Contents lists available at ScienceDirect

International Journal of Production Economics

journal homepage: www.elsevier.com/locate/ijpe

A location-inventory-routing problem to design a circular closed-loop supply chain network with carbon tax policy for achieving circular economy: An augmented epsilon-constraint approach

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ARTICLE INFO

Keywords:
Circular closed-loop supply chain
Carbon tax policy
Location-inventory-routing problem
Vehicle scheduling problem
Epsilon-constraint method

ABSTRACT

The emergence of the circular economy concept has pushed industry owners towards the green supply chain and waste reduction. The closed-loop supply chain originates from the concept of the circular economy and its purpose is to increase efficiency and profitability by reducing waste and energy consumption. Hence, in this research, an integrated bi-objective mixed-integer linear programming model is developed with the aim of optimizing both operational and strategic decisions in a closed-loop supply chain network. The proposed model benefits the location-inventory-routing problem to structure the network, and it applies a carbon tax policy and vehicle scheduling problem to reduce emissions and vehicle waiting time, respectively. Considering problems such as split-delivery, storage possibility, shortage, supplier selection, order allocation, heterogenous vehicles, and uncertain demand has led to the development of a comprehensive model. A stochastic scenario-based approach is used to deal with demand uncertainty, and an augmented epsilon-constraint method is employed to solve the proposed bi-objective model. The applicability of the proposed model and the effectiveness of the bi-objective solution approach for achieving circular economy are examined through its implementation in a cable and wire industry in Iran.

1. . Introduction

As a systematic approach, supply chain network (SCN) design aims to determine an ideal mixture of products, suppliers, and facilities by means of mathematical modeling (Zandkarimkhani et al., 2020). According to (Cammarano et al., 2022; Dwivedi et al., 2021), the current SCN should be reengineered by integrating circular economy concepts in order to achieve sustainable development goals (SDGs). When it comes to the optimization of SCN, one may refer to the design of it with the highest possible efficiency (Jain and Verma, 2021; Moreno-Camacho et al., 2019). In fact, SCN optimization provides companies with the possibility to assess the chain performance via some scenarios such as "what-if" to make practical plans as per robust criteria (Tavana et al., 2021). It should be noted that efficiency for SCNs may be variable based on the decision makers' (DMs) criteria and ideas as well as the modeling preferences they may employ (Chopra et al., 2021). Therefore, this concept has been referred to in the literature differently from varying viewpoints. A number of studies place the main focus on the significance of cost minimization (Salehi-Amiri et al., 2021; Yuchi et al., 2021), whereas some others lay the highest emphasis on the importance of profit maximization (Ghani et al., 2018). But most studies in this domain turn to multiple objectives to measure the efficiency and evaluate the performance of SCNs (Hasani et al., 2021; Nili et al., 2021; Nayeri et al., 2020). The consideration of order allocation and supplier selection is considered as the first step in the design of a SCN with a high efficiency (Bhayana et al., 2021; Kannan et al., 2020). This is so because the supplier is a major element at the top level of a chain and is highly influential in the downstream performance of the SCN (Bartos et

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https://doi.org/10.1016/j.ijpe.2023.108771
Received 1 May 2022; Received in revised form 4 November 2022; Accepted 3 January 2023
0925-5273/© 20XX

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