



## Comment: A conceptual framework for studying the interaction of demand, supply and the market environment in product line optimization

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### ARTICLE INFO

### ABSTRACT

This paper examines the work of Michalek et al. (2011) and Tsafarakis, Marinakis and Matsatsinis (2011), published in this issue of the *International Journal of Research in Marketing*, within a strategic framework. This framework allows a consideration of how the powerful tools that the two papers propose can be harnessed within the overall direction and activity of the firm.

On reviewing these two papers, one could concentrate on the algorithms and heuristics that make the complex problem of product line optimization tractable. Such an analysis would be valuable. Instead I concentrate on the strategic environment in which the optimization decision takes place to allow a consideration of applications and extensions within a managerial context. I do that by suggesting a framework for product line decisions after a brief overview of both articles. That enables me to examine managerial issues that arise in implementing such an approach in practice, many of which are addressed in the two papers. For those issues not addressed in the papers, I propose a set of research questions which would be valuable to managers.

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### 1. Introduction to the two papers

Michalek et al. (2011-this issue) and Tsafarakis et al. (2011-this issue) have much in common, but they also have a number of important differences. They both consider the issue of product line optimization, harness real world data and products to demonstrate the applicability of their approach, move beyond a myopic customer focus, and use iterative approaches to cycle to an optimal product line.

However, they primarily look at the influence of two different aspects of product line design. Michalek et al. (2011-this issue) are concerned with internal constraints inherent in meeting heterogeneous consumer demand, while Tsafarakis et al. (2011-this issue) study the effects of marketplace constraints, and, in particular, competition.

Michalek et al. (2011-this issue) bring together two largely independent literatures, those of R&D and marketing to establish a common joint language required for successful demand-supply optimization to take place. They are able to simplify the highly complex problem by decoupling the two elements and solving the engineering design and demand subsystems separately, coordinated by analytical target cascading (ATC). To me, one of the really appealing aspects to this approach is the level of flexibility that ATC allows in the specification of both demand and supply conditions.

Tsafarakis et al. (2011-this issue) use a particle swarm methodology to determine the likely path on which a competitive market is likely to head. The part that I particularly like about this approach is

the high diversity and proliferation of solutions with a high level of “fitness” (high objective functions). Firstly, this armoury of diverse, good solutions (relative to the more concentrated ones stemming from genetic algorithms) gives the manager a set of solutions likely to be applicable in a much wider range of environments, increasing robustness to changes in external influences. Secondly, good product line solutions from analysis provide an excellent springboard for brainstorming and creativity. The greater the number of good starting points, the greater the chance of finding an excellent solution. Again, this approach has considerable flexibility in terms of specifying the determinants of particle velocity change, making it adaptable to many managerial contexts.

### 2. A framework for product line development

In designing any product or line of products, the first strategic necessity is that the firm's capabilities allow it to meet the needs of the market (e.g., Roberts, 2011), as illustrated in Fig. 1. Initially, for expositional simplicity, I ignore fixed costs and assume that attributes may be designed independently.

One possible objective for the firm is to maximize the value created in the market, namely to find  $\max\{U(x_k) - c(x_k)\}$ . There is a lot of work in marketing and strategy to find such value maximizing positions using value curves (see Kim and Mauborgne, 1997). For example, Kumar (2004 Fig. 2–2) shows how easyJet uses an understanding of the preferences of its target segment (budget business and leisure travellers) to cost effectively and competitively design its service offerings.

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### Customer matching process

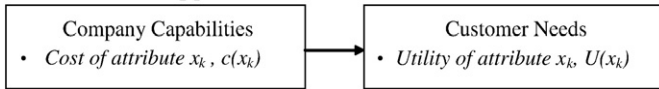


Fig. 1. Matching supply and demand considerations of product design.

The objective of the firm is more likely to be one of maximizing its profitability, rather than maximizing value created, so we can expand Fig. 1 to consider the firm's objectives, illustrated in Fig. 2.

In Fig. 2, the firm tries to maximize its contribution,  $\{(p(x_k) - c(x_k)) * Q(x_k, p(x_k))\}$  where demand,  $Q$ , is a function of the attribute level,  $x_k$ , and its price  $p(x_k)$ . The problem moves from value creation to value capture with the value created,  $(U(x_k) - c(x_k))$ , being split between the consumer surplus,  $(U(x_k) - p(x_k))$ , and the firm's contribution  $(p(x_k) - c(x_k))$ .

