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Optimal inventory policies for successive generations of a high technology product

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ABSTRACT

In today's era of globalization, periodically new products with better value and added features are introduced into the market. The rapid technological breakthroughs are creating significant risks of obsolescence at the product level. It creates enormous challenges to coordinate between technology management and inventory control policies. Due to the dynamic nature of the market, it becomes essential to integrate technological substitution along with diffusion of new products while formulating economic ordering policies for technological products. The literature of estimating and forecasting innovation diffusion patterns for technology product is fairly rich. In recent years these models were applied extensively to derive economic order policies under different economic situations. Unfortunately study on impact of technology substitution on economic order policies is still scarce. The proposed model acknowledged the relationship between substitution rates of product categories and the inventory policies. In this paper an attempt has been made to generate economic inventory policies for technology products under the condition of its diminishing demand. The model is based on the assumption that technological advancements do not essentially imply that existing generation products will be withdrawn from the market immediately. The results are very encouraging and the findings are consistent with the idea that optimal EOQ policies are highly receptive towards the dynamics of the product substitutions and hence it is imperative to identify the trend. A simple solution procedure in the form of algorithm is presented to determine the optimal cycle time and optimal order quantity using the cost function.

1 . Introduction

Evolution of high technology industries has been deeply affected by innovations in different forms. In recent years it has been observed that, in technology driven market, new products with better value and added features are introduced periodically. But technological advancements and feature additions do not essentially imply that previous generation products are withdrawn from the market immediately (Bayus, 1998; Chanda & Bardhan, 2008; Jaakkola, Gabbouj, & Neuvo, 1998) (Fig. 1). In the presence of multiple options, consumers' positive adoption decision for a particular generation is based on the benefit expected from it. Uncertainty in the consumer adoption process can put severe pressure on product availability, promoting manufacturers, distributors and retailers to relook upon their stock keeping policies. Also, due to the globalized economy and tough competition technological breakthroughs are reported quite frequently, reducing the product life cycles considerably. That puts enormous amount of pressure on the existing supply

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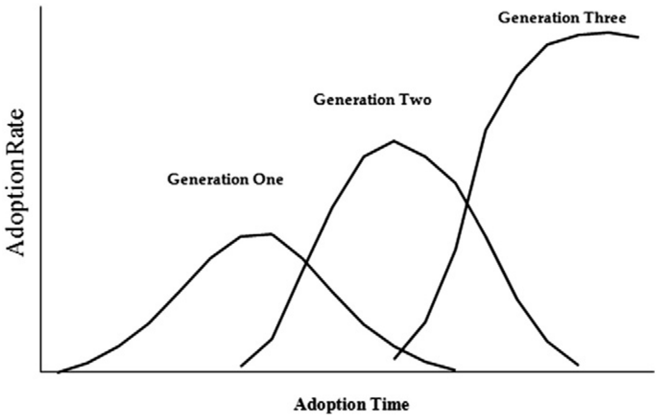

Fig. 1. Adoption of Series of Technological generations (Chanda & Bardhan, 2008).

chain system. For sustenance and expansion in such dynamic environment, it calls for better understanding of the dynamics of technology (or its application) diffusion. And together the due attention should be given to the supply chain management to assess internal and external investments.

In a technology driven market, for a successful business it is critical to understand the customer needs and as they arise deliver them without any delay. To effectively implement the strategy, a firm should have enough inventories on hand, but not too much, to fulfill demand. Excessive inventory can result into more funds being tied up and also the storage and other associated costs can reduce the profit margin significantly. Inventory management is the process to find an optimum level of inventory a firm should maintain to mitigate the risk of losing customers due to insufficient stocks under minimum inventory costs. It also helps the management to find an optimum cycle stock inventory that can satisfy regular sales orders. In general, goods are stocked to fulfill customer demands. At some point stocks get low, and the firm arranges another delivery to avoid shortages. This sequence of stock replenishment and reduction to meet demand is repeated continuously in a stock cycle. A typical stock level cycle can be shown by Fig. 2.

The challenge arises for the inventory managers when they have to deal with technology which is constantly improving and hence have to handle varying adoption timing. Adoption timing gets more complicated if a company is planning to introduce sequential innovations into the market. Consequently, for making early stage inventory policies for new products, it is essential to have good understanding of the diffusion patterns. In such dynamic environment, companies that can handle the market pressure effectively with changing conditions can expect to enjoy long-run competitive advantage and superior profitability. In this scenario, understanding and analyzing the rate of adoption of the technological products are of prime importance for the manufacturers to reduce inventory and inventory driven costs across supply and distribution networks to enhance the profitability. A demand model that is tested against reality can prove to be a disaster for the firm by grossly misjudging the demand.

The importance of inventory management, and the need for coordination of inventory decisions and rate of adoption, are well established. But, in inventory literature very little attention has been given to the diffusion of technology innovations, which can have a significant impact on the consumer service level and supply chain cost. Diffusion of innovation is an important tool for effectively assessing the merits of making inventory policies in technologies that are new and do not have predictable patterns of

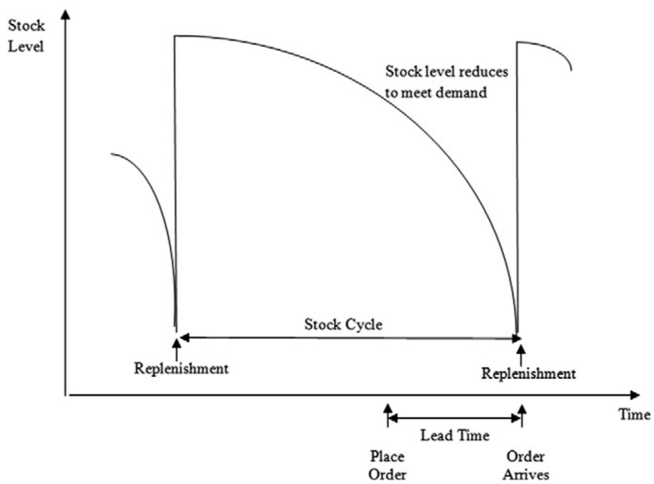

Fig. 2. Stock levels in a typical cycle (Waters, 2003).