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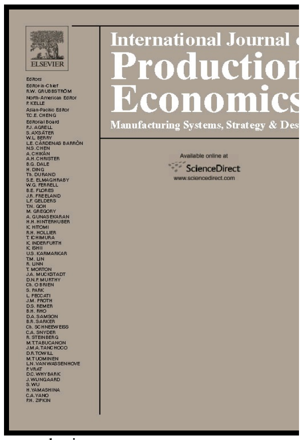

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A bi-objective interval-stochastic robust optimization model for designing closed loop supply chain network with multi-priority queuing system

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Abstract

This paper presents a bi-objective optimization model for designing a closed loop supply chain (CLSC) network under uncertainty in which the total costs and the maximum waiting times in the queue of products are considered to minimize. A general multi-priority and multi-server queuing system for parallel processing execution is proposed. Also a new hybrid solution approach is introduced based on interval programming, stochastic programming, robust optimization approach, and fuzzy multi-objective programming. Furthermore, a meta-heuristic algorithm called self-adaptive imperialist competitive algorithm (SAICA) is put forward for the given problem. Then, in order to evaluate the quality of the solutions obtained by this algorithm, a lower bound procedure is investigated. Finally, various computational experiments are carried out to assess the proposed model and solution approaches.

Keywords: closed-loop supply chains, meta-heuristics, priority queues, uncertainty modeling

1. Introduction

The significance of remanufacturing, product recovery, and recycling of end-of-life products is being progressively increased due to decrease of raw material resources, greater consciousness of the environmental impacts of disposal, reducing space in landfills, and growing levels of pollution (Kerr and Ryan, 2001; Hong and Ke, 2011). These problems start to impact manufacturers' behaviors, and customers' decisions are progressively forced to consider their products' impact on the environment. In order to deal with these concerns, manufacturers have to extend the traditional supply chain and consider the environmental influences of all products and procedures until they are returned to the end-of-life, which is referred to as closed loop supply chain (CLSC) (Kooi et al., 1996; Beomon, 1999). Hence, CLSCs are supply chains where, additionally to the conventional forward flow of materials from suppliers to consumers, are flows of products back to the manufacturers.

In CLSC networks design, decisions concerning issues like the location of distribution centers, collection centers, and disposal centers, and also the allocation of customer zones, manufacturing facilities, etc to these facilities directly influence the operational performance of CLSC networks (Tan and Kara, 2007). One of the important issues in design of the CLSC networks is priority service system. In this system, clients are served according to an absolute priority rule, specifically, while a server frees up, the server proceeds to serve the first client who has been waiting the longest time in the queue with the highest priority. Moreover, the difference between the arrival rate of products and processing rate of servers might cause queues to be built. Hence, appropriate management in these situations is necessary to exploit and optimize the usage of resources

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