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Performance Modeling of a Two-Echelon Supply Chain under Different Levels of Upstream Inventory Information Sharing

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Abstract

The advancement in information technology has facilitated the sharing of information in supply chain networks (SCNs), resulting in effective management of inventory and storage capacity. In this paper, our focus is on upstream inventory information sharing. Existing analytical performance evaluation models of SCNs are not capable of assessing the impact of inventory information sharing. To address this need, we develop performance evaluation models of SCNs that explicitly consider production capacity, inventory related decisions, variability, transit delays and inventory information sharing in a unified manner. We employ a two-echelon SCN configuration with two retail stores and two production facilities as a test bed. The retail stores have inventory information from the production facilities. We model three levels of inventory information sharing in our study; the information shared ranges from the stock-out information at the lowest level to inventory and back-order level information at the highest level. We develop analytical models first for Poisson arrivals and exponential processing times under all levels of inventory information sharing. We extend these models to general inter-arrival and processing time distributions and subsequently include transit delays between the production facilities and the retail stores. We demonstrate the performance prediction capability of the analytical models developed via extensive numerical experimentation.

Keywords: Queueing models, Supply chain network, Inventory information sharing, base-stock policy.

1. Introduction

The advancement in e-business and e-commerce has meant that customers have more choices for a product as well as retailers have more choices for producers/suppliers of that product. This has forced firms in a supply chain network (SCN) to adopt a more customer-centric view, where the focus is on reducing the stock-out rate and improving customer satisfaction. This need was clearly highlighted by Corsten and Gruen (2003) in their survey-based study. The study found the average

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