zhang, K., Zhan, J., Wu, W., Alcantud, J.C.R. (2019). Fuzzy β -covering based (I,T)-fuzzy rough set models and applications to multi-attribute decision-making. Computers & Industrial Engineering, 128, 605-621.

Zhang, L., Tian, J., Fung, R.Y.K., Dang, C. (2019). Materials procurement and reserves policies for humanitarian logistics with recycling and replenishment mechanisms. Computers & Industrial Engineering, 127, 709-721.

Zhang, L., Wang, Y.P., Sun, J., Yu, B. (2019). The sightseeing bus schedule optimization under Park and Ride System in tourist attractions. Annals of Operations Research, 273(1-2), 587-605.

Zhang, M., Guo, H., Huo, B., Zhao, X., Huang, J. (2019). Linking supply chain quality integration with mass customization and product modularity. International Journal of Production Economics, 207, 227-235.

Zhang, M., Hu, Q. (2019). An effective evolutionary algorithm for the biobjective full truckload transportation service procurement problem. Computers & Industrial Engineering, 127, 1012-1023.

Zhang, Q., Xie, Q., Wang, G. (2018). A Novel Three-way decision model with decision-theoretic rough sets using utility theory. Knowledge-Based Systems, 159, 321-335.

Zhang, R., Li, Z., Liao, H. (2018). Multiple-attribute decision-making method based on the correlation coefficient between dual hesitant fuzzy linguistic term sets. Knowledge-Based Systems, 159, 186-192.

Zhang, R.-Q., Wang, M., Pan, X. (2019). New model of the storage location assignment problem considering demand correlation pattern. Computers & Industrial Engineering, 129, 210-219.

Zhang, S., Song, H. (2018). Production and distribution planning in Danone waters China division. Interfaces, 48(6), 578-590.

Zhang, T., Zhang, W., Xu, W., Hao, H. (2018). Multiple instance learning for credit risk assessment with transaction data. Knowledge-Based Systems, 161, 65-77.

Zhang, W., Wang, Y., Yang, Y., Gen, M. (2019). Hybrid multiobjective evolutionary algorithm based on differential evolution for flow shop scheduling problems. Computers & Industrial Engineering, 130, 661-670.

Zhang, Y., Xu, Z. (2019). Efficiency evaluation of sustainable water management using the HF-TODIM method. International Transactions in Operational Research, 26(2), 747-764.

Zhang, Y., Yang, Y., Li, T., Fujita, H. (2019). A multitask multiview clustering algorithm in heterogeneous situations based on LLE and LE. Knowledge-Based Systems, 163, 776-786.

Zhang, Z., Chai, N., Ostrosi, E., Shang, Y. (2019). Extraction of association rules in the schematic design of product service system based on Pareto-MODGDFA. Computers & Industrial Engineering, 129, 392-403.

Zhang, Z., Cheang, B., Li, C., Lim, A. (2019). Multicommodity demand fulfillment via simultaneous pickup and delivery for a fast fashion retailer. Computers and Operations Research, 103, 81-96.

Zhao, J., Geng, X., Zhou, J., Sun, Q., Xiao, Y., Zhang, Z., Fu, Z. (2019). Attribute mapping and autoencoder neural network based matrix factorization initialization for recommendation systems. Knowledge-Based Systems, 166, 132-139.

Zhao, L., Zhou, Y., Lu, H., Fujita, H. (2019). Parallel computing method of deep belief networks and its application to traffic flow prediction. Knowledge-Based Systems, 163, 972-987.

Zhao, W., Wang, L., Zhang, Z. (2019). Atom search optimization and its application to solve a hydrogeologic parameter estimation problem. Knowledge-Based Systems, 163, 283-304.

Zhao, X., Liang, J., Dang, C. (2019). A stratified sampling based clustering algorithm for large-scale data. Knowledge-Based Systems, 163, 416-428.

Zhao, X., Yin, R. (2018). Coordination of a socially responsible two-stage supply chain under price-dependent random demand. 4OR, 16(4), 379-400.

