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Modeling the Decision to Add New Products by Channel Intermediaries

by

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ABSTRACT

Using data collected on new products presented to a major channel intermediary, logistic regression models are estimated to describe the intermediary's accept/reject decisions for these products. Results indicate how different variables influence these decisions. The logistic model is shown to fit extremely well with excellent validation performance. Implications of these results for marketing strategies and for improving performance of the marketing system are discussed.

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INTRODUCTION

Each year the U.S. grocery distribution system witnesses the introduction of a great number of new products. Due to different definitions employed, estimates of the number of new products--either fundamentally new products (e.g., derived from new technology) or line extensions (e.g., new flavors or package sizes)--introduced into grocery distribution channels in 1985 vary from 2,560 (A.C. Nielsen 1986) to 7,214 (DFS-Dorland 1986). Moreover, the number of introductions in 1986 was more than double its 1970-81 annual average (DFS-Dorland 1986). This relentless stream of new products creates continuous pressure on buyers--gatekeepers to the supermarket shelves--to decide quickly which of these new products to accept.

Although aggregate data on costs of new product introductions are not available, occasional references to individual product introductions suggest that industry-wide totals are very large. Fortune (August 1986), for example, reports a total development expenditure of $1.5 billion by the Procter and Gamble Company to introduce a single product, its Ultra-Pamper diaper, to U.S. supermarkets.

National brand manufacturers cite a number of reasons for introducing new products. New products are thought to maintain interest of both channel intermediaries and consumers in increasingly mature markets; they extend an item to an adjacent product-space in an effort to attract incremental business; many can be attributed to manufacturers attempting to take advantage of new technologies; some are attempts to preempt competitive thrusts for greater exposure on retail shelves; while others are efforts to transform commodity-based products to higher margin value-added items as manufacturers attempt to differentiate their offerings and avoid competition based on price alone.

Despite the critical role played by new products in manufacturers' marketing strategies, their proliferation imposes considerable costs on other channel members (e.g., distributors) and consumers. Although retailers often are attracted to new products by the lure of additional profit opportunities, substantial costs are associated with the addition of new products. Considerable human capital costs are required by retail firms for the evaluation of as many as several hundred new products each week (Hamm 1983).[1] Further, the entry and maintenance of new data is costly in terms both of personnel time and computer storage space. Additionally, each new item incurs costs for inventory control and handling, separate warehouse slots and codes, specialized retail shelf space requirements and production of shelf signs and price tags. Although estimates of the high costs of evaluation are not available, estimates of handling costs alone to introduce one new item into a retail distribution system can run as high as $600 (Supermarket News, August 24, 1987). Moreover, this estimate does not include the substantial discontinuance costs if the item fails.

Finally, new products impose substantial direct and indirect costs on consumers as well. These costs come in the form of higher information processing costs, potential counter effects of competitive brand advertising, higher search costs, potential confusion regarding new products' characteristics and availability, and higher prices.

Thus, the resultant costs and benefits associated with new products are of vital concern to both managers and public policy makers alike.

To maximize both distributive efficiency and the probability of new product acceptance manufacturers require an intimate knowledge of buyers' behavior, not just at consumer levels but at the pivotal channel intermediary levels as well. Economic theory suggests that manufacturers should allocate their new product budgets to various components of the new products' marketing plan in order to equalize marginal returns. To exercise this optimality criterion, manufacturers need better information regarding the product (and service) dimensions most important to buyers and the set of decision rules used in their accept/reject decisions. However, relatively little is known specifically about how channel intermediaries make the key accept/reject decisions for these new products.

The purpose of this paper is to develop a model to formalize the channel intermediary's decision process regarding new product introductions by manufacturers. The channel chosen for examination in this empirical study is the packaged grocery products channel where the intermediary of interest is the headquarters level of grocery buyer(s).

PREVIOUS RESEARCH

Past efforts to investigate the new product introduction process can be classified into those with either a private firm (strategic) or public policy perspective.[2] This paper takes the former orientation.

First, while various pretest market models attempting to predict sales performance of new products allude to the importance of distribution, these models treat the variable in an *ad hoc* manner or do not consider it at all (Robinson, 1981). The few studies of new product introduction from the perspective of the channel intermediary are summarized below.

