Bi-level Multi-objective programming in Supply Chain Management: A review

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Abstract

Bi-level Multi-objective programming is an optimization problem with conflicting objectives to be achieved, simultaneously. This presentation reviews literature about Bi-level Multi-objective programming problems for supply chain management. The scope of the literature review about Bi-level Multi-objective programming for supply chain problems involves Bi-level Multi-objective programming definition, problem statement, Bi-level Multi objective mathematical modeling and optimization techniques to solve this kind of problem.

A substantial body of research exists on Bi-level single-objective programming where many algorithms have been proposed for solving this kind of problems (Wang et al., 2005; Shi et al., 2005-a; Shi et al., 2005-b; Gao et al., 2010; Zhang et al., 2010; Zheng et al., 2011) but relatively few papers have considered Bi-level programming problems with multiple objectives on both levels. One of the first studies, utilizing an evolutionary approach for bi-level multi-objective algorithms was in Yin (2000) paper. Their study involved multiple objectives at the upper level, and a single objective at the lower level. It suggested a nested genetic algorithm, and applied it on a transportation planning and management problem. Then, Shi and Xia (2001) use the ε-constraint method at both levels of a Bi-level Multi-objective problem to convert the problem into an ε-constraint Bi-level problem. The ε-parameter is elicited from the decision maker, and the problem is solved by replacing the lower level constrained optimization problem with its KKT conditions. Dempe et al. (2006) in their work have suggested the Karush-Kuhn-Tucker (KKT) conditions of the lower level optimization problems. Studies by Eichfelder (2007, 2010) utilizes classical techniques to solve simple Bi-level Multi-objective problems where the lower level problems are handled

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using a numerical optimization techniques, and the upper level problem is handled using an adaptive exhaustive search method.

Zhang et al. (2007) in their work considered a company scenario where a leader may be interested in maximizing net profit of the company and quality of products, and the follower may maximize his own net profit and worker satisfaction. Later, Deb and Sinha (2010) proposed a hybrid bi-level evolutionary multi-objective optimization algorithm approach coupled with local search. Their work provided a suite of test problems for bi-level multi-objective optimization.

Wang and Ehrgott (2011) have proposed a transportation problem of a tolled road network where the objectives at the upper level are to minimize system travel time and total vehicle emissions. In their work, the upper level is an optimization task necessary for the planning organization and the lower level is a network equilibrium problem of traffic flow which results from the tax proposed by the planning organization. The lower level decision makers are users, who have two objectives in their mind, namely, minimize travel time and minimize toll cost.

Keywords: Bi-level programming, Bi-level Multi-objective programming, Supply chain management, Optimization techniques

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