

# INCORPORATING STRATEGIC PRODUCT-MIX DECISIONS INTO SIMULATION GAMES: MODELING THE “PROFITABLE-PRODUCT DEATH SPIRAL”

James N. Cannon\*

University of Utah

jamesncannon@email.com

\*Address correspondence to Jim Cannon

Hugh M. Cannon

Wayne State University

Hugh.Cannon@wayne.edu

Manfred Schwaiger

Institute for Market-Based Management

schwaiger@bwl.uni-muenchen.de

www.imm.bwl.uni-muenchen.de

## ABSTRACT

*There has been significant research appearing in the marketing literature regarding customer lifetime value (CLV) and its consequence, customer equity (CE), over the past decade. However, little has been done to incorporate these concepts into the literature on simulation and gaming. One of the implications of taking a CE approach is an increased emphasis on product mix. This paper discusses a simple method for incorporating strategic product-mix decisions into marketing simulation games. It illustrates the importance by showing how this addition will model Rust, Zeithaml, and Lemon's (2000) concept of the Profitable-Product Death Spiral into a CLV design developed by Cannon, Cannon, and Schwaiger (2005).*

## INTRODUCTION

Over the years, simulation designers have paid little attention to the modeling of product-mix strategy. While most marketing games include more than one product, implying a marketing mix, marketing has offered relatively little theory to guide strategic product-mix decisions. Hence, there has been little basis or motivation for modeling the process.

Recent developments in the areas of customer lifetime value (CLV) and customer equity (CE) have provided motivation for modeling product-mix decisions. On the surface, orienting oneself to the concept of CLV is simply a logical extension of conventional marketing. If marketing efforts are able to win customers for a company, what could be more logical than examining the value of these

customers? However, conventional marketing and the simulation games that model it measure success in terms of profit, generally breaking profit down by product and division. This is a legacy of the manufacturers' dominance of marketing. When companies begin breaking profit down by customer, including the discounted value of future sales, the conception of a product changes. They begin to think much more like retailers, where the “product” is the assortment of products and services that customers expect to find when they go shopping.

While the literature on simulation and gaming contains some work addressing retail issues (e.g. see Keyt and Cadotte 1981; Haverty 1990; Bacon and Pike 1993), none addresses the problem of product mix strategy. Furthermore, notwithstanding the fact that the notion of a desired product assortment is more naturally related to retailer than manufacturer decisions, retailers are vulnerable to the same profit-oriented traps as manufacturers. The contribution of CLV is the notion that one cannot measure the success of marketing efforts by simply looking at profit for a single, arbitrarily defined product or period of time. Real businesses, and students playing simulation games, make investments and engage in marketing programs, the full benefit of which does not pay out in the first year. According to CLV, decision makers will seek to maximize the return on these program investments. Both the expected life of the customer and the amount of future sales depend on the marketer finding an ideal portfolio of products their consumers would like to purchase from them as a supplier.

CLV focuses company attention on the customer rather than the company's products. While marketing theorists and practitioners have promoted this idea ever since the advent of the “marketing concept” and the ascendancy of customer

orientation in the late 1950s, CLV gives customer-oriented marketing efforts a new meaning. Conventional customer orientation grew out of the concept of market segmentation. It meant studying customers and positioning products to meet their needs (Smith 1956). The associated metric is segment profitability, which in turn, is driven by the profitability of the individual products targeted to the segment. CLV still gives customers the products they want, but the focus on relationship marketing drives marketers to the portfolio of products that will both drive sales and maximize “share of wallet”.

Perhaps the best way to illustrate the difference between the traditional profit-driven metric and CLV, or its composite effect, customer equity (CE), is through what Rust, Zeithaml, and Lemon (2000) characterize as the “profitable-product death spiral.” It states that conventional companies often seek to measure profitability by product, using this as an index of benefit to both the company and the customer. As companies seek to be more and more profitable within increasingly-stringent budgetary constraints, they become more and more demanding of their product managers to deliver profitability. Managers drop the less profitable products, ignoring the fact that customers typically want an assortment of products, and that the deletion may weaken assortments that customers want. The resulting loss of sales weakens demand for previously profitable products, subsequently causing them to be dropped. This weakens the assortments even further, and so forth in a downward death spiral. By focusing on customer rather than product profitability, marketers look at the portfolios of products their customers want rather than disrupting portfolios for the sake of individual product profitability.

This paper will build on a CLV framework developed by Cannon, Cannon, and Schwaiger (2005) to discuss a method of modeling strategic product-mix decisions in a simulating game environment. We will illustrate the effects of the model by discussing how it exposes players to the profitable-product death spiral.

