IDEA GROUP PUBLISHING **ITB11997**

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This paper appears in the book, *Business Applications and Computational Intelligence* edited by Kevin E. Voges and Nigel K. L. Pope © 2006, Idea Group Inc.

Chapter IV

Heuristic Genetic Algorithm for Product Portfolio Planning

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Abstract

This chapter applies the Genetic Algorithm to help manufacturing companies plan their product portfolio. Product portfolio planning (PPP) is a critical decision faced by companies across industries and is very important in helping manufacturing companies keep their competitive advantage. PPP has been classified as a combinatorial optimization problem, in that each company strives for the optimality of its product offerings through various combinations of products and/or attribute levels. Towards this end, this chapter develops a heuristic genetic algorithm (HGA) for solving the PPP problem. The objective of this chapter is to develop a practical method that can find near optimal solutions and assist marketing managers in product portfolio decision-making.

Introduction

To compete in the marketplace, manufacturers seek ways to expand their product lines and differentiate their product offerings, based on the intuitively appealing belief that large product variety will stimulate sales and thus be conducive to revenue growth (Ho & Tang, 1998). While a high variety strategy may offer effective means for companies to differentiate themselves from their competitors, it unavoidably leads to high complexity and costs in product fulfillment (Child, Diederichs, Sanders, & Wisniowski, 1991). Moreover, making a wide variety of products available and letting customers vote "on the shelf" may cause customers to be overwhelmed by the huge assortment offered or frustrated by the complexity involved in making a choice (Huffman & Kahn, 1998). Therefore, it becomes imperative for the manufacturer to determine how to offer the "right" product variety to the target market. Such decisions on the optimal number of product offerings to provide generally draw upon the general wisdom suggested in the Boston Consulting Group's notion of product portfolio strategy (Henderson, 1970). While representing the spectrum of a company's product offerings, the product portfolio must be carefully set up, planned and managed so as to match customer needs in the target market (Warren, 1983).

Product portfolio planning has been traditionally dealt with in the management and marketing fields, with a focus on portfolio optimization based on customer preferences. The objective is to maximize profit, share of choices, or sales (Urban & Hauser, 1993). Consequently, measuring customer preferences among multi-attribute alternatives has been a primary concern in marketing research. Of the many methods developed, conjoint analysis has turned out to be one of the most popular preference-based techniques for identifying and evaluating new product concepts (Green & Krieger, 1985). A number of conjoint-based models have been developed by those with particular interests in mathematical modelling techniques for optimal product line design (for example, Dobson & Kalish, 1993). These models seek to determine optimal product concepts using customers' idiosyncratic or segment-level part-worth (i.e., customer-perceived value of a particular level of an attribute) preference functions that are estimated within a conjoint framework (Steiner & Hruschka, 2002). While many methods offer the ability to determine optimal, or near-optimal, product designs from conjoint data, traditional conjoint analysis is limited to considering input from the customers only, rather than analyzing distinct conjoint data from both customers and engineering concerns.

In the engineering community, product portfolio decisions have been extensively studied with the primary focus on costs and flexibility issues associated with product variety and mix (for example, Lancaster, 1990). However the effect of product lines on the profit side of the equation has been seldom considered (Yano & Dobson, 1998). Few industries have developed an effective set of analysis techniques to manage the profit from variety and the costs from complexity simultaneously in product portfolio decision-making (Otto, Tang, & Seering, 2003). It is imperative to take into account the combined effects of multiple product offerings on both profit and engineering costs (Krishnan & Ulrich, 2001). Therefore, product portfolio planning should be positioned on the crossroad of engineering and marketing, where the interaction between the customer and engineering concerns is the linchpin (Markus & Váncza, 1998). In particular, portfolio