Chapter 74

Fashion Supply Chain Management through Cost and Time Minimization from a Network Perspective

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ABSTRACT

In this chapter, we consider fashion supply chain management through cost and time minimization, from a network perspective, and in the case of multiple fashion products. We develop a multicriteria decision-making optimization model subject to multimarket demand satisfaction, and provide its equivalent variational inequality formulation. The model allows for the determination of the optimal multiproduct fashion flows associated with the supply chain network activities, in the form of: manufacturing, storage, and distribution, and identifies the minimal total operational cost and total time consumption. The model allows the decision-maker to weigh the total time minimization objective of the supply chain network for the time-sensitive fashion products, as appropriate. Furthermore, we discuss potential applications to fashion supply chain management through a series of numerical examples.

INTRODUCTION

In recent decades, fashion retailers, such as Benetton, H&M, Topshop, and Zara have revolutionized the fashion industry by following what has become known as the "fast fashion" strategy, in

which retailers respond to shifts in the market within just a few weeks, versus an industry average of six months (Sull and Turconi (2008)). Specifically, fast fashion is a concept developed in Europe to serve markets for teenage and young adult women who desire trendy, short-cycle, and relatively inexpensive clothing, and who are willing to buy from small retail shops and boutiques

(Doeringer and Crean (2006)). Fast fashion chains have grown quicker than the industry as a whole and have seized market share from traditional rivals (Sull and Turconi (2008)), since they aim to obtain fabrics, to manufacture samples, and to start shipping products with far shorter lead times than those of the traditional production calendar (Doeringer and Crean (2006)).

Nordas, Pinali, and Geloso Grosso (2006) further argued that time is a critical component in the case of labor-intensive products such as clothing as well as consumer electronics, both examples of classes of products that are increasingly time-sensitive. They presented two case studies of the textile and clothing sector in Bulgaria and the Dominican Republic, respectively, and noted that, despite higher production costs than in China, their closeness to major markets gave these two countries the advantage of a shorter lead time that allowed them to specialize in fast fashion products. Interestingly and importantly, the authors also identified that lengthy, time-consuming administrative procedures for exports and imports reduce the probability that firms will even enter export markets for time-sensitive products.

Clearly, superior time performance must be weighed against the associated costs. Indeed, as noted by So (2000), it can be costly to deliver superior time performance, since delivery time performance generally depends on the available capacity and on the operating efficiency of the system. It is increasingly evident that, in the case of time-sensitive products, with fashion being an example par excellence, an appropriate supply chain management framework for such products must capture both the operational (and other) cost dimension as well as the time dimension.

For example, in the literature, the total order cycle time, which refers to the time elapsed in between the receipt of customer order until the delivery of finished goods to the customer, is considered an important measure as well as a major source of competitive advantage (see Bower and Hout (1988) and Christopher (1992)), directly

influencing the customer satisfaction level (cf. Gunasekaran, Patel, and Tirtiroglu (2001) and Towill (1997)). Moreover, according to the survey of Gunasekaran, Patel, and McGaughey (2004), performance metrics for time issues associated with planning, purchasing, manufacturing, and delivery are consistently rated as important factors in supply chain management.

Conventionally, there have been several methodological approaches utilized for time-dependent supply chain management, including multiperiod dynamic programming and queuing theory (see, e.g., Guide Jr., Muyldermans, and Van Wassenhove (2005), Lederer and Li (1997), Palaka, Erlebacher, and Kropp (1998), So and Song (1998), So (2000), Ray and Jewkes (2004), and Liu, Parlar, and Zhu (2007)). However, according to the review by Goetschalckx, Vidal, and Dogan (2002), the paper by Arntzen et al. (1995) is the only one that has captured the time issue in the modeling and design of a global logistics system, with the expression of time consumption explicitly in the objective function.

In particular, Arntzen et al. (1995) applied the Global Supply Chain Model (GSCM) to the Digital Equipment Corporation so as to evaluate global supply chain alternatives and to determine the worldwide manufacturing and distribution strategies. In their mixed-integer linear programming model to minimize the weighted combination of total cost and activity days, the authors adopted a weighted activity time to measure activity days throughout the supply chain, which is the sum of processing times for each individual segment multiplied by the number of units processed or shipped through the link. However, we believe that the authors oversimplified the weighted activity time in assuming that the unit processing activity days are fixed, regardless of the facility capacities and the product flows. Also, in some other mathematical models dealing with time-sensitive demand, the lead time is used as the only indicator to differentiate the demand groups (see Cheong, Bhatnagar, and Graves (2004)). We

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