Grashof (1970) employed three alternative computer simulations to examine hypothetical performance outcomes associated with different attribute levels for one particular product category, dog food. Product newness emerged as the most important qualitative criterion in this research. Heeler et al. (1973) obtained data from one Canadian grocery wholesaler for 67 new grocery product selection decisions in an attempt to model the selection process used by buyers. Although the results of this study were promising in identifying new products that merited no further examination, the researchers concluded that a much larger data base would be required before their initial findings could be confirmed. Subsequently, Montgomery (1975) modeled buyer reaction to a small set of hypothetical new products employing two different analytical techniques. While certain of his findings were consistent with the few past studies (e.g., advertising support was a significant predictor variable), Montgomery pointed to the cumbersome nature of his analytical models for larger data sets.

Thus, past studies examining supermarket buyer new product decisions either relied on simulated experiments, accept/reject decisions for a very limited number of items and product categories, or buyer reaction to hypothetical new products. Furthermore, although some recent research has examined the process by which retailers "select" the trade promotions they accept (Curhan and Kopp 1986, 1987/88, Hardy 1988, Levy et al. 1983), no new research has focused on the new product selection process in more than a decade. Given the surge of new products in the last ten years and their increasing economic importance, research on this problem using primary data is called for.

THE MODEL AND HYPOTHESES

The conceptual model guiding our analysis of the decision to accept or reject a new product by a channel intermediary is presented in Figure 1. The buyer, as channel intermediary, operates as an agent for

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Insert Figure 1 Here
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various consumers and evaluates all of the information presented to him/her regarding a vendor's new product. Subsequently, he/she makes a judgment to accept or reject the product considering such factors as potential demand for the product, expected costs to the firm, and overall profit potential of the product. Some of the underlying variables in this assessment are specific to the new product and its vendor and some are specific to the intermediaries. In particular, certain characteristics of the channel intermediary, such as buying committee structure and size of the intermediary firm can be expected to influence the format and content of the information presented by the vendor or sought by the intermediary, the buyer's judgments and inferences as well as final recommendations.

We can specify the functional relationship for the overall evaluation of a new product with defined characteristics $\underset{\sim}{X}$ as

$$u(\underset{\sim}{X}) = f(\underset{\sim}{X}) + \epsilon \tag{1}$$

where $f(\underset{\sim}{X})$ is the deterministic component of the evaluation dependent on the set of variables $\underset{\sim}{X}$. The term ϵ is the error term (stochastic component) associated with this evaluation. The variables under $\underset{\sim}{X}$ can be divided into two groups: $\underset{\sim}{Z}_1$: a set of descriptors for the new product as determined largely by the marketing strategy employed by the vendor and $\underset{\sim}{Z}_2$: a set of channel intermediary-specific variables, held constant in our model when applied to a particular intermediary's decision process. The variables under the subset $\underset{\sim}{Z}_1$ are those that assist the channel intermediary in the decision regarding whether to add the new product. Effectively, the decision maker evaluates the likely demand for the new product and the potential profits generated through the various outlets of the channel intermediary firm. Thus, these variables include those that affect the consumer response (demand) and those that affect the intermediary firm's costs.

Based on past research and several meetings with the buyers of the channel intermediary who provided the data for this study, a large number of potentially influential variables were identified. In Table 1, we have grouped these variables into four categories: financial, competition, marketing strategy, and other. Further, Table 1 shows how the principal variables are operationalized and measured in the model and their hypothesized direction of influence on the intermediary's accept/reject decision.

Insert Table 1 About Here

Both gross margin and unit profit are hypothesized to have positive influence on the decision to accept a new product, basically due to their presumed association with net profitability. However, since these relationships are complex and far from monotonic, the hypothesized positive relationships are felt to be weak. We expect the relationship between the decision to take on a new product and an approximate measure of the opportunity cost of doing so to be negative.

The two competition variables--number of competing firms and brands--are hypothesized as having opposite impacts. Buyers' decisions to add new products were hypothesized as being positively influenced by the number of competing firms in the trading area already carrying that product. This positive association derives from buyers' practice of closely monitoring new product additions of competitors. However, the number of competing or substitute brands (national brands and private label), given space constraints in both warehouse and store, is hypothesized to negatively influence the likelihood of acceptance.

We expect positive relationships between the intermediary's decision to accept a new product and the marketing strategy variables under the control of the vendor: product uniqueness (e.g., distinctive aspects of new product's quality and packaging), vendor advertising and promotion, non-price term of trade, and price.