Of course, preferences are likely to be heterogeneous, and Michalek et al. (2011-this issue) empirically demonstrate that, even for the single product firm, such distributions of taste should be taken into account. Their use of mixing distributions of continuous ranges of tastes allows for very general forms of heterogeneity.

Fig. 2 is readily extended to consider products with multiple interdependent attributes and multiple interacting products. These interactions may be either on the demand side (e.g., complementarities and non-IAA substitution) or the supply side (e.g., shared costs or negative externalities). Both papers reviewed here focus on this more complex problem, that of product line optimization. Note that as consideration moves from a single product to product line optimization the issue of fixed and semi-fixed costs becomes more important since product line length is obviously a function of the incremental fixed costs of each additional product.

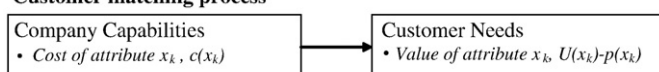
This simple conceptual framework enables us to understand the contribution of Michalek et al. (2011-this issue) in context. They allow for different forms of consumer heterogeneity, areas of infeasibility in terms of the company's capabilities to meet the needs identified in the marketplace, and study the interplay between the two.

Tsafarakis et al. (2011-this issue) also address the problem of product line design illustrated in Fig. 2, but their concern is the effect of market characteristics on the firm's capabilities to (differentially) meet the needs of its target customers. In particular, they consider the role of competition in influencing product line length and composition.

Michalek et al. (2011-this issue) and Tsafarakis et al. (2011-this issue) both contribute important tools to optimally designing product lines, especially aligning demand and supply aspects and understanding how optimal design may vary as a function of competitive reaction respectively. While it introduces a new level of numerical complexity, employing both approaches together incorporates a richer range of phenomena than either by itself.

In addition to supply and competition issues, Fig. 2 enables us to consider other issues that may weigh on the mind of the CEO and CMO when using these methods to design her product line. These are discussed below.

### Customer matching process



### Company matching process



Fig. 2. Elements of the marketing audit.

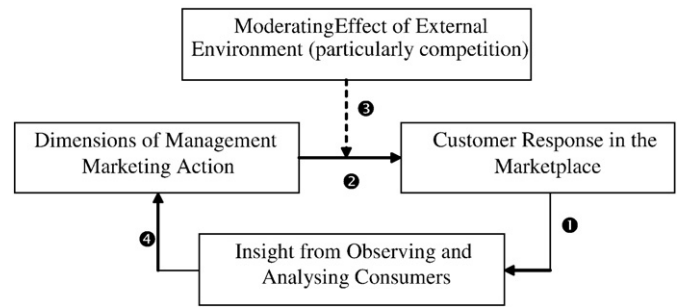


Fig. 3. The role of market feedback in adaptive managerial decision making.

## 3. The role of perceptions

Michalek et al. (2011-this issue) recognise the need to incorporate perceptual attributes rather than just objectively measured ones. The problem is actually bigger than that. In perceptual terms, marketing is about taking the physical features that the product offers and ensuring that they are perceived to deliver the benefits the consumer seeks. The dimensions of design and consumer evaluation are different, although there is a transformation between the two (Hauser and Clausing, 1988). Managers must firstly understand the link between the two and secondly work out how to influence it. The estimating challenge is well illustrated by the fact that Sony chairman and founder, Akio Morita, refused to let any market research be done on the highly successful and radical Sony Walkman prior to its launch. He said "The market research is all in my head! You see, we *create* markets."<sup>1</sup> The communications challenge and need to build the relationship between product features and needs and benefits in the customer's mind is epitomised by Xerox which developed much of the technology used in laser printing, the Windows interface, the Ethernet, and the mouse; all of which became the basis of highly successful products. Yet Xerox extracted almost no economic rents from them (Hiltzig, 1999). It does not matter if a company defines itself around its skills. For example, Bic's business is cheap disposable plastic technology. It must be able to meet a customer need. The company can define itself around a customer need. For example, IBM used to define its business as "problem solution." In that case it had better have the design and operations skills to deliver on those needs. Often, the nexus between the two boxes in Fig. 1 cannot be taken as read, so it may be necessary to supplement Michalek et al. (2011)'s approach with techniques such as the use of lead users (Urban and von Hippel, 1988) or information acceleration (Urban et al., 1997) to build the arrow between capabilities and needs.

