A DISTRIBUTION FREE MODEL FOR LEAD TIME REDUCTION EFFECT IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

This paper investigates the effect of lead time reduction on the financial performance of the supplier in the three-echelon serial supply chain who is faced with lead time uncertainty from upstream and demand uncertainty from downstream. A distribution free total cost model is presented and analyzed. We conclude that in order to effectively reduce cost, the decision to reduce the mean of lead time or the standard deviation of lead time depends on the coefficient of variation of demand (measurement of the variability of demand). Managerial implications of the decision rules are discussed.

Keywords*: Supply chain management; uncertainty; lead time; Coefficient of variation of demand; lead time reduction.*

1. INTRODUCTION

In a highly competitive market, individual agents (e.g., suppliers) in a supply chain are under continuous pressure to provide quality products and/or services to their customers at low costs. Consequently, cost and quality are common metrics for evaluating supplier performance in a supply chain. Hence, how to achieve low cost without compromising the quality of their products and services remains a very important goal of managers in a supply chain. Various tools have been employed to reduce cost and improve quality including just in time (JIT) and total quality management (TQM), especially as they relate to lead time reduction to improve supply chain efficiencies.

Lead time permeates all facets of a supply chain and is a prelude to flexible capacity management, cost reduction, speed to market, among others. Defined as the time between the receipt of an order and its delivery to the customer, lead time is comprised of internal and external components. While the former includes manufacturing and processing activities such as machine setup, the latter includes distribution and transportation activities (Christopher, 1992; Gunasekaran, 2001).

The benefits of lead time reduction in supply chains have been discussed from different perspectives. Blackburn (1991), Tersin (1995), and Treville (2004) surmised that lead time is a major competitive battleground of firms; Lee, Padmanabhan and Whang, (1997) suggest that lead time reduction increases operational efficiencies and diminishes bullwhip effect of supply chains; and Fisher (1997 and 2000) state that reducing lead time enables a company to react more quickly to demand information and, hence to better match supply with demand uncertainties, especially for products with short life cycles. Particularly, Matta (1994), Sirias and Methra (2005), Hsu, Lee and So (2007) and He, Wang and Lai (2010) conclude that lead time reduction is essential for deteriorating products in supply chain management.

In this paper, we present a mathematical model and investigate the effect of lead time reduction on the financial performance of supplier *i* in a three-echelon serial supply chain. Lalonde and Pohlen (1996), Lancioni (2000) and Ellram (2002) addressed the importance of linking performance of measurement with cost in supply chain management. Hence, we use cost to measure the financial performance of supplier *i* providing stable quality products.