### THE CONCEPT OF CUSTOMER LIFETIME VALUE

The concept of CLV calls for a company to determine the expected future revenue and costs for each of its customers. These values are then converted into net present value terms. The concept can be demonstrated in the following formula (adapted from Jain and Singh 2002):

$$CLV = \sum_{t=0}^n \left( \frac{R_t - C_t}{(1+d)^t} \right) \quad (1)$$

where

- $t$  = period of cash flow from a customer transaction
- $R_t$  = revenue from a customer for period  $t$
- $C_t$  = total cost of generating revenue  $R_t$  in period  $t$

- $n$  = the total number of periods for which revenue is expected from the customer
- $d$  = the discount rate for future profits

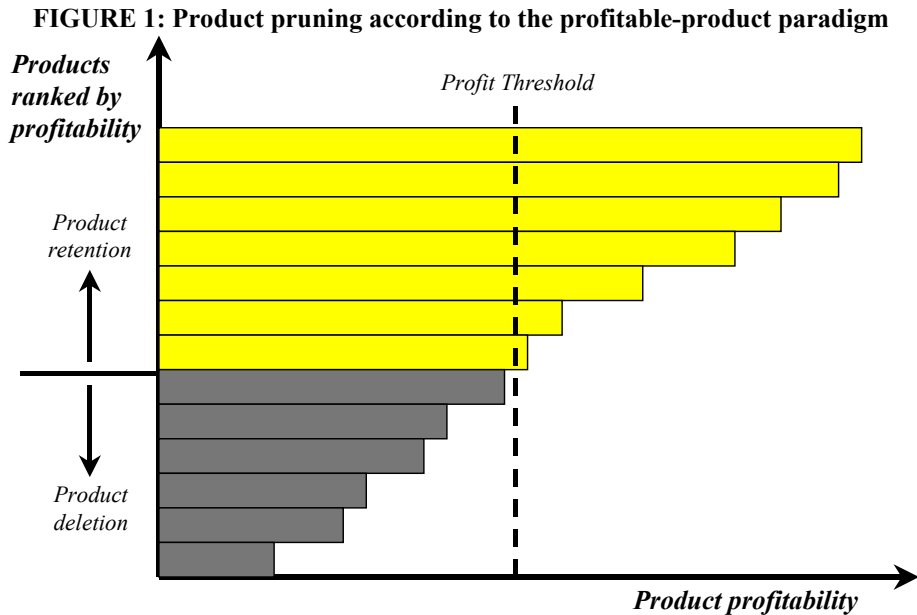
Customer equity is then calculated as the sum of all CLVs (Rust, Zeithaml, and Lemon 2004a). More specifically, customer equity is the residual value of the customer base after current period sales and profits have been accounted for.

$$CE = \sum_{j=1}^I \sum_{t=1}^n \frac{\prod_{i=1}^t L_{j,i} \cdot Q_{j,0} \cdot (R_i - C_i)}{(1+d)^{t-5}} \quad (2)$$

where

- $CE$  = customer equity
- $t$  = period of cash flow from a customer transaction
- $R_i$  = revenue from a single customer for period  $i$  (of  $t$ )
- $C_i$  = cost of generating revenue  $R_i$  in period  $i$  (of  $t$ )
- $n$  = the total number of periods for which revenue is expected from the customer
- $I$  = The total number of customer segments
- $j$  = a customer segment from the set of  $I$  customer segments
- $d$  = the discount rate for future profits
- $L_{j,i}$  = the customer retention probability for segment  $j$  at time  $i$  (of  $t$ )
- $Q_{j,0}$  = the number of customers in segment  $j$  at time  $t=0$

Equation (1) is a simplistic representation of a single customer’s CLV. Although the equation gets more complicated, it is conceptually the same when you account for multiple market segments and relax the assumption that there is zero probability that customers will defect. Equation (2) (Cannon, Cannon, and Schwaiger 2005) introduces these additional variables ( $j$  to represent segments and  $L$  retention probability). To illustrate, suppose there were a single segment with ( $Q_{j,0}$ ) of 1,000 customers, and expected life of two periods beyond initial acquisition, and a constant retention rate of .5 for each period. The CLV for would be determined by the individual CLV equation (Equation 1), multiplied by the number of customers remaining in each period. In the first period, half the initial customers would remain, so the value of discounted profits per customer would be multiplied by (.5 x 1,000 =) 500 customers. In the third period, half of the period 2 customers would remain, so the value of period 3 discounted profits per customer would be multiplied by (.5<sup>2</sup> x 1,000 =) 250.



Adapted from Roland T. Rust, Valerie A Zeithaml, Katherine N Lemon (2000). *Driving customer equity: How customer lifetime value is reshaping corporate strategy*. New York: The Free Press, p. 14.

### THE ASCENDANCY OF PRODUCT-MIX STRATEGY

Let us assume that customer satisfaction is a function of a portfolio of products offered at a point in time. If this is the case, then customer loyalty would be a function of the expectation that a desired portfolio of products will be offered in the future. Customer loyalty would then lead to a predisposition to make future purchases which can then be measured in terms of CLV as modeled in Equation (1) for a single customer.

Equation (2) introduces multiple customer segments and relaxes the unrealistic assumption of perfect customer retention. However, we still maintain some simplifying assumptions. For example, customer segments would clearly include customers whose life expectancy will differ one from another. We assume that a segment average life expectancy will suffice. If necessary, one could add a defection rate parameter which would account for varying customer life expectancies (although we believe that this introduces unnecessary complexity given the objective of the simulation).

