Philip Kotler

Corporate models: better marketing plans

Simulation from a computer's 'black box' has become a powerful new tool for rationalizing the art of marketing

Foreword

Marketing is so dependent on human judgment, so involved with complex relationships, and so beset with imperfect knowledge that decisions are all too often made by sheer intuition rather than rational analysis. Of course, experience and intuition are vital ingredients in marketing, but their value can be greatly enhanced by objective measurement of market forces. In this article, the author shows how a company can analyze its marketing system step by step, express various relationships explicitly in a model, and then simulate alternative plans on the computer. This process will help a decision maker increase his understanding of a complex operation and evaluate the financial implications of a proposed marketing plan.

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The market planner's task may seem no more onerous or complex than that of the plant manager who must plan the best utilization of the company's labor, equipment, and raw materials, or of the financial officer who must plan the flow of company funds. These other managers, however, generally work with better data, more measurable and dependable input-output relationships, and more direct control.

In marketing, information is poor, expenditures affect demand and costs simultaneously, and human factors play a large role. Thus it is no wonder that marketing management is considered essentially an art by both its practitioners and its critics.

The need to make order out of this chaos may be answered by one of management science's newest and most promising developments—the corporate marketing planning model, which is:

- Computerized.
- Industry-specific.
- Data-based.
- Comprehensive.
- Designed for developing and evaluating alternative company marketing plans.

In this article, I shall describe and illustrate a specific, seven-step procedure for mapping and programming such a marketing model for a typical company. Then, in the Appendix (beginning on page 168), I shall present some broader background information about the evolution

and current state of development of corporate marketing models.

Charting the system

Every company is a pioneer in this area because it must start fresh to create its own concepts, data base, and means of validation. I have found the following seven concepts and tools to be basic to any such system:

1. Core marketing system model.
2. Comprehensive marketing systems model.
3. Input-output models.
4. Functional relationship models.
5. Four-quadrant profit-forecasting and -planning model.
6. Mathematical sales and profit-model.
7. Computer model and output.

Before discussing these concepts in detail, I think it is important to emphasize that the development of a marketing system (or, indeed, of any system) must be undertaken with the full participation of the marketing and other company executives who will be the future users of the corporate marketing model. Education is one of the important by-products of model-building activity, and participation will help to expose the blind spots of various executives about the overall operation of the marketing system.

Executives in the same company tend to see the marketing system in different terms. It is not exceptional to find executives omitting or deemphasizing critical elements in the marketing system. The cooperative attempt to build a corporate marketing model should yield, as one of its major products, a comprehensive and consensual view of the company's marketing system.

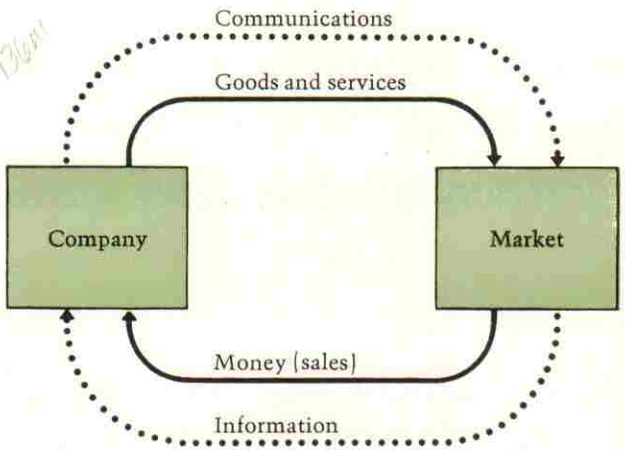
Readers of this article may be interested in "Corporate Models: On-Line, Real-Time Systems," by James S. Boulden and Edward S. Buffa, starting on page 65 of this issue.—*The Editors*

Core system model

The most elementary marketing system is made up of a company and a market. The company is related to the market through a set of four basic flows, those shown in *Exhibit I*. The company dispatches goods, services, and communications to the market; in return it receives dollars and information. The inner loop is an exchange of money for goods; the larger, outer loop is an exchange of information.

A modern marketing system includes additional institutions that play a crucial role in the operation of the system. For instance, the behavior of suppliers has many direct and indirect effects on the company's marketing program and its ability to serve its customers. Furthermore, the company typically faces competitors who are seeking to satisfy the same market needs. Between the company and its market stands a host of selling, facilitating, and consulting intermediaries who add time, place, form, and possession utility to the marketplace. Finally, all of these institutions interact with the larger social forces of public policy, economics, technology, and culture.

