Chapter II

Multi-Stage Efficiency Tools for Goal Setting and Monitoring in Supply Chains

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Abstract

This chapter discusses the extension and potential application of some recent theoretical results on efficiency monitoring and throughput rate optimization for serial processes. In particular, we consider the relevance and adaptation of these results for use in monitoring and continuous improvement uses in supply chains or networks, with particular emphasis on the importance to e-business. Linear programming models based on ideas from Data Envelopment Analysis have been developed for maximizing the throughput of serial input-output processes in which one or more outputs of an upstream process become inputs to a successor process. We
consider their adaptation to supply chain monitoring. We also propose some additional research needs in this area.

Introduction

A supply chain or network may be considered to be a set of linked processes connecting downstream customers to upstream suppliers, factories, distribution centers and retailers. Chopra and Meindl (2003) discuss a point of relevance to supply chain management of efficiency frontiers. In particular, they note that the supply chain should ideally operate on the cost-responsiveness efficiency frontier. In this chapter, we explore several other efficiency connections in supply chain links.

Some basic theory in this area has been developed in Troutt et al. (2001a). In that work, productive efficiencies between stages in a serial linkage of processes were modeled so that linear programming could be used to determine optimal throughput. This chapter proposes how these theoretical results might be extended and applied to supply chain management, especially to the monitoring of chains and supply networks for efficiency, capacity and continuous improvement.

This chapter is organized as follows. The second section discusses the importance of efficiency in the context of supply chains for e-business. The concepts of e-business and supply chains are reviewed. A particular form of e-business, the value net integrator, which focuses on supply chain management, is presented since the optimization model developed in this paper may have direct relevance to the operations of this e-business. In the next section, we review the previous theory results. In particular, a number of efficiency related issues that are relevant to optimal functioning of supply chains are raised, and salient LP models developed in previous research to address the issue of optimal throughput in supply chains are presented and extended. The chapter then considers how these results may be modified and extended to supply networks. Here, the application of the models developed is discussed with particular reference to centralized supply chains. Appropriate strategies for handling uncertainty when optimal value changes from period to period and efficiency bottlenecks are discussed. The fifth section provides a discussion with opportunities and needs for further research. Application of data envelopment analysis and stochastic programming to extend the research is discussed.
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