

Chapter 3

A Stochastic Approach to Product–Driven Supply Chain Design

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ABSTRACT

Supply chain is an alliance of independent business processes, such as supplier, manufacturing, and distribution processes that perform the critical functions in the order fulfillment process. However, the discussions in marketing and logistic literature universally conclude that it would be desirable to determine the life cycle of products in the firm, as they have a great impact on appropriate supply chain design. Designing a supply chain effectively is a complex and challenging task, due to the increasing outsourcing, globalization of businesses, continuous advances in information technology, and product life cycle uncertainty. Indeed, uncertainty is one of the characteristics of the product life cycle. In particular, the strategic design of the supply chain has to take uncertain information into account. This chapter presents a two-phase mathematical programming approach for effective supply chain design with product life cycle uncertainty considerations.

INTRODUCTION

Globalization has increased the complexity of supply chains with the involvement of more stakeholders, facilities, and technologies. Therefore, many new challenges and complexities have emerged in the field of supply chain management.

Indeed, global competition has imposed a tremendous pressure on product and service providers to transform and improve their operations and practices. Companies are responding to this pressure by re-engineering and streamlining their operations to better serve their customers. More specifically, firms are

DOI: 10.4018/978-1-4666-7258-1.ch003

involved in improving the performance of their supply chains through various strategic and operational tools. One of the strategies utilized by companies is to concentrate on their core competencies in the chain value and outsource the other functions. Actually, firms are indulged in strategic organizational networks such as network organizations, virtual corporations, and value-added partnerships. However, the success of supply chain networks depends, to a large extent, on how effectively they are designed and operated.

These supply chain networks are considered as a solution to effectively meet the customer's requirements such as low costs, a high product variety, high quality, and short lead times (Busby and Fan, 1993; Byrne, 1993; Goldman, 1994; Iacocca Institute, 1991; Johnston and Lawrence, 1988; Snow et al., 1992).

Referring to the marketing literature, we note that this performance is directly related to the life cycle of the product. Indeed, the product life cycle could direct the supply chain to the appropriate market strategy.

Similarly, it should be noted that the consumer's requirements are closely linked to the product life cycle and their relative importance differs from one stage to another; for instance, availability and technology are needed at the "introduction" phase, and cost, quality and speed are needed at the "maturity" phase.

Facing this problem, the whole company should carefully manage the product life cycle, and the supply chain actors' mechanism should also be matched up concurrently.

Nokia, the Finnish mobile phone manufacturer for example, manufactures the early series of its products in Finland at a product launch, and once established, will hand a volume production to contract manufacturers who are located in the Baltic and in China, and at the end of the life span (in some cases) even taking the production back in-house as they become close to withdrawing the product from the market.

The main concept that we focus on, in this study, is the consideration of the product life cycle in the supply chain network design.

The idea of the life cycle of a product is commonly used by the marketing professionals; this explains the presence of extensive researches focusing on this theory in the marketing literature. Cavinato (1987) studied the role of logistics during the product life cycle. In the same field, Kotler (1994) introduced a comprehensive marketing framework for developing new products and managing life cycle strategies. Christopher and Towil (2002) stipulated that products may well require different kinds of pipeline according to their position within the product life cycle. Aitken et al. (2003) showed that each stage of a product's life cycle has a significant impact on the supply chain strategy. Vonderembse et al. (2006) developed a framework for categorizing the supply chain types according to product characteristics and stage of the product life cycle.

Indeed, each product follows its own life cycle, characterized by four phases: initiation, growth, maturity, and decline. In many situations, it is difficult to accurately determine the life cycle of a product. This depends on both the product and the market in which it is commercialized.

The respective durations of the life cycle phases, as well as that of the total life cycle are highly variable depending on the products, and each stage is characterized by its growth rate, sales' volume, profitability, and adopted marketing and competitive strategies. Porter (1980) has studied many of these competitive strategies and techniques for analyzing industries and competitors according to the product and to its characteristics. Mahapatra et al. (2012) studied the effect of the product life cycle on the supplier management initiatives.

The concept of life cycle is not to be called into question. In contrast, its representation, by the classical curve is not always true. Indeed, some products have very atypical life cycles, whose curves are very different from the classical one.

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