Exhibit I. An elementary marketing system

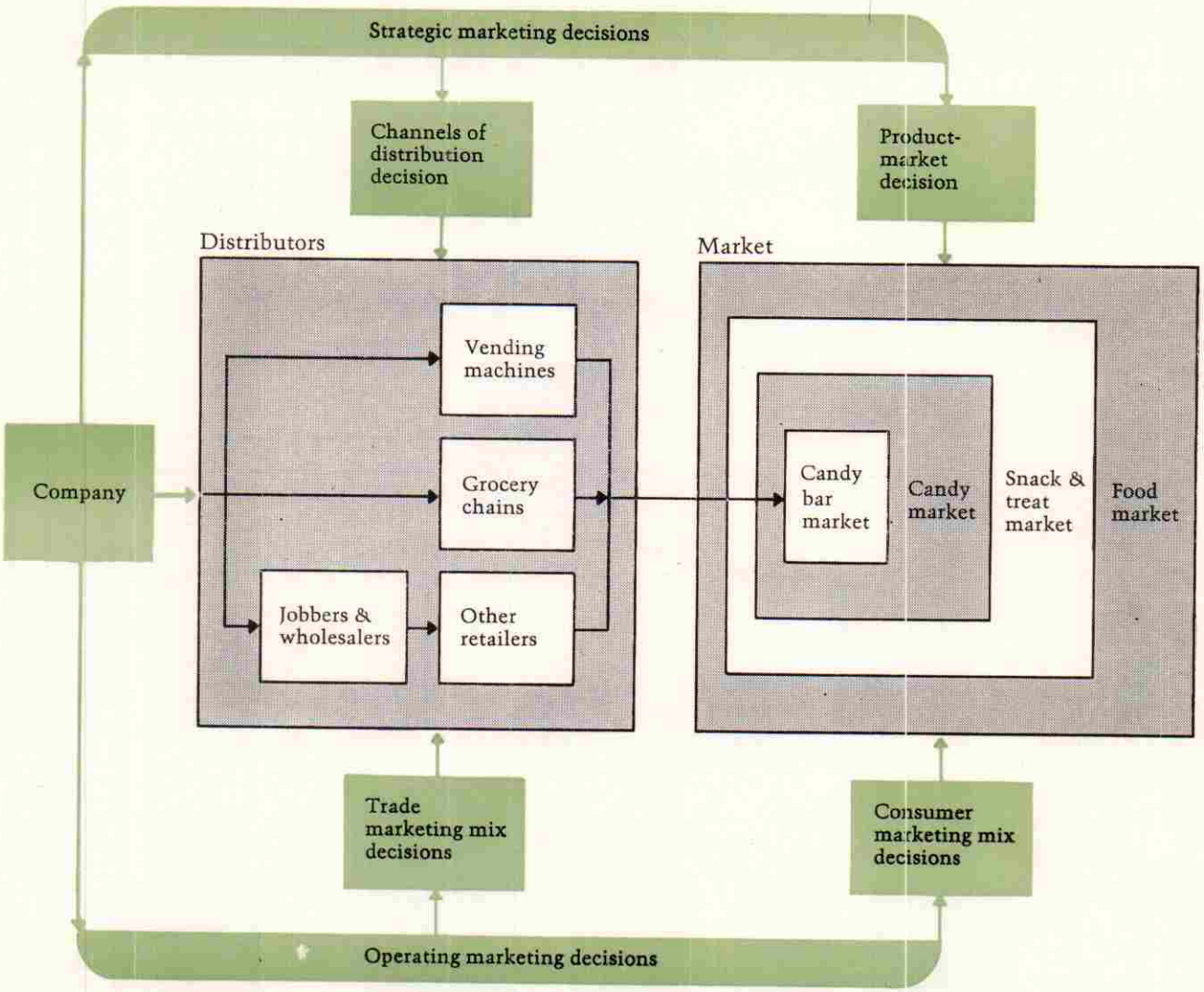


To illustrate these concepts, let us examine each one in relation to an actual, but disguised, company. We will assume that the company is a leading candy producer, and we want to develop the marketing model for one of its major products—a soft-centered chocolate-covered candy bar.

A diagram of the company's core marketing system can be constructed, showing the company, the market, and the linking channels of distribution (see *Exhibit II*).

