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# Guest editorial: Editorial for special issue on the role of big data on the transition to circular economy and sustainable operations management

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## 1. Introduction

Most modern technologies (e.g. big data (BD), Internet of things (IoT), blockchain, cloud services) are capable of leveraging the effective implementation of the circular economy (CE) concepts through companies, organizations, societies and people's daily life. To deal with the emerging challenges, BD can act as a facilitator to gain the preferred information that is helpful for decision-makers. BD has caused large, complex, growing data to be produced from many available sources. In general, decision-making on the basis of large, diverse data are highly favored; for that reason, BD is applicable to diverse disciplines. Significant issues of economy and environment, together with sustainability, have led society to a new paradigm shift, i.e. the CE, BD and Industry 4.0. Among them, a CE is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems. Following the circular approach, this newly-emergent type of economy can provide social, environmental and economic advantages by shifting from the linear economy (which is based on the take–make–dispose mechanism) to the CE (Lieder *et al.*, 2017). For the first time, during the Hannover Messe, 2011, Industry 4.0 was officially declared a German strategic initiative 2013, which is capable of revolutionizing the whole manufacturing industry (Rajput and Singh Surya; Xu *et al.*, 2018). On the other hand, although in the field of sustainable operations management (SOM) (Fahimnia *et al.*, 2017), the CE is an emerging approach to the sustainable use of natural resources (McDowall *et al.*, 2017), however, to date, a little attention has been paid to the relationship between SOM and the CE. Therefore, the implementation of the CE is a challenging issue in the different fields of SOM. However, Industry 4.0 can help to achieve sustainability and foster social, economic and environmental dimensions. In recent years, a few researchers explored the relationship between Industry 4.0 and CE practices in the different operation management fields (Rajput and Singh Surya; Lopes de Sousa Jabbour *et al.*, 2018; Tseng *et al.*, 2018; Nascimento *et al.*, 2019; Rajput and Singh, 2019; Rosa *et al.*, 2020).

In this regard, in this special issue, we have published several high-quality papers in the areas of BD, CE and sustainable operations management. Therefore, we classified some of the published papers based on different methods and approaches in the following sections.

## 2. Article classifications

### 2.1 Review papers

Chen *et al.* (2021) conducted a survey using expert interviews and literature to select the important criteria for selecting and evaluating third-party reverse logistics providers (3PRLPs) in manufacturing companies. In total, 16 criteria are selected to evaluate 3PRLPs, and these criteria are classified on the basis of three main elements of sustainable growth, including economic, social and environmental development. Therefore, a hybrid decision-



making approach is utilized to evaluate and rank the 3PRLPs in manufacturing companies. This paper proposes a new decision-making approach using the projection model and entropy method under the interval-valued intuitionistic fuzzy set to assess 3PRLPs based on sustainability perspectives. Using the literature review and experts' interview, a survey is conducted to select the important criteria to select and evaluate 3PRLPs in manufacturing companies. To assess the criteria weight, the entropy method is used. Further, the projection model is applied to prioritize the 3PRLPs option. The presented methodology used the benefits to determine the former for measuring the parameters considered and the latter for rating the 3PRLPs alternatives. Finally, a case study is taken to 3PRLPs in the manufacturing industry to illustrate the efficiency of the introduced hybrid method. The findings of this study indicate that when facing uncertainties of input and qualitative data, the proposed solution delivers more viable performance and therefore is suitable for wider uses.

