

Product Line Design & Positioning in the Presence of Quality Sensitive Consumers

Increasing product variety is a popular and well recognized strategy in marketing to increase demand and market share. Researchers have found that broader product lines result in significant market share benefits and increase in firms' profitability. It has also been observed that increasing product variety does not guarantee increase in long run profits, and in fact, it can worsen firms' competitiveness. With rapidly evolving technologies, firms' capabilities to produce variety of the same product are increasing, and over the years managing product variety has become a source of competitive advantage for firms. In this regard, the number and relative design and positioning of the products in the product line are critical determinants of a firm's profitability.

The motivation for our work in this area of variety creation comes primarily from the service industry. For instance, Aravind Eye Care reaches out to the masses and performs cataract surgeries for both *regular* and *premium* patients. Narayana Hrudayalaya performs cardiac surgery under either *general ward package* or *Karuna Hrudaya package*. In these examples, the same surgery is performed on a patient irrespective of its category. Similarly, Dell Inc. offers the same laptop with either a *limited* warranty scheme or with an *Accidental Damage Service* cover. The same iPad is available with 16GB, 32GB and 64GB storage space. In these examples, it can be noted that a product line is developed using a *core product* and *differentiating modules*. Here, the core product that performs the main functions of each variety is common across variety in the product line and a unique differentiating module that distinguishes one variety from the other is additive to the core product. The differentiating modules are created using one or more differentiating attributes of the core product that do not influence the performance of the product itself. In this regard, the firm faces the product line design problem with decisions involving the number of products to offer and relative design and positioning of the products in the product line. Our problem context is similar to the platform product based product line design problem mentioned in the literature. However, unlike the platform product based product line approach, which is a deliberate business process adopted in order to reduce design and production costs, the core product based product line approach can be seen as strategy that is adopted to increase the firm's profitability without altering performance of the product itself. Accordingly, we give a new dimension to the product line design problem and develop a modeling approach to understand the firm's decisions.

The number and relative design and positioning of the products in the product line are influenced by the cost of creating each variety. Since, the performance of each variety in the product line

is same, the firm can increase its profitability in two ways. On one hand, profitability can be increased by reducing costs by producing the same quantity but in fewer variety (ideally one). On the other hand, the firm can increase the profit through price premiums on high quality products and offering more product variety (ideally one variety for each consumer). The firm's product line design problem involves a trade-off between reducing production costs and extracting more consumer surplus through price premium. In this regard, the optimal size of the product line and design and relative positioning of the products in the product line are the critical decisions that the firm needs to make. In our paper, we build a mathematical model for the product line design problem with core product and differentiating modules that do not influence performance of the core product and characterize the impact of the cost parameters on the firm's decisions.

In our paper, we also analyze the firm's problem when the product design and positioning decisions are made sequentially. Books, movies, fashion goods, etc. are the typical examples of products in which different variety are introduced sequentially in order to extract consumer surplus. The available studies in the literature typically assume that firms determine the number of variants to be introduced during the product's life cycle, and accordingly, determine relative design, positioning and introduction sequence of the products. However, later in the future the firms may decide to introduce new variants of its already existing products in the market. Moreover, these studies also assume that the firms have complete and accurate information about the consumers and the consumer utility function is modeled accordingly. However, such information may not be always available with the firms, especially in the case of firms entering in an emerging market. In this regard, simultaneous design and positioning of all potential products in the product line is not always plausible. To start with, firms typically introduce limited number of products in the market and gather consumer information based on which they modify their existing product line. In this case, how to design and position new variants in relation to already existing products in the product line is an important issue that the firms need to address.

We obtain the results that are not so typical in the literature. For instance, we show that higher is the cost of the core product, higher is the quality level of each variety in the product line, however, the quality based differentiation between any two variety is lower. In the case of sequential product design, we show that if quality of the first product cannot be altered and the quality is *low (high)*, then the second product to be introduced is *high (low)* in quality. We also show that if the cost of the core product is higher than the quality based marginal cost of the first product, then it is suboptimal for the firm to introduce a lower quality product. In a special case of this model, we show that the optimal strategy for the firm is to introduce the second product lower in quality than

the first product. In this regard, we conclude that gain from increased market share outperforms gain from more consumer surplus extracted using price premium on a high quality product.