Additionally, we assume that the cost of customer retention is zero. While this is unrealistic, a CLV analysis would typically accompany a relationship-marketing strategy. One of the key elements of such a marketing strategy is to exploit lower transaction costs by growing sales with existing customers (Cannon and Schwaiger 2005). We could add an additional cost allocation for customer retention which would then reduce the attrition rate parameter mentioned above, further complicating the calculations. However, so long as retention costs do not

exceed the cost of attracting a comparable new customer, our simplifying assumption does not detract from our premise.

### THE PROFITABLE-PRODUCT DEATH SPIRAL

One way to illustrate the increased importance of product-mix strategy is by examining a phenomenon Rust, Zeithaml, and Lemon (2000) call the “profitable-product death spiral.” It is a process where, in an effort to increase a company’s earnings performance, managers prune the product line and precipitate a chain of events that not only decreases profit, but eventually destroys the company.

When put under pressure to increase profits, managers will often evaluate products according to their profitability. Figure 1 illustrates such an analysis. Recognizing that some products and services are more popular than others, managers establish a threshold for eliminating less profitable investments. Those whose profitability exceeds the threshold are retained, while those falling below are deleted from the product line, thus focusing and preserving resources for applications that have the greatest profit impact.

On the surface, this makes sense. But it ignores the fact that products are rarely purchased in isolation. In the case of a retail operation, where people enter a store to purchase a specific product assortment, this is obvious. But even for manufacturers, umbrella brands typically seek to exploit brand equity by incorporating multiple products within the same brand umbrella. And this failing, they still offer service features and add-on products. What’s more, the

## Developments in Business Simulation and Experiential Learning, Volume 33, 2006

specific products and features desired vary from customer to customer. Rust provides a personal example of a text book he had written that was accompanied by a readings book. The text book sold well, but the readings book did not, so the publisher discontinued the readings book. The problem was that many of the textbook adopters dropped Rust's textbook because the reader was no longer available (Rust, Zeithaml, and Lemon 2000, p. 27). Extending the logic, the publisher would feel additional pressure on its profits and would respond by cutting other less-popular features of the textbook package, thus alienating additional subgroups of adopters. In the end, the text itself would no longer be selling well, and it too would be deleted from the publisher's line.

Figures 2, 3, and 4 illustrate the situation. Let's begin by imagining a textbook (product A), supported by twelve additional ancillaries and support options (products B through M). For the sake of simplicity, assume that these are used by four different segments of professors, each teaching courses with a different support package. For instance, segment 1 wants products A, B, D, E, F, G and J. If each segment consisted of 20,000 students, the customer base for A would be 80,000. The base for B through E would be 60,000. The base for F through I would be 40,000 and for J through M, 20,000.

Figure 2 arranges the products by volume, following the logic of the profitable-product paradigm described in Figure 1. As competitors enter the market, shares within each of the product categories begin to fall, and the publisher takes a relatively conservative approach, deleting only the four products with the very weakest sales – products – J, K, L and M. This is the classic product-centered response Rust describes.

Figure 3 rearranges the analysis by segment, showing who is using each of the ancillaries to textbook A. Note that it does not change any of the numbers. Demand potential still ranges from a high of 80,000 students for the core product to 20,000 students for the least-used ancillaries. However, it shows us how demand is distributed. This is critical, because the Figure 3 indicates that that every one of the deleted products is part of the support package used by one of the segments. This suggests that, instead of eliminating four low-potential products, the deletion threatens all of the sales for every one of the products!

One common strategy for addressing the situation portrayed in Figure 3 is to “bundle” the products. This increases volume for weak products by forcing all segments to purchase them, whether or not the products are needed. This works in many cases because the added volume of less-popular products enables the company to offer a low enough price that segments do not begrudge the extra products they have to buy. Nevertheless, in a highly competitive market, such tactics are likely to fail. The company that uses them will be overcome by competitors who specialize in the various segments, giving them lower prices, including only the products they want.

By contrast, Figure 4 portrays an entirely different segmentation structure. It indicates that all of the deleted products are being used by a single, obviously less profitable segment. Eliminating the low-profit products would eliminate only one segment, at a cost of 20,000 units of product A in addition to 20,000 units of each weak product.

