Integrated Modelling for Supply Chain Planning and Multi-Echelon Safety Stock Optimization in Manufacturing Systems

Abstract

Optimizing supply chain is the most successful key for manufacturing systems to be competitive. Supply chain (SC) has gotten intensive research works at all levels: strategic, tactical, and operational levels. These levels, in some researches, have integrated with each other or integrated with other planning issues such as inventory. Optimizing inventory location and level of safety stock at all supply chain partners is essential in high competitive markets to manage uncertain demand and service level. Many works have been developed to optimize the location of safety stock along supply chain, which is important for fast response to fluctuation in demand. However, most of these studies focus on the design stage of a supply chain. Because demand at different horizon times may vary according to different reasons such as the entry of different competitors on market or seasonal demand, safety stock should be optimized accordingly. At the planning (tactical) level, safety stock can be controlled according to each planning horizon to satisfy customer demand at lower cost instead of being fixed by a decision taken at the strategic level. On the other hand, most studies that consider safety stock optimization are tied to a specific system structure such as serial, assembly, or distribution structure.

This research focuses on formulating two different models. First, a multi-echelon safety stock optimization (MESSO) model for general supply chain topology is formulated. Then, it is converted into a robust form (RMESSO) which considers all possible fluctuation in demand and gives a solution that is valid under any circumstances. Second, the safety stock optimization model is integrated with tactical supply chain planning (SCP) for manufacturing systems. The integrated model is a multi-objective mixed integer non-linear programming (MINLP) model. This model aims to minimize the total cost and total time. A case study for each model is provided and the numerical results are analyzed