The non-price terms of trade were measured by a set of four dummy variables indicating the presence or absence of off-invoice discounts, bill-back provisions, free cases, and slotting allowances. Thus, although we have captured only the qualitative effects of terms of trade, not their magnitude, Chevalier and Curhan (1976) found that the first three of these inducements accounted for 79 percent of all manufacturer promotion types and, moreover, that the size of the manufacturer allowance offered was not a good predictor of retail promotional response. The terms of trade will generally have a positive impact on the accept decision; however, certain non-price terms of trade (e.g., bill back) are perceived to be less beneficial by the intermediary due to high transactional effort involved. The directional impact of the price variable is hard to predict; while higher prices will dampen the movement of goods at the consumer level, hence, result in a negative impact, they are also likely to be associated with higher gross profit and a positive impact.

Finally, new items in fast growing product categories are more likely to be accepted, but a new item's synergy (overlap) with existing products is hypothesized to negatively influence acceptance probability. The latter reasoning is based on physical space limitation; intermediaries are less likely to add line extensions to already existing families of products.

Under certain assumptions of the error term, ϵ, the functional relationship (1) can be transformed into the familiar logistic function:

$$P_j = \frac{1}{1 + \exp(-\alpha - \underset{\sim}{\beta}'\underset{\sim}{X}_j)} \qquad (2)$$

where:

P_j = probability of acceptance of the j-th item by the channel intermediary;

$\underset{\sim}{X}_j$ = (px1) vector of descriptors measured for the j-th item;

$\underset{\sim}{\beta}$ = (px1) vector of parameters; and

α = an intercept term.

The marginal impact on the probability of acceptance due to changes in the k-th predictor variable, x_k, in model (2) is $\beta_k P_j(1-P_j)$; it increases (decreases) as the acceptance probability varies from 0 to 1 if β_k is positive (negative). Thus, the impact depends upon the values of the other predictor variables suggesting that interactive effects of the several predictor variables are already implicitly included in the model.[3]

Since the choice variable is dichotomous (accept or reject), equation (2) can be estimated by maximum likelihood methods. The LOGIST procedure (logistic regression) developed by Walker and Duncan (1967) and implemented in the SAS package (Harrell, 1984) is suitable for this purpose and is utilized here.

Empirical Study

Data were collected from a large supermarket chain located in the Northeastern U.S. The chain covers a large trading area, has approximately 100 stores and its 1986 sales approached $1 billion. The chain's headquarters region is one frequently employed by manufacturers for test marketing due to the representativeness both of the consumer profiles and trading area. Hence, although the model developed here applies to only one company, the representativeness of the firm and its environment may permit a cautious generalization of the results to other market conditions.

Two types of primary data were collected from the chain: (a) vendor supplied materials including product physical characteristics, financial information, and promotional support, and (b) a one-page questionnaire completed by each buyer assessing qualitative attributes for every new item considered during the term of this research. These data were collected for over 2,000 new products (a new product is defined here as a stock-keeping unit--e.g., a single flavor/size--not previously carried by the chain) on a weekly basis from June, 1986 to February, 1987. The vendor supplied materials were not uniformly complete or available for every product. Often, for example, information on test marketing, point of purchase materials, or advertising and promotional support either were not presented by the vendor, or were missing. Experienced coders evaluated the total packet of materials and developed a series of measures regarding the overall quality of the presentation and marketing plan proposed for the new item.

<u>Overview</u>: An overview of the acceptance rates of new products by this chain can be seen in Table 2. These data show the variation in the

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Insert Table 2 Here

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rates of acceptance by product category, by suggested retail price of the item and by the amount of marketing support overtly given by the vendor. The variation in the product categories was accounted for in the model by using a set of eight dummy variables to represent the nine major groups of items.[4] Marketing support is a variable reflecting the proposal of television advertising and/or coupons by the manufacturer. Support was defined as "none" if neither of these are used by the vendor, "limited" if only one is used and "high" if both are offered; in a large number of cases (about 45%), this information was missing. The relationships between the acceptance rates and price and marketing support are quite consistent with prior expectations.

The marketing support variable is likely to be highly correlated with the size of the firm offering the product to the channel. Our attempt to collect additional data on manufacturer size using total sales as a measure was not completely successful, due in major part to the large number of privately held firms for which data were not available. However, dividing the size distribution of firms with available data into approximate thirds, the acceptance rate was 41.3% for firms with annual sales over $700 million, 28.6% for firms with sales between $2 and 700 million and 29.2% for firms with sales under $2 million.