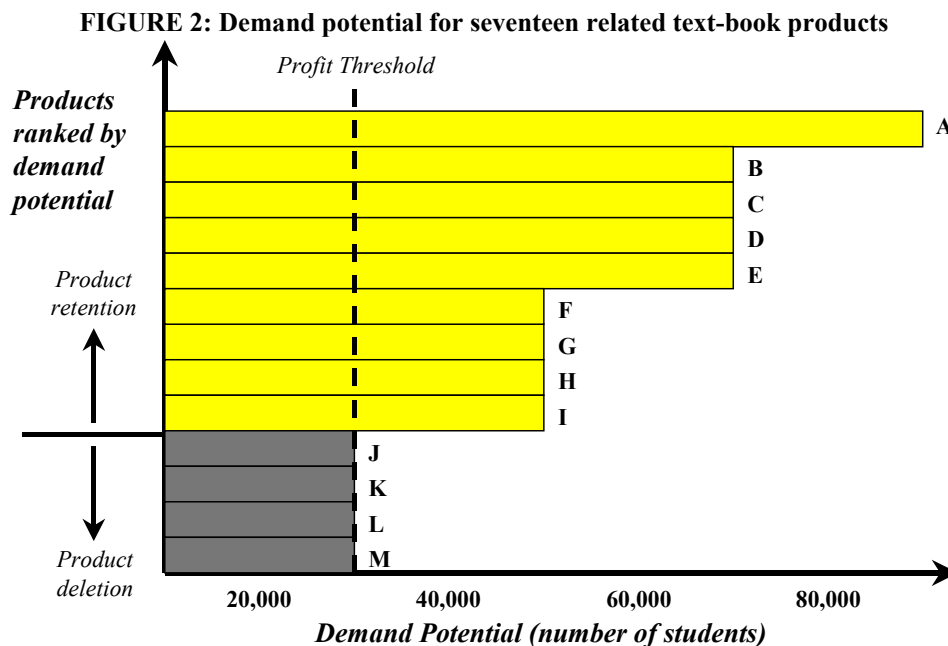


FIGURE 3: Demand potential for seventeen related text-book products, arranged by segment

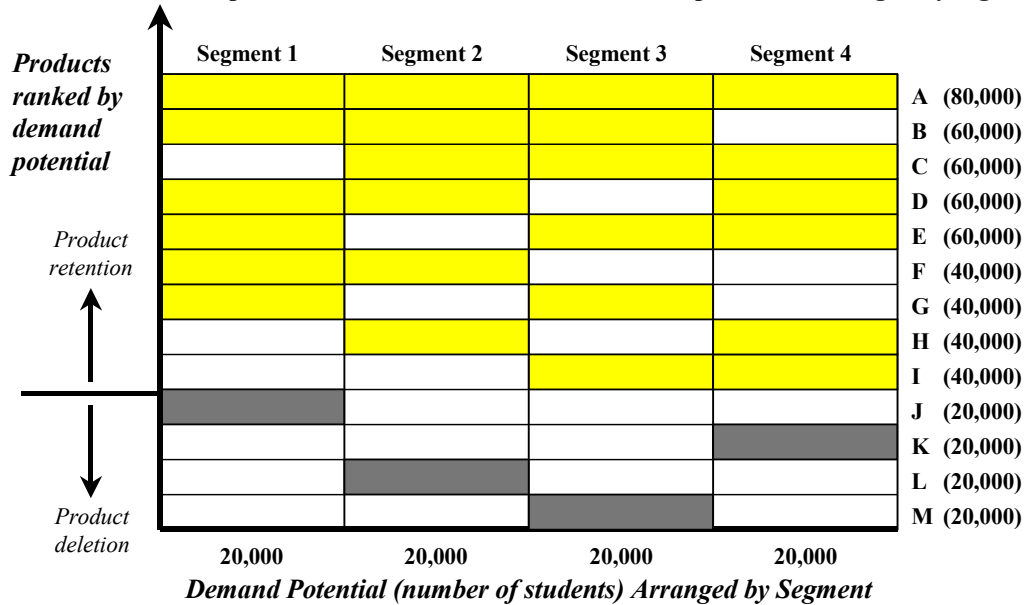
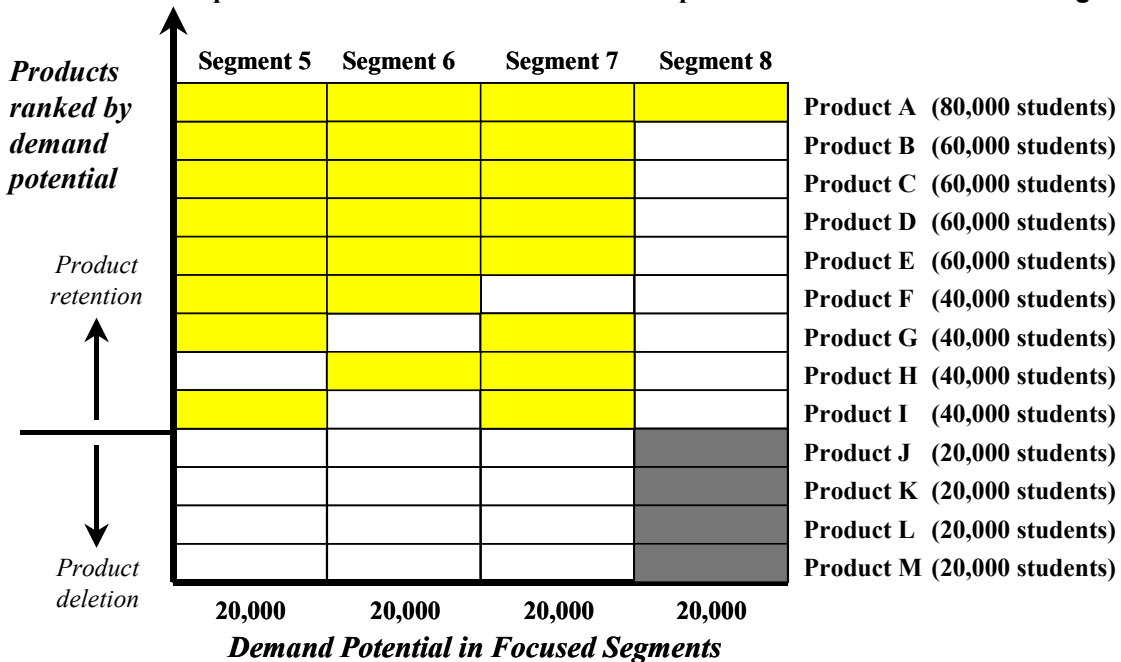


