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A Heuristic Based Decomposition Approach for a Hierarchical Production Planning Problem

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Abstract : The production planning problem is concerned with specifying the optimal quantities to produce in order to meet the demand for a prespecified planning horizon with the least possible expenditure. Making the right decisions in production planning will affect directly the performance and productivity of a manufacturing firm, which is important for its ability to compete in the market. Therefore, developing and improving solution procedures for production planning problems is very significant. In this paper, we develop a Dantzig-Wolfe decomposition of a multi-item hierarchical production planning problem with capacity constraint and present a column generation approach to solve the problem. The original Mixed Integer Linear Programming model of the problem is decomposed item by item into a master problem and a number of subproblems. The capacity constraint is considered as the linking constraint between the master problem and the subproblems. The subproblems are solved using the dynamic programming approach. We also propose a multi-step iterative capacity allocation heuristic procedure to handle any kind of infeasibility that arises while solving the problem. We compare the computational performance of the developed solution approach against the state-of-the-art heuristic procedure available in the literature. The results show that the proposed heuristic-based decomposition approach improves the solution quality by 20% as compared to the literature.

Keywords : inventory, multi-level capacitated lot-sizing, emission control, setup carryover
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