We assume that the company has already made a major *product-market decision* to produce and sell this candy bar. Such a decision is not made lightly or frequently; it is, rather, a *strategic* decision that is followed by sizable resource commitments to its pursuit. Only at long-

Exhibit II. Core marketing system model



run intervals will the company evaluate and decide whether to continue or drop the product.

The right side of the diagram attempts to expand the generic market underpinnings of this particular product. It can provide clues to spotting other opportunities and also to understanding the sources of competition. Thus:

☐ A candy bar is part of a larger market, the candy market, which contains many other forms of candy that may constitute potential opportunities or threats.

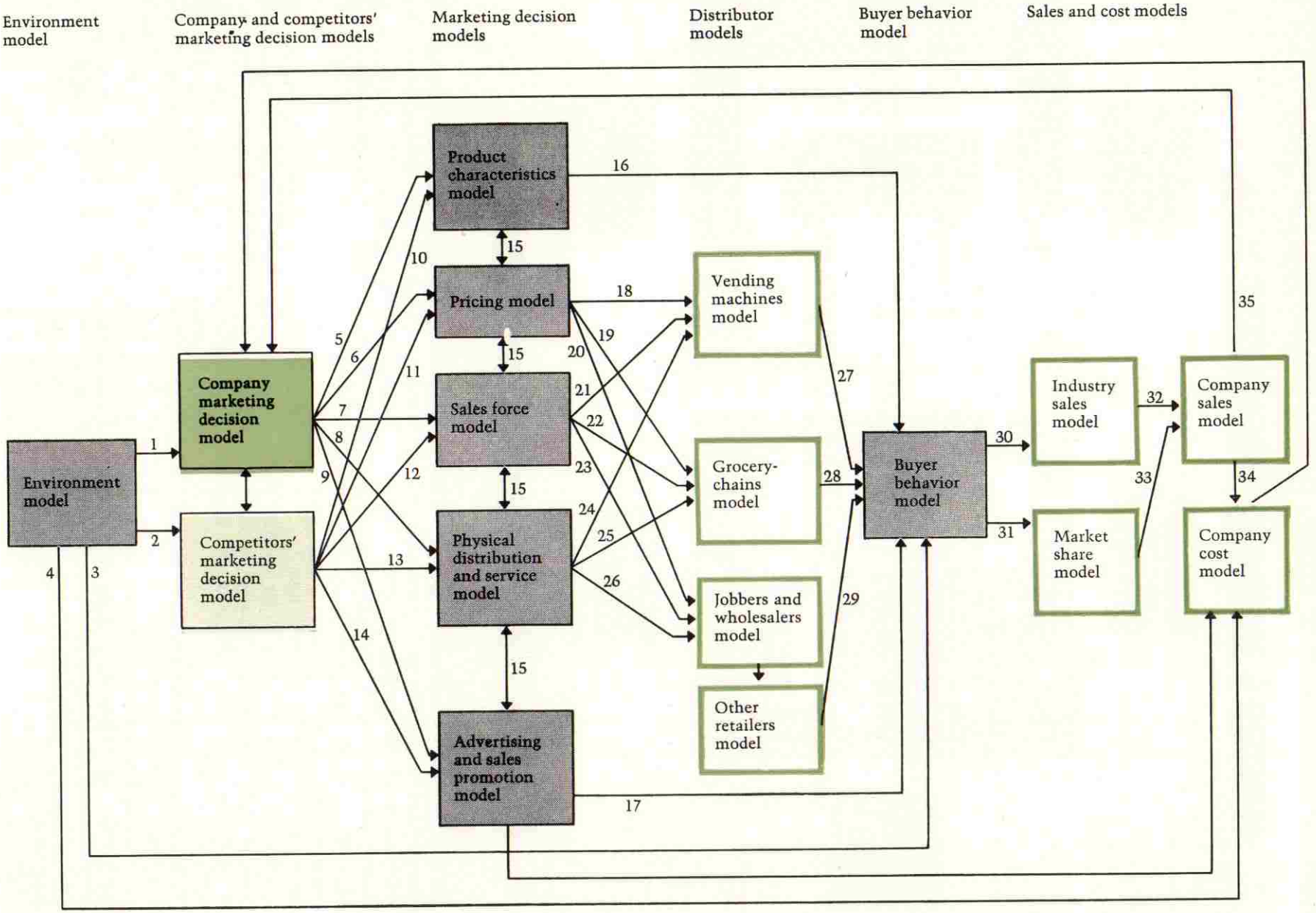
☐ In turn, the candy market itself is embedded in a much larger market, known as the snack and treat market, which represents all products that provide nourishment or taste satisfaction between major meals. Seen in this light, candy is in competition with such sundries as potato chips, soft drinks, pastry, and chewing gum.