FIGURE 4: Demand potential for seventeen related text-book products for a different set of segments



The argument, of course, is that only by shifting from a product-centered to customer-centered marketing approach (Bell, Deighton, Reinartz, Rust, and Swartz 2002; Rust, Zeithaml, and Lemon 2004b) will the implications of this kind of strategic product-mix decision become clear. The customer-centered approach shifts the focus from profitability by brand to profitability by customer. To do this, the strategy recognizes that customer profitability is driven not by products, but by bundles of benefits derived by an entire portfolio of products and services.

### MODELING THE OUTCOMES OF PRODUCT-MIX STRATEGY

In order to model product-mix strategy, we will seek to introduce simple modifications to a standard simulation platform, referred to as the “Gold standard” (Cannon and Schwaiger 2005). Gold (2005) proposed a system-dynamic-based model that draws on well-accepted economic theory in an effort to avoid incompatibilities created by individual biases and disciplinary conventions. By applying the Gold standard to our design efforts, we hope to minimize the

## Developments in Business Simulation and Experiential Learning, Volume 33, 2006

number of design modifications a simulation developer would need to make when incorporating the profitable-product death spiral phenomenon into the CLV framework within their game.

The simplest way to introduce product mix into the CLV model is to leverage the retention probability variable ( $L$ ) in the existing customer equity equation (2). Cannon, Cannon, and Schwaiger 2005 suggest that ( $L$ ) should be a function of past customer loyalty (as measured by the prior period's retention probability variable), relative price advantage, relative product mix fit, and relative budget performance, as shown in Equation (3).

$$L_{j,t} = a \left[ L_{\min} + (L_{\max} - L_{\min}) \cdot \left( \frac{(\tilde{P}_j \cdot \tilde{D}_j \cdot \tilde{M}_j)^b}{c + (\tilde{P}_j \cdot \tilde{D}_j \cdot \tilde{M}_j)^b} \right) \right] + (1-a) \cdot L_{j,t-1} \quad (3)$$

$$\tilde{P}_j = \left( \frac{P_j}{\bar{P}_j} \right) \quad (4)$$

$$\tilde{D}_j = \left( \frac{D_j}{\bar{D}_j} \right) \quad (5)$$

$$\tilde{M}_j = \left( \frac{M_j}{\bar{M}_j} \right) \quad (6)$$

where

$L_{j,t}$  = the customer retention probability for segment  $j$  at time  $t$

$L_{\min}$  = the minimum loyalty the company can be expected to achieve

$L_{\max}$  = the maximum loyalty the company can be expected to achieve

$\tilde{P}_j$  = an index of relative price advantage in segment  $j$

$\bar{P}_j$  = a reference price, against which the relative performance of the company would be compared in segment  $j$  (generally that of the next closest competitor)

$P_j$  = the company's effective price in segment  $j$

$\tilde{D}_j$  = an index of relative product-market fit in segment  $j$

$\bar{D}_j$  = a reference product-market fit, against which the relative performance of the company would be compared in segment  $j$  (generally that of the next closest competitor)

$D_j$  = the company's product-market fit in segment  $j$  (a value between "0" and "1", where "1" represents a perfect fit)

$\tilde{M}_j$  = an index of relative budget performance in segment  $j$

$\bar{M}_j$  = a reference budget, against which the relative performance of the company would be

compared in segment  $j$  (generally that of the next closest competitor)

$M_j$  = the company's effective marketing budget in segment  $j$

$a$  = a smoothing factor to account for customer "inertia" in withdrawing loyalty

$b$  = a parameter determining the slope of the response curve (suggested  $b=10$ )

$c$  = a parameter determining the shape of the response curve (suggested  $c=1$ )