## 4. Dynamics, diffusion and product life cycles

Tsafarakis et al. (2011-this issue) deal with one aspect of dynamics; possible iteration paths to a Nash equilibrium as competitors adjust to each other's reaction functions. However, there are many other sources of dynamics in the evolution of markets. One important source is consumer learning. The Tsafarakis et al. (2011-this issue) model could be extended to have a consumer learning phase embedded in the competitive interaction phases. For example, at the individual choice level Roberts and Urban (1988) suggest a mechanism by which consumers update their beliefs, leading to aggregate level diffusion patterns.

<sup>1</sup> <http://www.pocketcalculatorshow.com/walkman/history.html>.

## 5. Other issues

### 5.1. Diversity of firm objectives

Tsafarakis et al. (2011-this issue) speak of the possibility of a multi-objective firm and multi-criteria optimization. The need to consider diversity in the bottom left box of Fig. 2 may arise from two causes. First, the firm may have one criterion (for example, maximization of expected net present value of future earnings), but may find it useful to have intermediate criteria (such as flanking protection, platforms for growth, market coverage) as more manageable way to address it. Roberts (2011) provides a classification of the different roles that members of a product line can fill to achieve such intermediate objectives.

Alternatively, the firm may have diverse objectives that it is trying to accomplish. For example, Elkington (1994) suggests that firms should manage against a triple bottom line involving profit for shareholders, conditions for employees, and prosperity for the community. Both papers reviewed here lend themselves to this treatment, but to handle multiple objectives clearly we need a common measure against which to compare them, what Pessemier and Baker (1971) might call a “dollar metric.”

### 5.2. Market characteristics

While Tsafarakis et al. (2011-this issue) consider one market characteristic that might affect the length and composition of a product line, namely competition, there are other market characteristics that are important (the bottom right box in Fig. 2). These include channels and collaborators, and climate (including regulatory, technological, economic, etc.). Bergen, Dutta, and Shugan (1996) point out that a diversity of distribution outlets can lead to channel profits being increased by product line proliferation and differentiation. Similarly, climates involving substantial turbulence or short product life cycles are more likely to reward companies with longer product lines. Srivastava, Shervani, and Fahey (1999) stress the need for product line coverage not just across segments but also over time (across stages of the product life cycle).

There are a number of other extensions that could increase the external validity of these models and both papers identify several (e.g., linear costs, lack of category expansion, and pioneering brand advantages). However, that should not diminish the useful contribution of both papers.

## 6. Summary

Marketing processes consist of firstly understanding customer needs and secondly harnessing the resources of the firm to meet them. If we examine the marketing literature in our academic journals it focuses foremost on consumer behaviour or, at best, calibrating consumer response to pre-defined marketing initiatives (e.g., Hanssens, Parsons, and Schultz, 2001). George Day (1999) terms the first of these processes market sensing, and the second market relating. While both are undoubtedly valuable, they constitute not so much research in marketing as market research. If academic researchers are really going to influence what managers do, we are going to have to broaden our focus from just understanding consumer behaviour (● in Fig. 3) and how consumers respond to marketing activities (●). We have to better

understand the effect of the external environment on the efficacy of marketing activity (●). If one combines the lists of key marketing metrics of three of the leading books on marketing accountability one comes up with a list of 165.<sup>2</sup> Of these, only seven are related to the external environment despite its strong moderating role in determining the effectiveness of our marketing activity. Indeed, most of those seven are not even related to strategic concerns of the firm, but rather deal with such operational issues as cost per thousand impressions for communications. Therefore, in addition to its specific contribution to understanding the effect of competitive reaction on optimal product line design, we can be grateful to Tsafarakis et al. (2011-this issue) for reminding us of the need to understand the effect of factors external to the firm and its prospective customers in determining marketing effectiveness and its optimal levels, particularly competition.

Perhaps more importantly even than the external environment is for marketing academics to be able to understand the dimensions of potential management actions so that they can proactively advise managers on new strategies, based on the insights they derive from steps ● and ● in the process; step ● in Fig. 3. Michalek et al. (2011-this issue) provide a valuable tool for calibrating what is feasible, incorporating constraints of what is not feasible, and valuing the options that arise from analysis. They get us thinking about the tools that give us the skill base to proactively generate new strategic options, as opposed to just evaluating existing ones. Until we are able to do this we cannot call ourselves marketers. We are merely marketing researchers.

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<sup>2</sup> These books are Farris et al (2006) *Marketing Metrics: 50+ Metrics Every Executive Should Master*; Davis (2007) *Measuring Marketing. 103 Key Metrics Every Marketer Needs*; and Ambler (2003) *Marketing and The Bottom Line*.