☐ Finally, the snack and treat market represents only a small part of the food industry. The company must see itself as primarily in the food business. Further analysis will reveal that the product is also deeply involved in the pleasure market as well.

To reach candy bar consumers, the company some time ago decided to use the three major channels of distribution shown in *Exhibit II*. The *channels-of-distribution decision* is another *strategic* decision that will have a major effect on current operations. The relative importance of these various channels has been changing through time, and management will want to periodically evaluate the channels with respect to at least five measures of performance:

1. Relative sales volume.
2. Relative profit volume.
3. Expected growth in sales.

Exhibit III. Comprehensive marketing system model



4. Expected growth in profits.
5. Degree of control and adaptability of each distribution channel.

Within the context of these two major strategic decisions on the product market and the channels lies the whole area of *marketing operations planning*. This company has the dual problem of developing marketing plans for the trade and for the consumers.

Strategic vs. tactical decisions

From a model-building point of view, it is useful to recognize the distinction between strategic marketing decisions and tactical marketing decisions (in the marketing operations planning area). It may be that quite different models have to be built for these two categories of decisions. A General Mills executive recently articulated his view of the difference between the two as follows:

"At General Mills, our marketing activities can be classified in two basic ways. The first of these would be the *tactical operations* which are continually going on with the objective of getting the right balance between elements in the marketing mix. This type of operation can result in spending efficiencies, proper tactical responses to competitive thrust, etc. To a certain extent, you might classify it as the money-saving end of the marketing business as opposed to the money-making end of the business.

"We feel tht the second basic marketing activity, *strategic innovation*, is probably more likely to create major increases in profit than optimizing tactical operations. At General Mills the responsibility for strategic innovation is primarily shared by the marketing groups and the R&D groups. We feel most strongly that only by creating major discontinuities in established marketing patterns are we going to be able to grow in profit at our targeted rate." [1]

Clearly, if strategic innovation involves changing the system itself, the model necessary for its evaluation may be quite different from that required for evaluating marketing operations planning that takes place within a stable system.

Comprehensive system model

The next step is to diagram the company's marketing system more comprehensively to show other marketing entities and decisions and the feedback-control relationships. *Exhibit III* illustrates how such a model could be constructed for the candy company. The system is logically divided into six aspects:

1. The environment, or, more precisely, those forces in the environment that affect candy demand, such as population growth, per-capita income, attitudes toward candy, and so on.
2. The company and competitors' marketing decision models.
3. The major categories of decision making in this market—product characteristics, price, sales force, physical distribution and service, and advertising and sales promotion.
4. The three major distribution channels that the company uses for this product.
5. The buyer behavior model which shows customer response to the activities of the manufacturers and the distribution channels, as well as to the environment.
6. Total industry sales and market shares for each company.

The various arrows show the flows which connect the major elements in the marketing system. The flows are numbered for ease of reference by the company subsequently. Flow "5," for example, would refer to a detailed diagram and description showing types of product characteristic decisions, the inputs used to influence each of the decisions, the sources of data for each of the inputs, and so forth. Using this device, the company can develop a detailed documentary analysis of its marketing system.