We can introduce the effect of marketing mix into the equation by reconceptualizing the product-market fit variable ( $D_j$ ). The Gold standard for addressing product market fit follows Teach's (1984, 1990a) multi-attribute demand model. Following this logic, the relative attractiveness of the product/service portfolio a company offers can be expressed as a function of the Euclidean distance between the company's offering and the ideal established for a particular segment. In this context, a customer's desired portfolio becomes a kind of metaproduct, where the desired products/services are analogous to the desired product attributes customers would look for in a conventional product. Again, following Teach's (1984, 1990a) logic, the relative attractiveness of the company's product/service mix can be expressed as the distance between the company's offering and the ideal established for a particular segment. In the simplest conception, we would assume that all competing products are equal. The model would include a dummy variable indicating whether a product or service is offered by the company. A metaproduct would typically contain a core product (defining the product category) with a value of "1" and ancillary products/services having values of "0" or "1". In this conception, the use of nominal variables suggests that the more commonly used Euclidean distance measure would be replaced with a city block distance (see Anderberg 1973; Jobson 1992). Teach (1984) notes that the city-block is an acceptable method for measuring fit.

Notwithstanding our conceptualization of an "ideal" portfolio, we recognize that not all products have equal value in this ideal. This can be incorporated into the calculation of fit by assigning an importance value,  $w_i$ , to weight each ideal-actual evaluation.

Equation (7) incorporates these concepts to create a distance measure whose value varies between "0" and "1," approaching "1" as the product-market fit gets better:

$$D_j = \frac{n_j - \sum_{i=1}^{n_j} w_{i,j} |I_{i,j} - d_i|}{n_j} \quad ; \quad \sum_{i=1}^{n_j} w_{i,j} = 1 \quad (7)$$

where

$I_{i,j}$  = the components of the ideal product portfolio for segment  $j$ , with "1" indicating that product  $i$

## Developments in Business Simulation and Experiential Learning, Volume 33, 2006

was included in the portfolio.

- $d_i$  = the components of the actual product portfolio, with “1” indicating that product  $i$  was included in the portfolio and “0” indicating that it was not
- $w_{i,j}$  = a weighting factor (between “0” and “1”) representing the importance of product  $i$  in segment  $j$ ’s ideal product portfolio
- $n_j$  = the total number of products included in the ideal portfolio for segment  $j$ .

Note that the calculation of  $D_j$  only considers those ( $n_j$ ) products that are included in segment  $j$ ’s product portfolio. This is a subset of a larger number ( $n$ ) of products a company might include in its product mix. By considering only “ideal” products in Equation (7), we are not penalizing a company for offering products that segment members do not want. Customers rarely object to a company offering too many products, but only to omitting products they want. The penalty for offering unwanted products comes from the costs associated with maintaining these products in the company’s product mix. Indeed, it is the desire to avoid these costs that causes companies to fall prey to the profitable-product death spiral.

As a final refinement to Equation (7), we can relax the assumption that all products are equal in quality. In a more complex game, the designer might want to conceptualize each ideal product as varying in desirability to the segment, depending not only on its inclusion in the product mix, but on its individual attributes as well. In this case, the presence of product  $i$  in a company’s product mix would no longer be represented by a value for  $d_i$  of “0” or “1”, but rather, a value of “0” or some value between “0” and “1”, depending on the distance of each product in the mix compared to the corresponding segment ideal. Following the logic of Teach (1984, 1990a), this value would be expressed as shown in Equation (8):

$$d_i = \frac{1}{\sqrt{\sum_{k=1}^{m+1} w_{i,j,k} (I_{i,j,k} - a_{i,k})^2}} \quad (8)$$

where

- $d_i$  = the individual product fit of product  $d_i$  relative to the corresponding ideal within the portfolio for segment  $j$
- $I_{i,j,k}$  = the ideal level of attribute  $k$  relative to product  $i$  in segment  $j$
- $w_{i,j,k}$  = a weighting factor (between “0” and “1”) representing the relative importance of attribute  $k$  for attribute  $k$  relative to product  $i$  in segment  $j$ ’s portfolio
- $a_{i,k}$  = the level of attribute  $k$  possessed by product  $i$  in

the company’s product mix

- $m$  = the total number of attributes. ( $m+1$  represents a fictitious attribute for which the ideal value ( $I_{m+1}$ ) is always “1” and for which the value of the product’s attribute ( $a_{i,k}$ ) is always “0”, thus ensuring that the ideal and a company’s product are never identical and the value of  $d_i$  is never zero).

Teach (1984) points to a potential problem arising from using the reciprocal of the distance measure as a measure of product fit. If a company’s product were identical to the ideal, the distance would be zero, and the value of  $d_j$  would be undefined. To solve this problem, he suggests adding extra attribute for which the company’s value would always be zero, thus ensuring a non-zero value of the distance. We have incorporated this into Equation (8) by suggesting that index  $i$  runs from 1 to  $m+1$ , or one more than there are attributes available for a company’s product formulation.

The Equation (8) conceptualization does not use nominal values for the value of  $d_i$ , but the maximum value is still “1” – i.e. a product whose quality is equal to the ideal, based on calculations made using Equation (8). This means that we can still use Equation (7) to calculate the overall value of a company’s product fit for segment  $j$  ( $D_j$ ). Any lapses in the quality of products included in the company’s mix, as determined by Equation (8), simply weaken the mix’s overall product fit.

