# A coordinated production-distribution planning for a single product

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## Abstract

The various activities of an manufacturing organization including assembly, storage, and distribution are often decoupled into their functional and geographical components based on the scheme of arranging buffers of large inventory. Moreover, the associated decision complexity is reduced (relaxed) for treating each component of any others. Ignoring such component dependencies, however, can cause costly consequences, which becomes increasingly apparent with market globalization. As a result, firms are moving from decoupled decision making processes towards more coordinated and integrated design and control of all the components in order to provide goods and services to customers at low cost and high service levels. These have been directed to consider new management approaches such as supply chain management (SCM).

Thomas and Griffin have classified SCM into two categories including strategic planning and operational planning. The strategic planning issue may include plant or distribution center (DC) openings and closings, allocation of equipments to manufacturing facilities, or evaluation of any changes in the distribution flow of a particular product on a supply chain. The operational planning issue may address various coordinations of planning and scheduling, so that it may be targeted at several topics including selection of batch size, choice of transportation mode, and choice of production quantity. They have defined three categories of operational coordination including Buyer-Vendor coordination, Production-Distribution coordination and Inventory-Distribution coordination. Among the three categories, this paper is interested in the Production-Distribution coordination category.

To solve the integrated (Production-Distribution) problem (model) efficiently, no capacity constraint is allowed and the distribution problem is simplified as a dynamic transportation routing model. The objective of the model is to minimize the whole system cost consisting of inventory-holding cost, transportation cost, production cost, and set-up cost. Them, the objective will be minimized subject to inventory-balancing constraints, set-up related constraints, and route related constraints.

A solution technique based on the Benders decomposition is developed for the proposed problem and tested with various numerical examples. To solve the proposed problem more efficiently, a strong cut generation method and some additional cuts are proposed. Two test problem sets were constructed to demonstrate the effectiveness and efficiency of the proposed BD-based algorithm with reasonable size problems, and the performance behavior of the BD-based algorithm with variable cost parameter sets. Experimental tests show that the algorithm solves all the numerical problems within reasonable time. The solutions were found within 5% gap. The tested problem size seems to be practical so that the proposed algorithm may be used to planning the production-distribution schedule at general manufacturing-distribution companies.