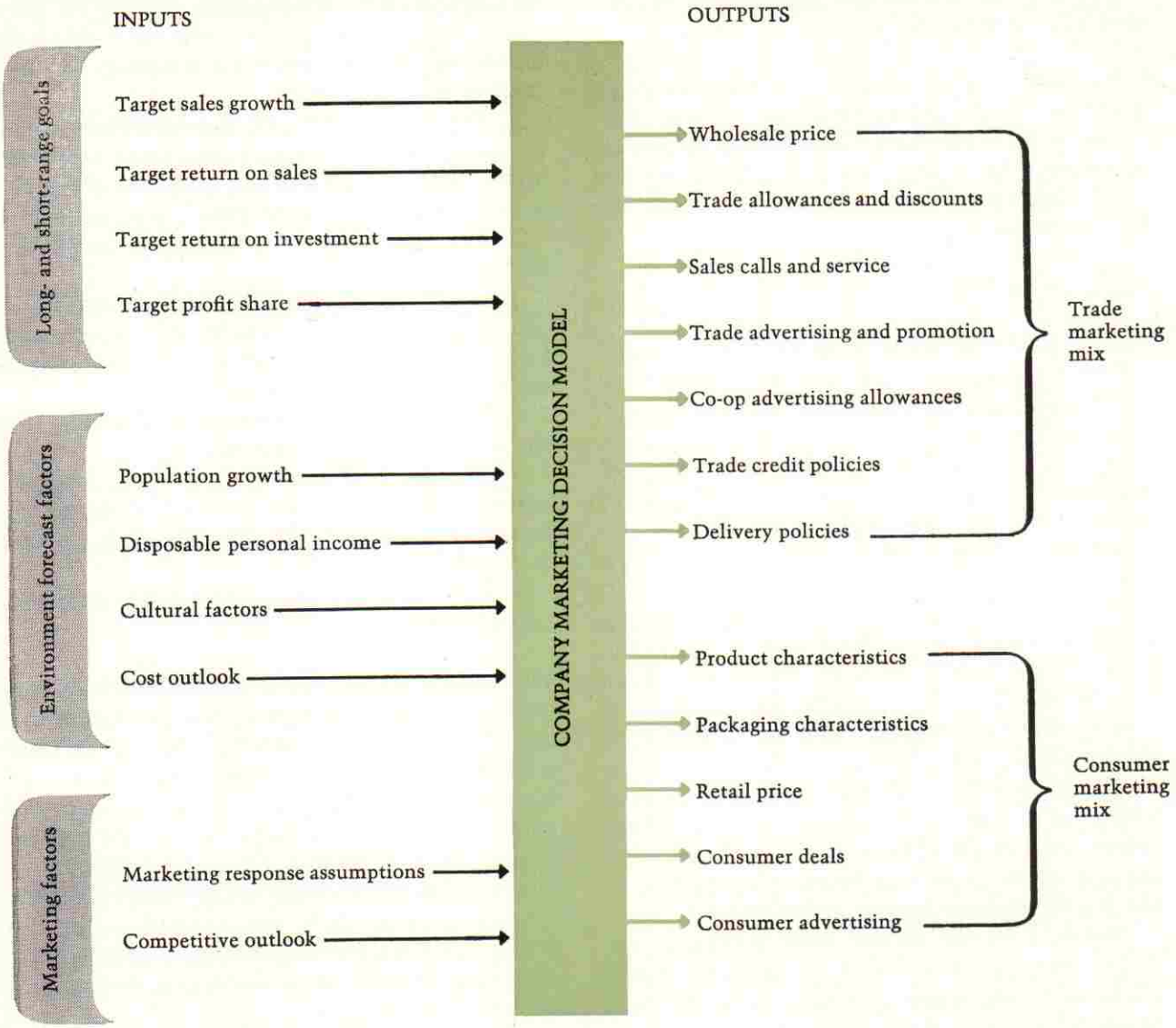
Input-output models

At this stage the marketing system is further refined by preparing diagrams of the inputs and outputs shown in the boxes of *Exhibit III*.

As an illustration of this technique, consider the company marketing-decision box which is singled out and featured in *Exhibit IV*. To obtain the information shown in such an exhibit, company executives are asked to list the major types of marketing decisions made in the company. A variety of answers can be expected, which again emphasizes the fact that managers in the same company carry in their heads only partial models of the total marketing system.

1. H.B. Atwater, Jr., "Integrating Marketing and Other Information Systems," a paper presented to the National Industrial Conference Board, New York City, October 18, 1967, p. 7.

Exhibit IV. Input-output model of company marketing decisions



Note that their answers generally seem to relate to either trade decisions or consumer decisions. The two kinds of decisions are called outputs and are listed on the right side of the exhibit. To influence the trade, the company uses the wholesale price, trade allowances, sales calls and service, trade advertising, co-op advertising allowances, credit policy, and delivery policy. To influence the consumer, the company uses product characteristics, packaging characteristics, retail price, consumer deals, and consumer advertising.

Having identified the major decision outputs, management then lists the various inputs and influences on these decisions, which fall into one of three groups:

1. The company's long- and short-range goals for sales growth, return on sales, and return on investment.
2. Forecastable factors in the environment, such as population growth, disposable personal income, cultural factors, and the cost outlook.
3. Various assumptions about the sales effectiveness of different marketing instruments as well as expectations concerning competition.

