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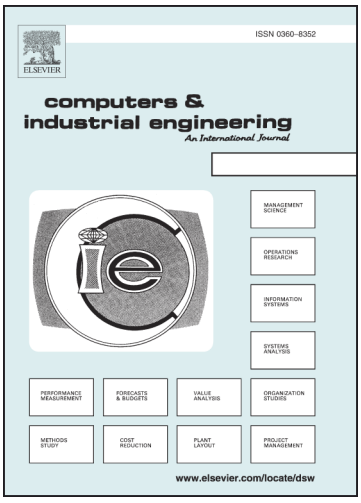

Modeling and Optimizing of Variance Amplification in Supply Chain Using Response Surface Methodology

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Modeling and Optimizing of Variance Amplification in Supply Chain Using Response Surface Methodology

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Abstract

Supply chains experience variance amplification in replenishment orders and inventory levels, leading to severe inefficiencies. Extensive studies are conducted while focusing mainly on the demand variance amplification (also known as bullwhip effect), but limited research is undertaken to optimize the variance amplification that considers both the orders and net stock variability. A single-echelon supply chain with a stationary demand process, a generalized periodic-review order-up-to (OUT) policy, and an exponential smoothing forecasting model are assumed. Hence, this paper seeks to optimize the best values of the exponential smoothing and OUT policy parameters that minimize the sum of demand and inventory variances. A hybrid approach that integrates simulation modeling and response surface methodology is proposed. The algorithm is iterative in nature, where at each iteration simulation runs are conducted to generate a response surface for the variance amplification, and a gradient search is applied to locate a new incumbent solution. Several experiments are conducted to demonstrate the applicability of the approach, and to validate its results with previous researches. The proposed RSM-Simulation based algorithm produces comparable results to existing methods and thus having a good potential to accommodate more supply chain complexities. It can be used to model and optimize nonlinear supply chains, supply chain with stochastic lead-time, supply chains with correlated demand, and supply chains with capacity constraints.

Keywords: Supply chain; variance amplification; bullwhip; simulation; response surface methodology; optimization

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