

Strategic inventory deployment for retail and e-tail stores[☆]

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Abstract

In this paper, we study a supply chain comprising one manufacturer and one retailer. Customers can make purchases either from the retailer or directly from the manufacturer via an e-tail channel. From the manufacturer's perspective of managing the two channels, we study three different inventory strategies, namely centralized inventory strategy, a Stackelberg inventory strategy, and a strategy where the e-tail operation is outsourced to a third party logistics provider (3PL). For each strategy, we obtain the optimal inventory levels in retail and e-tail stores and the respective expected profits. We compare the performance of various strategies. Managerial insights are provided through analytical and numerical analyses to illustrate the applicability of different strategies.

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1. Introduction

With the development of e-business, many companies are reorganizing their channels of distribution so that customers can have convenient access to their products. In addition to traditional retail stores, companies have increasingly adopted e-tail channels, i.e., selling retail goods on the Internet (e.g., [1]). For example, Circuit City has both physical retail stores and circuitcity.com, so that customers can make purchases from its retail stores or from the e-tail store. Firms following this dual-channel strategy are referred to as click-and-mortar companies, which is distinct from

their traditional brick-and-mortar counterparts. This new kind of business model has an enormous effect on all business functions, especially on the area of operations management. It is not surprising that most e-business failures are operations related. For example, one of the major reasons of lack of success for early e-business attempts was the failure of order fulfillment. Late delivery or stockout was commonplace, especially during peak seasons like Christmas. Tarn et al. [2] pointed out that “it was too late for some e-commerce companies before they realized that too much emphasis had been put on marketing websites along with promoting web shopping and not enough emphasis on establishing required backend operations.” It is a simple truth that a package cannot be sent over the Internet (except for some digital products such as music CDs). Therefore, even a well-designed e-tail store is useless if it cannot deliver the goods as promised. Managing inventory

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effectively in both channels is a critical success factor for the survival of click-and-mortar companies. Hill et al. [3] point out that, currently, click-and-mortar firms are applying different inventory strategies for retail and e-tail channels. For example, Penny uses a strategy to segregate retail and e-tail channels, each channel having its own warehouse, and keeps the e-tail in-house. The advantage of this strategy is that inventory items of both channels are not intermingled, and, therefore, fulfillment quantity in each channel is assured. Other companies, e.g., Wal-mart and Macy's find it hard to manage inventory for the same product in two different channels and, therefore, outsource the e-tail channel to third party firms having expertise in the order fulfillment process of this kind. Another strategy followed by some companies like Hardwarestreet.com is the drop-ship strategy [4], where the e-tailers rely on a third-party player to pick, pack, and ship e-orders to customers. A qualified drop-shipper has all distribution information available and puts the e-tailer's name and logo on the package, so that the shipment looks like as if it actually came from the e-tailer. This strategy was initially adopted by Amazon.com with different wholesalers and publishers [5]. Another strategy commonly used in practice is called the professional shopper strategy, where customers first surf online for product information on an e-tail store, and then make the purchase in a retail store. Alternatively, they order online, and then pick up the product in a retail store, i.e., e-tailers partner with the retailer for the order fulfillment process. Lee and Whang [6] list this as one of the five strategies to win the last mile of e-commerce.

The business practices detailed above raise the following interesting research question for supply chain management: What should be the optimal inventory decisions for the retail and e-tail stores, for different e-business strategies? It is intuitive to note that inventory policy would have an impact on the firm's performance. An additional challenge here is to determine not only the inventory level in the traditional brick-and-mortar channel but also in the e-tail channel. Each of these decisions has an impact on the other's optimal level. We consider the situation where demands in the two channels are related, and customers are split between the two channels. We investigate the optimal inventory decisions in each channel where the two-stage supply chain is facing random demand.

We consider three different channel strategies generally found in practice. All these are for a two-stage supply chain with one manufacturer and a retailer. There is also a direct channel from the manufacturer to customer—the e-tail channel. The three strategies

investigated here are as follows:

- (1) *Centralized inventory strategy*: The manufacturer owns both the retail and e-tail channels and has full control of the inventory decisions. This is the case where the manufacturer and the retailer form a strategic alliance or a retailer, such as Circuit City or Target, owns a traditional retail channel and an e-tail channel simultaneously. Therefore, there is only one centralized decision maker in this strategy.
- (2) *Stackelberg (leader–follower) inventory strategy*: In this case, the manufacturer owns the e-tail store, whereas the retailer controls the retail store. The manufacturer has full control of the inventory level in e-tail store and the wholesale price to the retailer. In response to the wholesale price, the retailer, acting as the follower in the game, makes inventory decisions for the retail channel. In order to integrate Internet fulfillment operations into their distribution networks, a number of manufacturers use this option to add an e-tail channel and has full control of it [7].
- (3) *Outsourcing inventory strategy*: Similar to the Stackelberg strategy, the manufacturer still owns the e-tail store, while the retailer owns the retail store. However, the manufacturer outsources the e-tail channel to a third-party logistic provider (3PL). Actually, the e-tail channel is a variant of the vendor-managed inventory (VMI) strategy, because the manufacturer makes the inventory decision on the e-tail channel managed by the 3PL.

It needs to be mentioned that these three strategies are not exhaustive. Lawrence et al. [8] summarized as many as five potential structures of distribution channels for e-commerce strategies. However, three strategies chosen here are commonly practiced in business. In this paper, we will find and compare optimal inventory decisions for retail and e-tail channels for these three strategies. The rest of the paper is organized as follows. In Section 2, we present a survey of recent literature and position our paper vis-à-vis the current research. We present our model and analyze the centralized strategy in Section 3. Optimal inventory levels for retail and e-tail stores for the Stackelberg strategy are presented in Section 4, and those for outsourcing strategy in Section 5. Managerial insights obtained from numerical analysis are presented in Section 6. Section 7 concludes the paper where we mention avenues of further research.

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