The inputs listed at the left represent one possible way to classify the factors affecting the company marketing decisions listed at the right. Each input and output can be elaborated further. For example, in the area of cultural factors, it is possible to isolate three such factors that will have a significant effect on future candy consumption:

Weight consciousness—if there is any relaxation of the pressures in American society toward the idea that "slimness is beautiful," and we return to a Peter Paul Rubens view of feminine beauty, this will lead to a substantial increase in the sales of candy.

Cavity-consciousness—as better dentrifices are developed, people will worry less about the negative effects of sugar on their teeth, and this will reduce their inhibitions against eating candy; nevertheless, worry about sugar may remain a factor, and some companies will see this as an opportunity to develop a tasty, sugarless candy which will offer the double appeal of not contributing either to tooth decay or to overweight.

Cigarette consumption—as people reduce their cigarette consumption in response to the publicity given to the health hazards, we can expect candy, gum, and other "oral" gratifiers to take the place of cigarettes.

All this adds up to the fact that the traditional economic-demographic factors used in marketing forecasting should be supplemented whenever possible with forecasts of cultural factors. Cultural forecasting, like technological and public policy forecasting, is a field that is just beginning to be developed.

Flow of information

Having identified the major inputs and outputs of the company marketing decision model, we now proceed to trace how these data feed into other parts of the system. Consider the output described as the trade marketing mix. This output now becomes input into each of the distribution channels—for example, the grocery chain model (*Exhibit V*).

The next step is to consider the major outputs of the grocery chain model—that is, the decisions which grocery chains independently make that affect the purchase rate of this candy bar. These include:

- The amount and location of shelf facings that will be devoted to this candy bar product.
- The extent of store cooperation in special displays and promotions.
- The amount of retail advertising of this candy product that each store decides to undertake.
- The policy of the stores toward maintaining good inventories and keeping the shelves filled with the product.

These are store decisions that vitally affect the sales of this candy bar through the stores, especially considering that candy bar sales have a large impulse component. The manufacturer, however, has no direct control over the stores' decisions in this area.

This is why it is vitally important to identify the factors on the left, since they represent the "handles" the manufacturer can use to influence the store decisions shown on the right. That is, the manufacturer will develop wholesale price, trade allowances, sales calls and service, trade advertising, cooperative advertising, credit policies, and delivery policies in such a way as to exert the maximum amount of influence on the grocery chains to feature its product.