All observations with missing data were deleted from the analysis. Results reported below are based on 1,030 items with no missing data on any variable. Statistical tests on differences between means and distributions (two sample t-tests and χ^2-tests) were made on each of the variables to determine the degree of difference between the total sample of 2,034 items and the subsample of 1,030 items used in this paper. This analysis showed that the subsample selected is not statistically different from the population of 2,034 items on which data were collected.

<u>Analysis Method</u>: The data were divided randomly into two subsamples for analysis and validation; the validation data constituted about 1/3 of the total sample. The major analysis consisted of building logistic regression models for all categories of items, for subgroups of items with several levels of marketing support and for groups of items of different price ranges. Analyses for subgroups of items were conducted to account for the inherent heterogeneity among the various categories of products.

RESULTS

Model Fit: The logistic regression model fits the data extremely well. The classification accuracy for this model is presented below.

Actual	Prediction: Accept	Prediction: Reject	Total
Accept	125	98	223
Reject	51	413	464
Total	176	511	687

classification accuracy (125+413) ÷ 687 = 78.6 percent is very high; this accuracy is much higher than that of a random model which yields a hit rate of $\alpha^2 + (1-\alpha)^2$ where α is the prior probability of acceptance [Morrison (1969)]. Using the observed acceptance rate of 0.325 as an estimate of α, the classification accuracy for the random model is approximately 56 percent, and it is 67.5 percent for a naive model which predicts all cases to the model. Examining the other statistics of the fit--% correct accept (56.1%) and % correct reject (89.0%)--we find that the logistic model predicts the rejection decision much better than the accept decision. This result is perhaps due to our model's inability to capture all of the idiosyncratic factors associated with the accept decision. We will return to this point under predictive validation.

Structure of the Overall Model: The estimated coefficients for the variables for the logistic model for the total sample of items are shown in Table 3. The model chi-square is highly significant. Further, the

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Insert Table 3 Here
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coefficients of the majority of the variables are in the predicted direction as shown in the table. The variables of product uniqueness, expected category growth, and number of competing firms show positive and significant effects. The variable bill-back terms of trade shows negative and significant effect. These results are in accordance with our hypotheses. The only variable with negative and significant effect is gross margin for which we have hypothesized a weak positive relationship. However, this finding is consistent with similar results of Montgomery, who found that the relationship between new product acceptance and gross margin to be negative but not significant. The only other variables that appear with a contradictory sign were the remaining terms of trade factors, but their coefficients are not statistically significant.

Product Category Effects: The effects of the product categories are estimated by the use of dummy variables in the logistic model. The estimated coefficients for the overall model presented in Table 4 show

Insert Table 4 Here

that the acceptance probability differs significantly across the product categories. The more negative the coefficient for a category, the lower is the probability of acceptance of an item in that category, relative to a comparable item in the "others" category. Illustrative acceptance probabilities are shown in Table 6 assuming 0.4 is the acceptance probability in the "others" category. Naturally these probabilities will change with changes in the reference probability of the "others" category. Relative to an item in the "others" category, the chances of being accepted are lower for comparable item profiles in frozen foods, dairy foods, beverages, and household supplies, while they are higher for candy and gum. Other differences are not statistically significant. Reasons for these differences are likely to be found in the relative lack of merchandizing appeal despite large gross margins (household supplies), the constraints of space (dominant for frozen and refrigerated foods) and apparent lack of significant brand differences among selected product categories (e.g., beverages and dairy department items).

Predictive Validation: The models are validated using the validation subsample. The model correctly predicts 196 out of 225 reject decisions and 48 out of 113 accept decisions yielding a correct hit rate of over 72 percent.

Given the large number of items (65 = 113-48) rejected according to the fitted model but accepted by the intermediary, we attempted to probe further into the actual decision process. For this purpose, a sample of 27 of these items was presented to the buyers to understand the reasons for their decisions. Interestingly, the buyers were able to recall vividly the circumstances surrounding the introduction of each of the items. The reasons expressed for their initial acceptance and the status of the items after approximately one year are summarized below:

Reasons for Acceptance		Status After Twelve Months	
Low Price	14	Discontinued	6
Product Uniqueness	7	Likely to be discontinued	4
Completion of Line	2	Selling well	11
Others	4	Selling quite well	6

In our discussion, buyers indicated that five of the fourteen items accepted for reasons primarily of low price were accepted for temporary distribution only (i.e., "in-and-out" decisions); this may have been related to the size of the manufacturer deal. Further, three of the seven items accepted for product uniqueness reasons, were taken on to satisfy the specialized demands of several local ethnic groups. Moreover, after twelve months ten of the 27 items were either discontinued or likely to be discontinued shortly. Therefore, there seem to be special characteristics associated with some of those items accepted by buyers but predicted as rejects by the model.

