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Comment: Product line design optimization

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The development of new products spans functional boundaries. The border between marketing and engineering is perhaps where this interface is more intense and important. Even when marketing managers and engineers have the same overall objective (e.g., firm's market share), their priorities and constraints are quite different. It can be very hard to develop and solve optimization models that are general enough to account for key variables on both sides simultaneously. However, as optimization methods evolved in the recent years, the problems that they could solve became more and more comprehensive and realistic. This issue of IJRM presents two very interesting papers that take an important further step towards realism in product line optimization. Hence, I would like to congratulate Michalek et al. (2011-this issue), and Tsafarakis et al. (2011-this issue) for their key contribution to this literature. Both expand the marketing optimization toolbox with interesting and comprehensive methods to solve the problem of product line design.

Based on very different approaches, both papers help firms optimize their product lines with enough flexibility to account for competing interests and concerns. Michalek et al. (2011-this issue) do that by explicitly incorporating the trade-off between the engineering feasibility and the fulfillment of heterogeneous consumer needs using Analytical Target Cascading (ATC) with Bayesian estimation. Tsafarakis et al. (2011-this issue) use Particle Swarm Optimization (PSO) to generate a list of near-optimal designs that can then be used in a broader negotiation process between the two areas, and benchmark the PSO model against genetic algorithms.

The goal of this commentary is to build on the recommendations and results of both papers to discuss future possibilities of research. The overall long-term vision for research on innovation and new products, in general, has recently been the focus on a detailed review (Hauser, Tellis, & Griffin, 2006) so I will focus here on research perspectives for product line design.

1. Some interesting opportunities and future possibilities

First, there is the important question of how consumer theory can be included in product line optimization models. Michalek et al. (2011-this issue) gave us a magnificent structure to approach this question, using cutting edge tools to incorporate heterogeneous consumer preferences into ATC. Their Hierarchical Bayesian model allowed them to show, among other things, that consumer heterogeneity can be important even for a 'one-size fits all products'. Their paper provides the marketing field with the first model that integrates marketing and engineering and explicitly acknowledges heterogeneous preferences using ATC. In doing so, they also leverage marketing researchers interested in product line modeling who now can build on their paper and take the next step. That next step might be an even richer look at consumer reaction to new products.

An interesting source of consumer heterogeneity emerges when consumer preferences change over time, as a function of consumer experience with the product. Experience with products can influence how consumers react to product features (Thompson, Hamilton, & Rust, 2005), which, in turn, will produce different part-worth utilities at different points in time for the same person. While these dynamics might not be particularly strong for many utilitarian products, they can be quite critical for complex products such as high-tech products, or for experience goods (e.g., rock-climbing shoes). These changes can influence repurchases and profits.

Tsafarakis et al. (2011-this issue) inspect how near-optimal policies can change as a function of the dynamics of competition. A similar dynamic approach could indeed be used in future research to inspect how optimal policies can change as a function of consumer experience with products. The empirical literature in marketing has reported various patterns of change in consumer preferences for different industries, and the psychology literature has analyzed psychological processes resulting from repeated consumption, such as satiation, sensitization, addiction, learning, and others (e.g., McAlister, 1982; McSweeney & Swindell, 1999). These theoretical and empirical findings on consumer psychology might prove helpful as product line research reaches deeper into consumer dynamics.

Second, interesting research can be done to extend both models assuming forward-looking firms are able to anticipate consumer reaction to new products. Michalek et al. (2011-this issue) established a much-needed unified optimization method for integrated product design that now can be extended to explicitly model product line design problems and opportunities in some industries in particular. For example, in high-tech industries, a forward-looking firm might be able to anticipate alterations in consumer preferences (which can be detected and measured with market research methods and prototype usage analysis), and use that information to plan the evolution of its product line. Despite its importance, the implementation challenges of multi-period optimization of ATC might be non-trivial due to the curse of dimensionality.

Third, it would be interesting to understand how firms and industries differ in terms of the rewards expected from greater integration between marketing and engineering decision processes. This now became a reasonable – and feasible – research challenge because Michalek et al.'s (2011-this issue) model is general enough to accommodate the disjoint sequential decision-making process nested as a special case of the joint

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decision making process i.e., disjoint decision would be a single pass through ATC (which, as expected, leads to suboptimal outcomes). By creating a comprehensive Bayesian + ATC method, the authors have set the stage so that this question can be now pursued, and answered. More specifically, marketing theory and practice will benefit from learning more about the conditions, product characteristics, industries, NPD resources and other factors that determine the gap between expected rewards from joint and disjoint decision-making. Such findings would show the conditions in which ATC can be expected to generate the largest returns, and should be a top priority for new product development (NPD) managers. Leenders and Wierenga (2008) found evidences suggesting that the level of NPD resources and strategic scope might play a role in this process.

Finally, impact. Both are timely and relevant papers that solve critical and hard problems of immediate practical interest for new product managers, engineers and marketing managers. However, as it is often the case with new methods, ATC and FSO are complex, beyond the complexity level of the methods used by a typical manager or consultant. In order to increase the speed of adoption, and the impact of these great papers beyond academia and into managers' toolbox, it would be interesting to put into place mechanisms that accelerate the diffusion of both methods among practitioners.

In marketing, this same process has already happened – with remarkable success – in the recent past with data collection and estimation methods. For example, the development and usage of innovative data collection methods was greatly accelerated when computer-based and web-based questionnaires provided the basis for adaptive scales. Also, conjoint analysis and, more recently, hierarchical Bayesian estimation of partworths have been (and still are) widely used by practitioners in hundreds of industries, and thousands of applications every year. The availability of commercial software that automated substantial parts of such methods was quite influential to its dissemination among consultants, market researchers and marketing managers. This is in line with Little's (1970) seminal recommendations, which suggested that managers will use a model if it is simple, robust, easy to control, adaptive and complete on important issues.

ATC and FSO were shown in these papers to work very well to solve product line design problems. Parts of the analysis are automated, but they still require substantial work and time in terms of coding, and advanced optimization skills. As more of these parts become automated, requirements in terms of time and expertise might decrease. This tends to broaden the audience for these two great papers, and increase the usage of these methods.

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