The influence of the dealers' decisions on the

Exhibit V. Input-output model of grocery-chain decisions

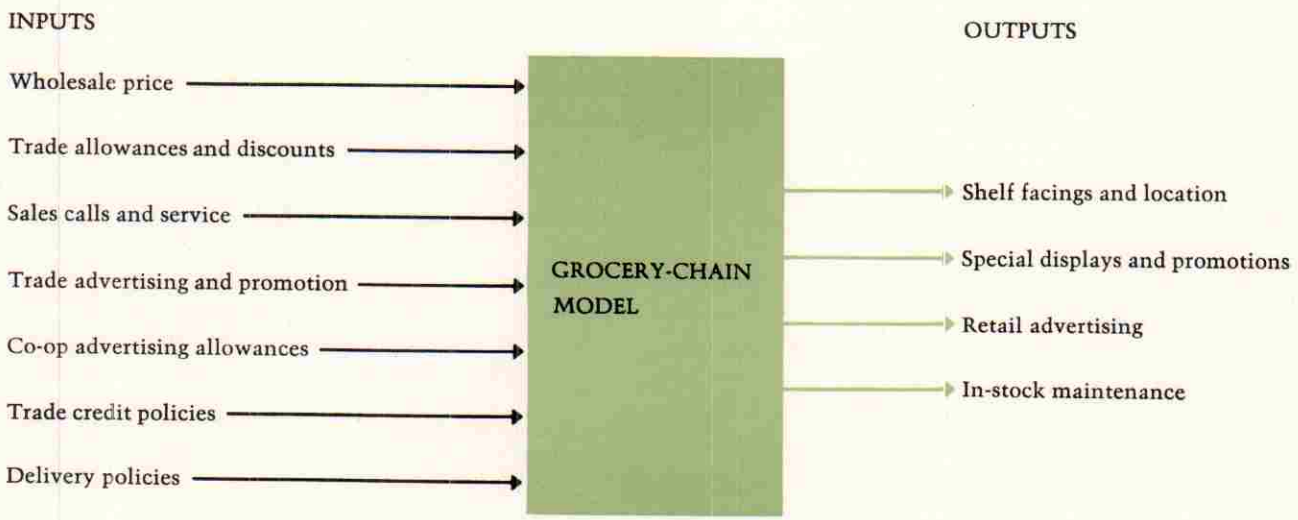
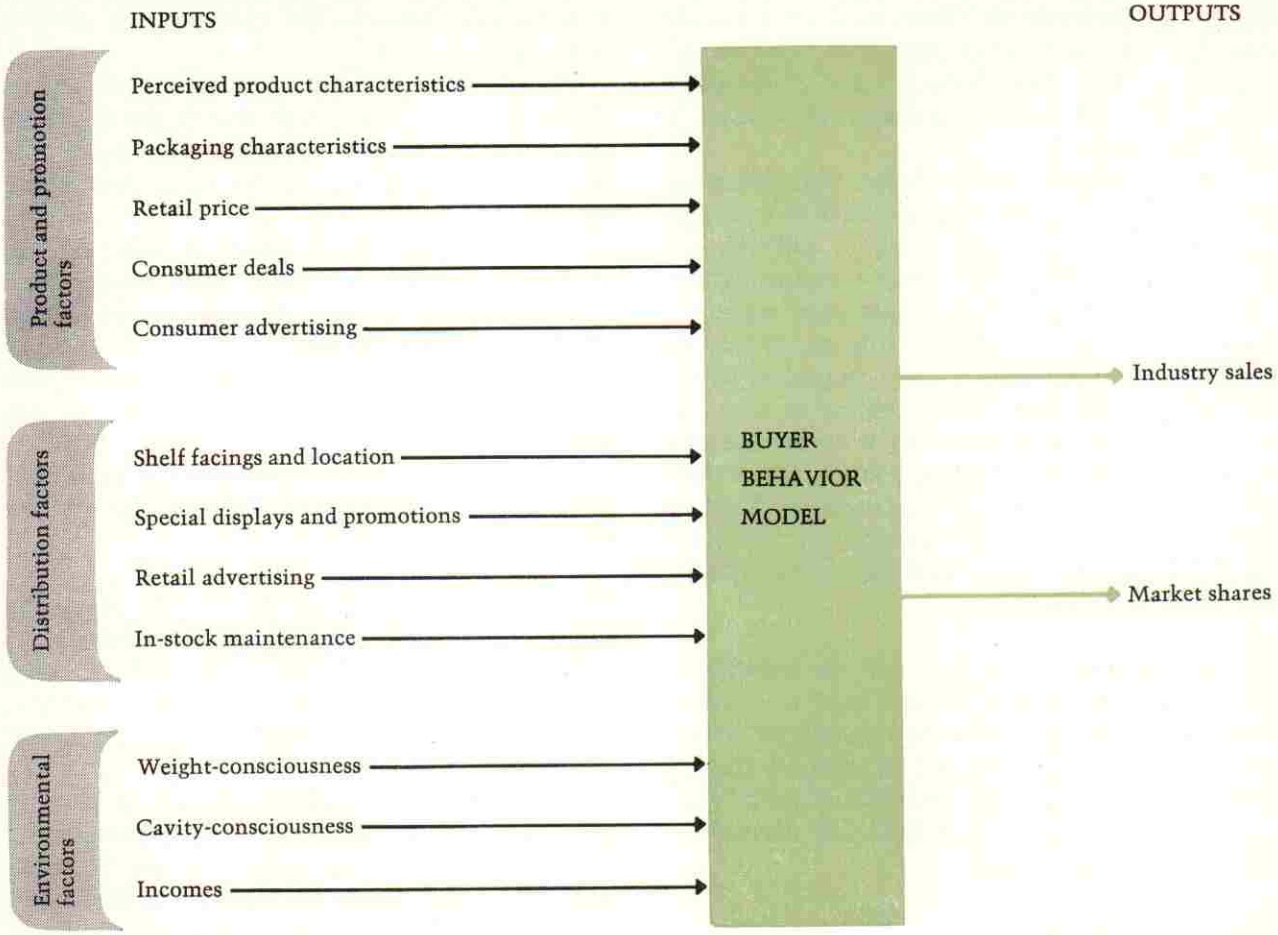


Exhibit VI. Input-output model of buyer behavior



final consumers is shown in *Exhibit VI*, along with influences coming from other parts of the marketing system. The various influences are classified into product and promotion factors (outputs coming from the company marketing decision model), distribution factors (outputs coming from the channels of distribution models), and environmental factors (outputs coming from the environment model). These factors shape consumers' buying behavior to bring about a certain level of industry sales and brand share sales of candy bars.[2]

Functional relationships

I have illustrated how each model component can be analyzed in greater detail to define its inputs and outputs, and how the outputs of one component become the inputs to other components. The next task is to measure the functional relationships between various key elements. For instance, it is obvious that the retail price and advertising affect the rate of consumer purchase; the real task is to measure by how much.