### *2.2 Decision-making and fuzzy sets methods*

Decision-making and fuzzy sets area is another field that we have published some papers (Xiaofei, 2021). Yang *et al.* (2021b) examined the IoT challenges of sustainable supply chain management in the manufacturing sector using an integrated q-Rung Orthopair Fuzzy-CRITIC-VIKOR method. Numerous studies have confirmed that manufacturing firms have to accelerate the shift of their focus toward sustainability and the implementation of novel technologies, such as IoT, to accomplish their organizational goals most effectively. Although the literature consists of many theoretical approaches to IoT and numerous studies that have extremely concentrated on the IoT technology and its potential applications, it lacks research with a focus on the challenges that arise when applying IoT to the "sustainable supply chain management (SSCM)". The present study proposes an integrated framework using the "Criteria Importance Through Intercriteria Correlation (CRITIC)" and "VlseKriterijumska optimizacija I kaompromisno resenje in Serbian (VIKOR)" models and employs to evaluate the IoT challenges to implement the SSCM. For estimating the criteria weights, the CRITIC tool is utilized. The organization's prioritization is obtained by the VIKOR procedure, which delivers simple mathematical procedures with precise and consistent outcomes. To exhibit the practicality of the introduced model, a case study is taken to evaluate the IoT challenges of implementing the SSCM within the "q-Rung Orthopair Fuzzy Sets (q-ROFSs)" environment. Moreover, the authors exhibit a sensitivity investigation over given parameter values, examining the stability of the developed approach. Finally, the authors compare the developed q-ROF-CRITIC-VIKOR decision-making approach with an existing q-ROF-TOPSIS method to show its superiority and potency.

Liu *et al.* (2021) evaluated sustainable circular suppliers in the manufacturing sector using the Pythagorean fuzzy EDAS approach. In this regard, a framework is developed to assess and establish suitable suppliers in the SSCM and the CE. That paper introduced an extended framework using the evaluation based on distance from average solution (EDAS) with PFSs and implemented it to solve the SCSS in the manufacturing sector. First, the PFSs to handle the uncertain information of decision experts (DEs) are employed. Second, a novel divergence measure and parametric score function for calculating the criteria weights are proposed. Third, an extended decision-making approach, known as PF-EDAS, is introduced. The outcomes and comparative discussion show that the developed method is efficient and capable of facilitating the DEs to choose desirable SCSS. Therefore, the proposed framework can be used by organizations to assess and establish suitable suppliers in the SCSS process in the CE.

Wang and Rani (2021) extended the double normalization-based multiple aggregation approach under an intuitionistic fuzzy environment for the assessment of sustainable supply

chains under risk in manufacturing firms. That paper aims to provide a comprehensive framework to evaluate the sustainability risk in the supply chain management mechanism. To do so, a novel approach using the double normalization-based multiple aggregation (DNMA) approach under the intuitionistic fuzzy (IF) environment is extended to identify, rank and evaluate the sustainability risk factors in supply chain management. This study has conducted a survey using interviews and literature review to provide comprehensive sustainability risk factors. In this regard, this study identified 36 sustainability risk factors in supply chain management of the manufacturing firms in 5 different groups of risk, including sustainable operational risk factors, economic risk factors, environmental risk factors, social risk factors, and sustainable distribution and recycling risk factors. The results of this paper found that poor planning and scheduling was the important sustainability risk in supply chain management of the manufacturing firms, followed by the environmental accidents, production capacity risk, product design risk and exploitative hiring policies. In addition, the results of the study found that the extended approach was effective and efficient in evaluating the sustainability risk factors in supply chain management of the manufacturing firms.

Shang *et al.* (2022) assessed circular supply chains barriers in the era of Industry 4.0 transition using an extended decision-making approach. Therefore, this study to evaluate the related barriers of CSCs in the era of Industry 4.0 transition developed an innovative decision-making approach with the help of the “Combined Compromise Solution (CoCoSo)” method and “Criteria Importance Through Intercriteria Correlation (CRITIC)” method on the “q-Rung Orthopair Fuzzy Sets (q-ROFSs).” CRITIC in this combined method was used to predict the importance or weighting degrees of the CSCs barriers in the age of Industry 4.0 transition. The results of this study found that the absence of knowledge about the Industry 4.0 technologies and circular approaches was the first barrier, followed by the problems associated with data security in relationship management in circular flows, the deficiency of knowledge regarding the data management among stakeholders and the lack of awareness about the potential benefits of autonomous systems in labor-oriented “End-of-Life (EOL)” activities for CSCs in the era of Industry 4.0 transition.