Zhao, Z., Xu, F., Wang, M., Zhang, C.-Y. (2019). A sparse enhanced indexation model with norm and its alternating quadratic penalty method. Journal of the Operational Research Society, 70(3), 433-445.

Zhen, L., Hao, H., Shi, X., Huang, L., Hu, Y. (2018). Task assignment and sequencing decision model under uncertain available time of service providers. Journal of the Operational Research Society, 69(12), 1935-1946.

Zhen, L., Li, M., Laporte, G., Wang, W. (2019). A vehicle routing problem arising in unmanned aerial monitoring. Computers and Operations Research, 105, 1-11.

Zhen, L., Wang, B., Li, M., Wang, W., Huang, L. (2019). Inspection routing problem for coal mine safety personnel in underground mines. Computers & Industrial Engineering, 130, 526-536.

Zhen, L., Wang, S., Laporte, G., Hu, Y. (2019). Integrated planning of ship deployment, service schedule and container routing. Computers and Operations Research, 104, 304-318.

Zheng, Y., He, Y., Xu, Z., Pedrycz, W. (2018). Assessment for hierarchical medical policy proposals using hesitant fuzzy linguistic analytic network process. Knowledge-Based Systems, 161, 254-267.

Zheng, Y., Wang, W., Liu, W., Mingers, J. (2019). A performance management framework for the public sector: The balanced stakeholder model. Journal of the Operational Research Society, 70(4), 568-580.

Zhou, F., Wang, X., Goh, M., Zhou, L., He, Y. (2019). Supplier portfolio of key outsourcing parts selection using a two-stage decision making framework for Chinese domestic auto-maker. Computers & Industrial Engineering, 128, 559-575.

Zhou, J., Lai, Z., Gao, C., Miao, D., Yue, X. (2018). Rough possibilistic C-means clustering based on multigranulation approximation regions and shadowed sets. Knowledge-Based Systems, 160, 144-166.

Zhou, L., Geng, N., Jiang, Z., Wang, X. (2018). Multiobjective capacity allocation of hospital wards combining revenue and equity. Omega, 81, 220-233.

Zhou, L., Lin, Y., Wang, X., Zhou, F. (2019). Model and algorithm for bilevel multisized terminal location-routing problem for the last mile delivery. International Transactions in Operational Research, 26(1), 131-156.

Zhou, M., Liu, X.-B., Yang, J.-B., Chen, Y.-W., Wu, J. (2019). Evidential reasoning approach with multiple kinds of attributes and entropy-based weight assignment. Knowledge-Based Systems, 163, 358-375.

Zhou, M., Zhou, M., Duan, Y., Yang, W., Pan, Y. (2018). Capacitated multi-modal network flow models for minimizing total operational cost and CO2e emission. Computers & Industrial Engineering, 126, 361-377.

Zhou, X., Hu, Y., Deng, Y., Chan, F.T.S., Ishizaka, A. (2018). A DEMATEL-based completion method for incomplete pairwise comparison matrix in AHP. Annals of Operations Research, 271(2), 1045-1066.

Zhou, X., Wang, L., Liao, H., Wang, S., Lev, B., Fujita, H. (2019). A prospect theory-based group decision approach considering consensus for portfolio selection with hesitant fuzzy information. Knowledge-Based Systems, 168, 28-38.

Zhou, X., Xu, Z., Chai, J., Yao, L., Wang, S., Lev, B. (2019). Efficiency evaluation for banking systems under uncertainty: A multi-period three-stage DEA model. Omega, 85, 68-82.

Zhou, Y., Wu, H., Luo, Q., Abdel-Baset, M. (2019). Automatic data clustering using nature-inspired symbiotic organism search algorithm. Knowledge-Based Systems, 163, 546-557.

Zhu, Q., Shah, P., Sarkis, J. (2018). Addition by subtraction: Integrating product deletion with lean and sustainable supply chain management. International Journal of Production Economics, 205, 201-214.