We may utilize the above observed rate of discontinuance of the items--10 out of 27 items--in revising the predictive power of our model. Such a revision will yield 165 correct accept decisions, improving the hit rate to (165 + 413)/687 = 84 percent. Incorporation of such revised data will enable researchers to develop better predictions of new product acceptance.

Model Structure for Subgroups: Logistic models were also estimated for subgroups of items--by marketing support and by price. The statistics on fit of these models are presented in Table 5. As could be expected due to greater homogeneity within a subgroup, the classification accuracy and predictive ability improve for the various subgroups of items.

Insert Table 5 Here

Explanations of the coefficient estimates (not presented here) of the subgroup models revealed a few differences. First, for the "highly supported" items, opportunity cost of capital and price dummies are significant with negative signs, results that could be expected. Second, for low priced items, as the intensity of vendor effort and profit per shelf volume increase, the probability of acceptance increases. These differences suggest that analyses of the variation inherent in subgroups might be a fruitful area for further research.

DISCUSSION

This paper reported on the modeling of the accept/reject decisions by one channel intermediary for new items. Generally, the statistical results are significant and the explanatory variables behaved as predicted. Such results, especially when refined and validated with subsequent analyses should prove useful to both firm managers and public policy makers. Calculation of marginal returns associated with manufacturer investments into various marketing mix factors becomes straightforward. Thus, channel efficiency increases: profits are likely to be higher for channel members and at the same time prices may be lower for consumers.

Such analysis should prove useful to manufacturers in the new product development process, especially in marketing budget allocation decisions. Grocery product marketers, in particular, are regularly forced to make resource allocation decisions with little information regarding the probabilities of likely outcomes. Operating under limited budgets, for example, a marketing manager of a packaged goods firm might need information regarding the expected payoff for additional investment in marketing effort, say couponing or T.V. advertising, for a proposed new product, or to extending the line or family of an existing product or category. The analysis here suggests that the appropriate response to such a question depends inter alia on the product's price and its product category. Specifically, there is a positive nonsignificant impact on buyer acceptance when a low price item (under $1.00) is evaluated as part of a family; the opposite result seems to hold when the item is priced over $1.00 (medium price) and a significant negative effect for items over $2.00.

Next, the lack of significant effects of certain terms of trade (e.g., slotting allowance and free cases) suggests that grocery product marketers might consider redirecting some of these funds into activities more likely to positively influence buyers, such as improvement of product uniqueness or quality. Such a redirection is particularly important in light of the increasingly large expenditures on non-price trade allowances to gain entry into supermarket shelves (see, for example, Supermarket News, 1984; New York Times, 1988).

In general, the higher acceptance rate for new products introduced by the large manufacturers (whether due to their greater resources in R&D, advertising and promotion, larger "families of products or to superior products" etc.) may imply still greater barriers to entry for smaller, regional suppliers. One long run consequence may be a continued grocery industry dominance by larger manufacturers (increased concentration). However, since non-price terms of trade are generally not found to be statistically significant, this study suggests that much of the large and currently expanding manufacturer promotional allowances directed to the retail trade may be redundant. Indeed, small manufacturers may be better off by concentrating on product quality, uniqueness and competitive prices.

LIMITATIONS AND POTENTIAL REMEDIES

Our data collection efforts were somewhat disappointing since various key pieces of information were missing (e.g., number of coupons, dollar amounts of advertising, etc.) for a number of items. This absence is frequently a problem for retailer buyers as well. We believe that information from vendors could be much improved by including, perhaps even standardizing, advertising and promotional materials, discounting schedules, etc., in new product packets. Although some vendors may not embrace such a proposal due to feared loss of competitive advantage, overall results would undoubtedly increase the efficiency of the entire system.

Additionally, in light of the issue of missing data, a complementary study could be designed to seek evaluations of buyers with respect to hypothetical new products. Development of predictive models using such judgments could improve our understanding of the choice process and also enable us to check the consistency between decisions on actual items and hypothetical items. In a sense, data on hypothetical products could be devoid of any "halo" effects.

Although the channel intermediary studied here was selected because of its representativeness in the grocery industry, it must be stressed that the generalizability of these results may be limited. This line of research needs to be extended to determine the degree of interfirm (intermediary) differences among additional channel intermediaries, both in the grocery industry and other industries entirely.

