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Variations to the CFCLP-TC for Multiobjective Supply Chain Design

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Abstract

This work reexamines a supply chain design problem called the Capacitated Fixed Cost Facility Location Problem with Transportation Choices (CFCLP-TC). The problem was formulated as a bi-objective optimization model with objective functions based on time and cost. The problem has two echelons with plants serving distribution centers and these serving directly to the customers. Several transportation channels are available between nodes with lead times and variable transportation costs associated. The decisions are the discrete location of the distribution centers, the selection of the transportation channels, and the flow to be transported. We propose one variation to the original model to compare the approximate sets of efficient solutions and the computational time required to obtain them. In the original problem each customer must be served by a single distribution center. In the proposed variation we remove this constraint to compare the effects in the Pareto fronts and in the solution time. The models are implemented in GAMS and solved with CPLEX for a set of instances to assess the efficacy of the approach.

Keywords

Bi-objective Optimization, Facility Location, Pareto Front

1. Introduction

Supply Chain Management (SCM) is the process of planning, implement and controlling the operation of the supply chain efficiently. SCM spans all movements and storage of raw materials, work-in-process inventory, and finished goods from the point of origin to the point of consumption. Part of the planning processes in SCM aim at the finding the best possible supply chain configuration so that all operation can be performed in an efficient way.

The bi-objective supply chain design problems are extensions of classic locations problems. These problems are the median, knapsack, quadratic, covering, unconstrained, location-allocation, hub, hierarchical, competitive, network, undesirable and semi-desirable location problems. Considering capacities in these location problems, there are capacitated and uncapacitated problems in the literature. Tragantalerngsak et al [1] proposed a Lagrangian relaxation-based branch and bound algorithm for a facility location problem in which there exist two echelons of facilities. Yapicioglu et al [2] presents an approach to solve a model for the semi-obnoxious location problem, this model is composed of a weighted minisum function to represent the transportation cost and a distance-based piecewise function to represented the obnoxious effects of the facility. In the literature on multi-channel supply chain management, researches mainly focus on operation issues relating to channel conflict and coordination , Liu et al [3] presents a location model that assigns online demands to the capacited regional warehouses currently serving in-store demands in a multi-channel supply chain. For instance, Myung et al. [4] have considered an uncapacitated facility location problem with two maxisum objectives (net profit and profitability of investment) and modeled it as parametric integer program with fractional and linear objectives. Villegas et al. [5] has modeled a supply network as a bi-objective uncapacitated facility location problem, with minisum and maxisum objectives (cost and coverage). In contrast, Galvao et al [6] developed an extension of the capacitated model to deal with locating maternity facilities with a minisum objective (distance traveled and load imbalance). Costa [7] has utilized a different bi-criteria approach to the single allocation hub location problem. This approach has two objectives, the first has a minisum form (cost), while the second objective (process time) has two alternative forms.