Advance Information Sharing in Supply Chains

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INTRODUCTION

With the continuous development and improvement in information technology, information sharing has been broadly adopted in supply chain management. The effects of information sharing have been extensively studied in the literature (Chen 1998; Cachon & Fisher, 2000; Lee et al, 2000; Simchi-Levi & Zhao, 2005; and Croson & Donohue, 2005). Information sharing can mitigate the bullwhip effect which refers to the amplification of variability in order quantity at different supply chain stages because one major cause of the bullwhip effect is the asymmetric demand information obtained by the downstream/upstream members in supply chains (Forrest, 1958; Lee et al, 1997; and Lee & Whang, 2000).

Information sharing in supply chains is also facilitated by the development and implementation of new data-capturing technologies. For example, the implementation of radio frequency identification (RFID) technology has been promoted by major retail channels. In June 2003 Wal-Mart announced a mandate to its top 100 suppliers to attach RFID tags to selective cases and pallets by January 2005. Later on, other retail chains like Target, Best Buy, CVS, and Tesco also announced plans to implement RFID systems. Although RFID technology is not new, its recent business applications based on the unique technical advancement, such as no line-of-light needed and multiple tags can be read simultaneously, provide an efficient means for information sharing. It is vital and valuable to the adopters because RFID can provide timely point-of-sale data, accurate inventory records, and production lead time information.

The value of information sharing has been analyzed from different perspectives, such as inventory control and lead time reduction, and under different scenarios, such as stochastic demand and capacitated supply (Bourland et al, 1996; Chen, 1998; Aviv & Federgruen, 1998; Gavireni et al, 1999; Lee et al, 2000; Cachon & Fisher, 2000; Yu et al, 2001; Simchi-Levi & Zhao, 2005; and Croson & Donohue, 2005). In particular, accurate and timely demand information helps to dampen upstream variability propagation in supply chains, especially under situations with capacity constraints and large demand uncertainty (Balakrishnan et al, 2004; Wijngaard, 2004; Bollapragada & Rao, 2006; and Boute et al, 2007).

In addition to sharing the information of orders received, retailers can also share their forecasts on future demand with their suppliers. Such advance demand information (ADI) provides additional information and opportunities for the suppliers to have better production planning and inventory replenishment. There is a line of research which focuses on ADI sharing in supply chain management (Thonemann, 2002; Moinzadeh, 2002; Ozer, 2003; and Ozer & Wei, 2004).

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Supply uncertainty originated from upstream members affects the downstream members' performance as well. According to a survey conducted by Anderson Consulting, supply (production) capacity is one of the most broadly shared types of information in the PC supply chain (Lee & Whang 2000). Insufficient supply capacity results in lead-time uncertainty as well. While stochastic lead-time may also be caused by stochastic transportation time, the major source of lead-time uncertainty comes from production delays in manufacturing plants. Lead-time uncertainty affects the decisions on the safety stock in inventory control (Chopra et al, 2004; Simchi-Levi & Zhao, 2005). Dobson and Pinker (2006) study a firm provides customers with estimates of the lead-time to satisfy new requests. They investigate whether a firm should share the lead-time information with its customers. They show that whether or not the firm benefits from sharing lead-time information depends on the demand curve, i.e., the customer's sensitivity to waiting.

The study on stochastic lead-time can be traced back to Kaplan (1970) who considers stochastic lead-time with a known distribution in his dynamic inventory model. Ehrhardt (1984) proposes (s, S) policy for a dynamic inventory model with stochastic lead-time in a single-item inventory system. Eppen and Martin (1988) present a model for determining the safety stock with stochastic lead-time and uncertain demand. Song and Zipkin (1996) develop an inventory model with a Markovian replenishment lead-time. They show that in the case of a linear order cost, the optimal policy is a state-dependent base-stock policy which is not increasing with lead-time. Chen and Yu (2005) consider a supplier knows exactly when the order will be delivered and he may or may not share that delivery lead-time information with the retailer. They show that the value of lead-time information can be significant if the lead-time highly varies or the demand is high.

Huang et al (2003) conduct an extensive literature review on production information sharing in supply chain. Simchi-levi and Zhao (2005) study the impact of stochastic lead-time on safety stock positioning in supply chains. They provide approximations and algorithms to coordinate the base-stock levels in those supply chains to minimize system-wide inventory costs under service-level requirements. Jain and Mionzadeh (2005) study a two-way information sharing mechanism where the manufacturer shares inventory availability and production capacity information with the retailer. They propose a two-level state-dependent base-stock policy in a continuous-time Markov decision process. In their model, the lead-time depends on the retailer's order quantity size. Ganesh et al. (2013) point out upstream members in a multi-level supply chain may over-estimate the value of information sharing if they ignore products substitution, demand correlation, and partial information sharing effects.

The following section provides a literature review on advance information sharing (AIS). RFID technology is used as an example to demonstrate how new technology could support AIS and the process and challenges when implementing it along the supply chain. For example, the availability of real time inventory information provided by RFID systems facilitates the changes in the business process such as vendor managed inventory (VMI). VMI is a supply chain initiative where the supplier is authorized to manage inventories of agreed on stock keeping units at retail locations (Cetinkaya & Lee, 2000). We find that AIS improves the visibility of material flow through supply chain in a timely manner and provides opportunities for each supply chain member and the entire supply chain to improve the efficiency and effectiveness. In contrast to typical information sharing, AIS involves more participants and requires timely data capturing and shring. The challenges in information sharing are also studied to understand the potential risks and barriers in implementing AIS in supply chains.