DIRECTIONS FOR FURTHER RESEARCH

Various directions for further research can be identified. First, it would be useful to further investigate potential interactive effects among the variables included in the model. This would include further exploration of the differential effects of various product groups on buyer decisions mentioned above. Next, simultaneous modeling of profit potential judgments and actual decisions could lead to a better predictive model. Some research on new product profit potential is reported in McLaughlin and Rao (1988). Additionally, future work is possible in identifying reasons for poor prediction by the model. In this context, intensified interaction with decision makers could help considerably.

While we have focussed on the addition problem, there is a need to formalize the product deletion process as well. It appears that most buying committees engage in the deletion task simultaneously with the addition task. Moreover, examination of sales trends of accepted items should help us determine the characteristics of new products predictive of long run marketplace success. Finally, from a public policy viewpoint, it would be of interest to estimate the impact of the channel intermediary procurement behavior on producer and consumer welfare.

Figure 1

A VIEW OF BUYER'S EVALUATION PROCESS

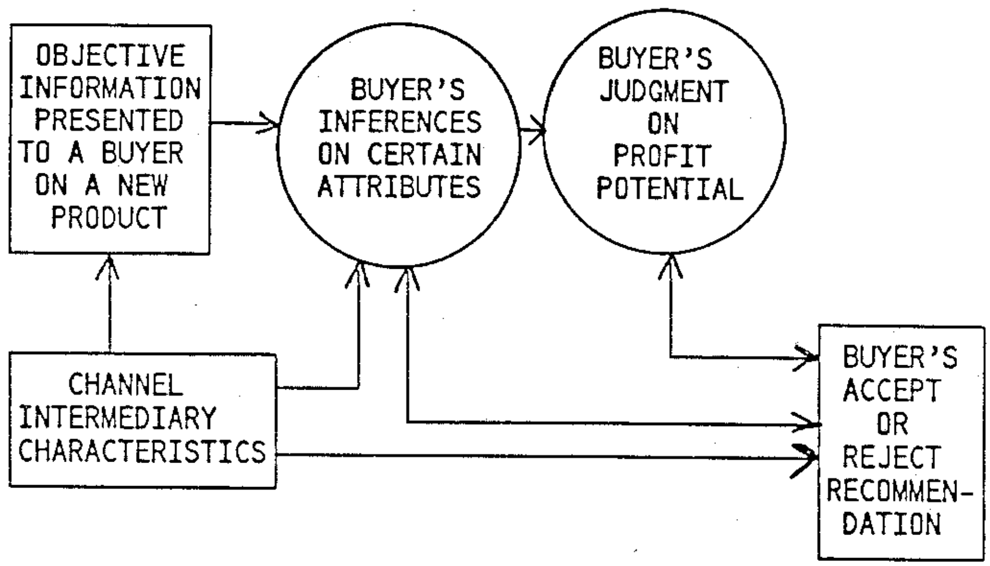

Table 1

VARIABLES, OPERATIONALIZATION, SPECIFIC MEASURES AND HYPOTHESES

Category	Variable	Operationalization	Measure(s)	Hypothesized Direction of Influence
FINANCIAL	GROSS MARGIN	Gross Margin $\left(\frac{\text{Retail Price-Cost}}{\text{Retail Price}}\right)$	Percentage gross margin	Positive (?)
	PROFIT	Profit per shelf volume	$ profit per cu. ft. of shelf volume	Positive (?)
	OPPORTUNITY COST	Opportunity cost of capital	Dollars needed to meet min. order quantity	Negative
COMPETITION	FIRM	Firm - number of competing items	Actual buyer determination	Positive
	BRAND	Brand - number of competing brands		Negative
MARKETING STRATEGY	PRODUCT UNIQUENESS	Product performance, quality and package design ratings	Buyer judgments on 0-10 scales (sum)	Positive
	VENDOR EFFORT	Vendor advertising and promotion effort promised and vendor reputation ratings	Buyer judgments on 0-10 scales (sum)	Positive
	MARKETING SUPPORT	Vendor's plans for TV advertising and coupons	Three categories --no, partial and high support	Positive
	TERM OF TRADE	Presence or absence of four types of non-price marketing incentives	Dummy variables	Positive
	PRICE	Manuf. suggested retail price/unit	Two dummy variables for low and medium prices	Positive (?)
OTHER	CATEGORY GROWTH	Expected growth of product category	Index of buyer judgments on 0-10 scales	Positive
	SYNERGY	Association with family of existing products	Whether item is a member of a family (0,1)	Negative