### *2.3 Machine learning models*

Machine learning was one of the topics that we published some important articles (Feng and Qu, 2021; Peng *et al.*, 2021; Sun and Shi, 2021; Yang *et al.*, 2021c; Zhao and Chen, 2021). For example, Wu *et al.* (2021) discussed how to realize the sustainable development of the social economy through the innovation of green computing technology. For the green computing technology and sustainable social and economic development problems, this study proposed the backpropagation (BP) neural network model and analyzed the topological structure of the network model as well as the impact of the training errors allowed by the network on its performance. By optimizing the number of input nodes, the number of hidden nodes and the target value, the genetic algorithm (GA) can get the optimal neural network model. The simulation experiment proves that the proposed model is effective.

### *2.4 Times series and regression methods*

Times series and regression methods are other topics that we published some high-quality papers (Miao, 2021; Xie *et al.*, 2021; Yang *et al.*, 2021a; Yaoteng and Xin, 2021; Duan *et al.*, 2022). For example, Zhao and Chen (2021) examined the role of an effective government and an effective market in preventing and controlling the withdrawal of innovators. Based on balanced panel data of 31 provinces and cities from 2010 to 2018, this study uses the individual fixed-effect model to study the impact of the marketization level, the market’s scale and government interventions on the withdrawal of innovators. Simultaneously, based on the

spatial econometric model, this study examines the spatial spillover effect of the withdrawal of innovators. The study results indicated that government interventions have an inhibiting effect on the withdrawal of innovators. Moreover, there was a positive “U”-shaped nonlinear relationship between the marketization level and the withdrawal of innovators and an inverse “U”-shaped nonlinear relationship between the market size and the withdrawal of innovators.

### 2.5 Optimization models

Under this special issue, we have published some high-quality papers in the area of optimization modeling (Yang and Lin, 2021; Wang and Xue, 2022).

Wang *et al.* (2021) constructed the e-tailing service supply chain (SSC) model to explore the coordination relationship in the supply chain, and BD analysis provides realistic possibilities for the creation of coordination mechanisms. By analyzing the e-tailing SSC coordination mechanism and adjusting relevant parameters, this study found that the synergy mechanism can be implemented and optimized.

Daifen (2022) evaluated the sustainable marketing strategy for optimal online leasing of new energy vehicles under the background of a BD economy; therefore, the study aims to provide solutions for the sustainable development of NEV. The sustainable marketing strategy of NEV in China is put forward. This paper first analyzes the subsidy policy effect of NEV under the background of BD. It then establishes the online optimal leasing strategy under multiple strategy choices and the online leasing strategy of multiple vehicles under the inflation market. With the fixed cost of NEV in each lease period, the optimal competition ratio of online decision-makers will continue to decrease with the increase of the difference between prepaid funds and government subsidies. In the decision-making of renting and purchasing multiple vehicles, the general strategy competition ratio is 2.922, while the optimal competition ratio of the online renting and purchasing strategy proposed by the research is 2.723.

## 3. Discussions

Industry 4.0 can help scholars and practitioners overwhelm existing technological barriers and attain the CE. In Industry 4.0, there is the capacity to achieve a stable pattern of production and consumption to manage the production efficacy using technological innovations. However, as disruptive technologies on the basis of the Industry 4.0 pillars have come to exist, the CE can be presently achieved through the adoption of advanced technologies (Lopes de Sousa Jabbour *et al.*, 2018). Nevertheless, it is worth noting that the relationships among Industry 4.0, the CE and BD technologies are still unclear because of the recent emergence of such ideas. Furthermore, to embrace Industry 4.0, it is needed to adopt appropriate technologies of BD that can be easily integrated to gather, store, process and analyze data. In the context of Industry 4.0, BD is produced by a number of sources such as manufacturing systems, sensors, machine controllers, people, etc. Remember that different industrial sectors' data-driven analysis approaches and techniques may be remarkably different. In spite of the obvious advantages of BD-driven industrial symbiosis, corporates have argued that in their activities within the cross-industry networks, sustainable development is of high importance.

The main objectives of this special issue were:

- (1) To provide an extensive contribution to the literature by presenting discussions on the ways BD, the CE and the Industry 4.0 can be integrated into the favor of SOM.
- (2) To present the state-of-the-art literature on Industry 4.0 and establish a reliable connection between Industry 4.0 and the CE in the SOM context.

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