Evolutionary Approach for a Multi-Objective Spare Parts Location–Inventory Problem with Time–Based Service Levels

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Abstract

Facility location-allocation decisions and inventory stocking decisions are very important in spare parts logistics. Both sets of decisions affect total costs in the system and the service levels that can be achieved by establishing distances between customers and distribution centers (DCs) in facility location-allocation, and by determining the availability of parts in inventory stocking. There is a trade-off between total costs and service levels that decision makers have to explicitly take into account when designing a spare parts logistics (SPL) system. The integration of the location-inventory decisions along with the multiple objectives could lead to an approach in which the sub-optimality of solutions obtained separately and in a sequential approach can be overcome. However, this integration also increases the complexity of the problem. In this research, a nonlinear multi-objective optimization model was formulated in which the objectives are to minimize cost and maximize the service level. The goal is to determine the number and location of DCs, the allocation of customer demands to DCs, and the safety stock for parts to maintain at DCs. A time-based service level requirement is considered by allocating customers to DCs that can serve demands of those customers within a specified time window. To solve this formulation, an NSGA-II solution method was implemented and used to obtain Pareto optimal solutions for problems of different sizes. A full factorial experimental design was implemented to analyze the impact of factors on the problem and the performance of the solution approach. Computational results and general insights about the problem are presented.

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