To summarize, Equation (7) models the customer segment’s desired product portfolio. The value of product-market fit ( $D_j$ ) always falls between “0” and “1”, where “1” is a perfect market fit. Players would seek to enhance their performance by formulating and selecting products (represented by non-zero values for  $d_i$ ) for the company’s product mix that would best address the needs of their targeted segments. As the value of  $D_j$  falls, customers defect to other suppliers. The equations discussed in this section address the demand side of the firm’s economic equation. The framework acquires a strategic imperative when we impose financial constraints on the development of product assortments. By making products subject to relatively large economies of scale, low-volume products are likely to incur financial losses. In terms of Gold’s (2005) standardized model, this would mean increasing the size of the total fixed cost assigned to segment  $j$  ( $IFC_j$ ). The prospect of losses motivates players to trim unprofitable products, thus setting the stage for the “death-spiral” phenomenon if players do not consider product-mix interactions.

### STUDENT DATA

In order to make informed strategic product mix decisions, players need to be given research information on different segments’ product preferences. Table 1 illustrates a report that might be used to deliver this information.

The first set of data, *product preferences*, is designed to assist the student in assessing relative product desirability

TABLE 1: An illustrative research report conveying critical information regarding segment product preferences and company performance

<i>Segment 1 Product Preferences</i>	
<i>Available products</i>	<i>Average preference for segment (1 to 10)</i>
P <sub>1</sub>	8
P <sub>2</sub>	6
Etc	Etc

<i>Segment 1 Product Mix feedback</i>	
	<i>% Frequency of Purchases</i>
p <sub>1</sub> sold with p <sub>2</sub>	60%
p <sub>1</sub> sold with p <sub>3</sub>	25%
Etc	Etc

within a portfolio for a given customer segment. Any product that has a value above zero is part of the segment's desired portfolio. However, as suggested by the weighting factor ( $w_{i,j}$ ) in Equations (7) and (8), some products/product attributes are more important than others. The preferences shown in Table 1 are simply the importance weights (multiplied by 10 in order to yield a number rather than a percentage). In fact, this information does not assist in the student's awareness of a potential profitable-product death spiral. That is, it does not tell students how customers are likely to respond as a result of their preferences. If a product rated "5" is dropped, how likely is a customer to defect? How does this change if the rating is a "9"? Only by examining both preference and actual purchase patterns (*product mix*) together will students be able to build their own model for estimating the cost in lost sales of dropping different products from their lines.

In the real world, the first set of data would be gathered through a market survey. The second set of data would be based on actual observed historical purchasing patterns. This is important in that the student would not get any *product mix* information for products that they have not selected for production. This, in fact, increases the importance of the first set of data, as it provides the student with at least some information regarding products that they may not have selected for production.

## SUMMARY AND CONCLUSIONS

The purpose of this paper has been to address the inclusion of product-mix strategy into computer-based marketing simulations. By this, we mean the inclusion of product-mix interactions in the demand function, where we assume that consumers prefer to buy multiple products from a single vendor, rather than creating their own assortment from several different sources. In a review of more than 2,000 papers contained in the 2005 Bernie Keys Library, we were not able to find any papers discussing this subject.

The importance of this kind of product-interaction is increasingly important in today's marketing environment. Many marketers are seeking to compensate for falling

margins, resulting from decreased product differentiation, by using relationship marketing to lower transaction costs and increase the sales per customer. The task of the game developer is to reward players for making decisions that are consistent with this trend. As suggested by our discussion of Figures 1-4, players should invest in products that enable them to deliver the product assortments desired by as many customers as possible. Implicitly, they would need to strategically focus on those segments whose needs tend to overlap, as suggested by Davidow and Uttal (1989). This is illustrated in the difference between the unfocused segments illustrated in Figure 3 versus the focused ones portrayed in Figure 4. By focusing on segments 5-8, the company is able to delete the weak products from its line with minimal impact on sales.

To implement this approach in a gaming situation, players need to be given research information on the ideal product portfolios for each of the available market segments. This is given in Table 1. The preference data allow players to prioritize products for each segment. The product mix data enable them to categorize products into customer preference portfolios, thus avoiding a profitable-product death spiral.

A second requirement is to create algorithms within the game that reward players for strategically focusing on compatible market segments, and for creating product/services mixes to address these segments. We have described such an algorithm, treating product mixes as a kind of meta-product where the included products are "product attributes". The value for different meta-products varies by segment. In order to give the selection of meta-products strategic significance, the game imposes a cost structure so that products are subject to relatively large economies of scale, causing low-volume products to incur financial losses. Thus, players are forced to prune products if they are to succeed financially. However, if they fail to consider product interactions, and ultimately to focus their segmentation strategy, they will precipitate the company into a profitable-product death spiral.

Note that the algorithm we have used does not actually model product interactions. It simply defines the relative desirability of product assortments for a given segment.