Zhu, T., Lin, Y., Liu, Y., Zhang, W., Zhang, J. (2019). Minority oversampling for imbalanced ordinal regression. Knowledge-Based Systems, 166, 140-155.

Zhu, T., Luo, L., Liao, H., Zhang, X., Shen, W. (2019). A hybrid multi-criteria decision making model for elective admission control in a Chinese public hospital. Knowledge-Based Systems, 173, 37-51.

Zhu, T., Luo, L., Liao, H., Zhang, X., Shen, W. (2019). A hybrid multi-criteria decision making model for elective admission control in a Chinese public hospital. Knowledge-Based Systems, 173, 37-51.

Zhu, W., Hu, X., Xia, W., Sun, H. (2019). A three-phase solution method for the scheduling problem of using earth observation satellites to observe polygon requests. Computers & Industrial Engineering, 130, 97-107.

Zhu, X., Ni, Z., Ni, L., Jin, F., Cheng, M., Li, J. (2019). Improved discrete artificial fish swarm algorithm combined with margin distance minimization for ensemble pruning. Computers & Industrial Engineering, 128, 32-46.

Zhu, X., Yang, X., Ying, C., Wang, G. (2018). A new classification algorithm recommendation method based on link prediction. Knowledge-Based Systems, 159, 171-185.

Zhu, X.-J., Feng, C.-Q., Lai, H.-Y., Chen, W., Hao, L. (2019). Predicting protein structural classes for low-similarity sequences by evaluating different features. Knowledge-Based Systems, 163, 787-793.

Zhu, Y.-H., Toffolo, T.A.M., Vancroonenburg, W., Vanden Berghe, G. (2019). Compatibility of short and long term objectives for dynamic patient admission scheduling. Computers and Operations Research, 104, 98-112.

Zhu, Z., Zhou, X., Shao, K. (2019). A novel approach based on Neo4j for multi-constrained flexible job shop scheduling problem. Computers & Industrial Engineering, 130, 671-686. Zohali, H., Naderi, B., Mohammadi, M., Roshanaei, V. (2019). Reformulation, linearization, and a hybrid iterated local search algorithm for economic lot-sizing and

sequencing in hybrid flow shop problems. Computers and Operations Research, 104, 127-138.

Zohali, H., Naderi, B., Mohammadi, M., Roshanaei, V. (2019). Reformulation, linearization, and a hybrid iterated local search algorithm for economic lot-sizing and sequencing in hybrid flow shop problems. Computers and Operations Research, 104, 127-138.

Zouache, D., Ould Arby, Y., Nouioua, F., Ben Abdelaziz, F. (2019). Multi-objective chicken swarm optimization: A novel algorithm for solving multi-objective optimization problems. Computers & Industrial Engineering, 129, 377-391.

Zweers, B.G., Bhulai, S., van der Mei, R.D. (2019). Optimizing barge utilization in hinterland container transportation. Naval Research Logistics, 66(3), 253-271.

Announcement:

The "Useful links" section of the group's homepage

(www.cs.put.poznan.pl/ewgmcda)

is being enlarged. Contributions of URL links to societies, research groups and other links of interest are welcome.

A membership directory of the European Working Group on "Multiple Criteria Decision Aiding" is available at the same site. If you would like to be listed in this directory please send us your data (see examples already in the directory).

Contact: José Rui Figueira (figueira@ist.utl.pt)

Web site for the EURO Working Group "Multicriteria Aid for Decisions"

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

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

Web site Editor: Milosz Kadzinski (Milosz.Kadzinski@cs.put.poznan.pl)

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



EURO Working Group on Multicriteria Decision Aiding Groupe de Travail Européen Aide Multicritère à la Décision

NEWSLETTER BULLETIN

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	Contributions should be sent to:			
José Rui Figueira	José Rui Figueira (figueira@ist.utl.pt)			
Instituto Superior Tecnico				
Departamento de Engenharia e Gestao				
Campus da Alameda				
Av. Rovisco Pais				
1049-001 Lisboa, Portugal				
E-mail: fiqueira@ist.utl.nt				