## Developments in Business Simulation and Experiential Learning, Volume 33, 2006

That is, it models the interaction between segments and product preferences. In fact, product interactions often exist in the real world. For instance, to use the text book example, some segments may have a high preference for a student workbook to accompany the text offered by a publisher. However, if the text were eliminated, the desirability of the workbook to the segment's portfolio would fall dramatically.

We have chosen not to address the problem of product-interactions within a portfolio, because we believe that the product-preference algorithm we have suggested would be adequate to handle product-mix strategy issues for most situations we can envision. Indeed, an analogous issue exists regarding product attribute interactions as well, where the overall impact of attributes tends to be evaluated using some kind of a distance measure (e.g. our Equation 8). To illustrate, segment preferences for a textbook containing a glossary would drop dramatically if the book were written without the use of many technical terms. But, as a rule, a segment that valued a glossary would also value technical terms, so strategic decision makers would be motivated to include both or neither in their product design, depending on the segments they were targeting.

If a simulation were to address a specialized situation where product interactions became a meaningful issue, this would have to be addressed in a separate article. The article would be highly relevant to the mainstream marketing literature as well as to the literature on simulation and gaming.

### REFERENCES

- Anderberg, Mr. R. (1973). *Cluster Analysis for Applications*. Academic Press: New York.
- Bacon, Donald R. and James S. Pike (1993). "Shelf wars: A grocery channel simulation." *Developments In Business Simulation & Experiential Exercises* 20, 4-6.
- Bell, David, John Deighton, Werner J. Reinartz, Roland T. Rust, and Gordon Swartz (2002). "Seven Barriers to Customer Equity Management." *Journal of Services Management* 5:1 (August), 77-86.
- Cannon, H. M., J. N. Cannon, and M. Schwaiger. "Simulating Customer lifetime value: Implications for Game Design and Student Performance," *Developments in Business Simulation and Experiential Learning*, vol. 32 (March 2005), (Reprinted in *The Bernie Keys Library*, available at <http://www.absel.org>).
- Cannon, H. M. and M. Schwaiger (2005). "An Algorithm for Incorporating Company Reputation into Business Simulations: Variations on the Gold standard." *Simulation & Gaming: An International Journal*, 36:2 (June), 188-202.
- Davidow, William H. and Bro Uttal (1989), "Service Companies: Focus or Falter," *Harvard Business Review*, 67-4 (Jul-Aug), 77-85.
- Gold, Steven (2005). "System-dynamics-based modeling of business simulation algorithms." *Simulation & Gaming* 36:2 (June), 203-218.
- Haverty, John L. (1990). "Superstore: A specialized retailing simulation within a specialized marketing curriculum." *Developments in Business Simulation & Experiential Exercises* 8, 88-91. Reprinted in *The Bernie Keys Library*, 5<sup>th</sup> edition [Available from <http://ABSEL.org>]
- Jobson, J. D. (1992). *Applied Multivariate Data Analysis, Volume 2: Categorical and Multivariate Methods*. Springer: Berlin.
- Jain, Dipak and Siddhartha S. Singh (2002). "Customer Lifetime Value Research in Marketing: A Review and Future Directions." *Journal of Interactive Marketing* 16:2 (Spring), 34-46.
- Keyt, John C. and Ernest R. Cadotte (1981). "Chips: A marketing channels management game." *Developments in Business Simulation & Experiential Exercises* 8, 242-246. Reprinted in *The Bernie Keys Library*, 5<sup>th</sup> edition [Available from <http://ABSEL.org>]
- Rust, Roland T., Valarie A Zeithaml, Katherine N Lemon (2000). *Driving customer equity: How customer lifetime value is reshaping corporate strategy*. New York: The Free Press.
- Rust, Roland T., Valarie A Zeithaml, Katherine N Lemon (2004a). "Customer-Centered Brand Management." *Harvard Business Review* 82:9 (September), 110-120.
- Rust, Roland T., Katherine N. Lemon, Valarie A. Zeithaml (2004b). "Return of Marketing: Using Customer Equity to Focus Marketing Strategy." *Journal of Marketing*, 68:1 (January), 109-127.
- Smith, Wendell R. (1956). "Product Differentiation and Market Segmentation as Alternative Marketing Strategies," *Journal of Marketing* 20:3 (July), 3-8.
- Teach, Richard D. (1984). "Using Spacial Relationships to Estimate Demand in Business Simulations." *Developments in Simulation and Experience Learning*, 11, 244-246. Reprinted in *The Bernie Keys Library*, 5<sup>th</sup> edition [Available from <http://ABSEL.org>]
- Teach, Richard D. (1990a). "Demand Equations which Include Product Attributes." *Developments in Simulation and Experience Learning*, 17, 161-166. Reprinted in *The Bernie Keys Library*, 5<sup>th</sup> edition [Available from <http://ABSEL.org>]
- Teach, Richard D. (1990b). "Profits: The false prophet in business gaming." *Simulation & Gaming* 21:1 (March), 63-72.