Let us look at two examples of measured functional relationships. Part A of *Exhibit VII* shows the estimated effect on candy bar sales of an important characteristic—i.e., the relative amount of chocolate (measured as a percent of the total weight of the candy bar). In our case example, the candy bar is chocolate-covered, and the question is: How thick should this chocolate covering be?

The company would like to keep this percentage down because chocolate is an expensive ingredient compared with the ingredients that make up the soft center. However, consumer tests reveal that, as the chocolate content of the bar is reduced, preference and sales decline. The soft center begins to appear through the chocolate in places and leads the average consumer to

2. For a review and comparison of some recent buyer behavior models, see James F. Engel, David T. Kollat, and Roger D. Blackwell, *Consumer Behavior* (New York, Holt, Rinehart & Winston, Inc., 1968), Chapter 3.

feel that the bar is poorly made. Furthermore, his palate desires more chocolate to offset the soft center.

Surprisingly, when the layer of chocolate gets too thick (above 35% of the weight of the bar), consumer preference for the bar also falls, but for a different reason. The consumer begins to think of this, not as a soft-centered candy bar, but as a chocolate bar with "some stuff in it." He relates this bar to pure chocolate bars, and it suffers by comparison.

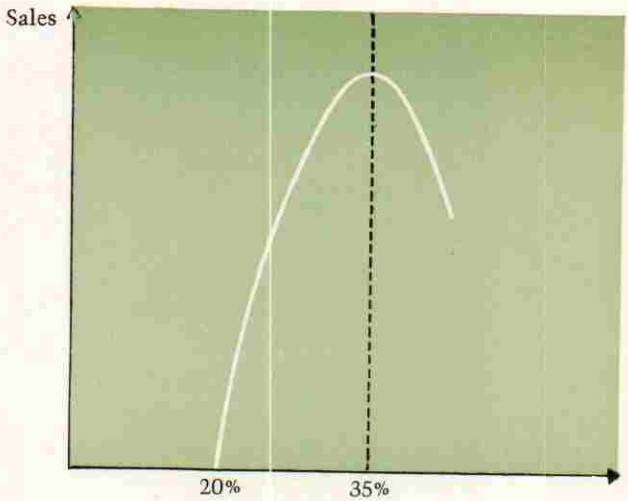
To the best of management's knowledge, then, sales have the parabolic relationship to percentage chocolate weight that is shown in Part A of *Exhibit VII*.

Given this functional relationship, what is the optimum level of chocolate? If the company wishes to maximize sales, then chocolate should constitute 35% of the candy bar's weight. However, since the company is primarily interested in maximizing profit, management needs the ingredient cost functions, as well as the sales response function, to determine the profit-maximizing amount of chocolate.

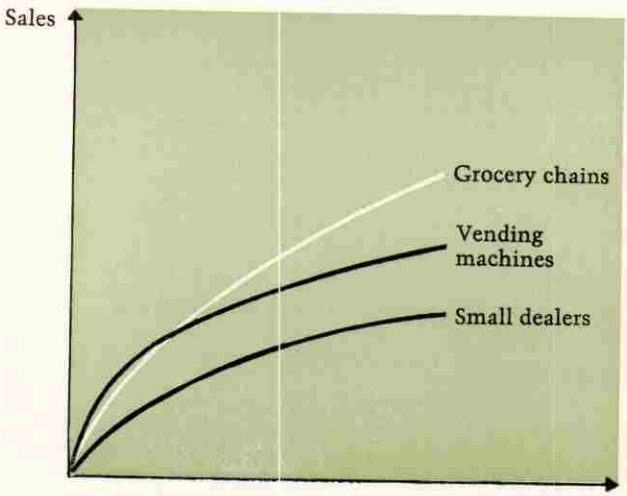
Part B of *Exhibit VII* shows another functional relationship—namely, the one between the amount of trade allowance (deal level) and sales. It appears that the channels of distribution differ in their response to deal offers. Small retailers are less responsive to deals than are other channels. They do not handle as high a volume, nor do they calculate as closely the profit implicit in various deals. The grocery chains, on the other hand, are quick to take advantage of deals. These functional relationships can be useful in determining the optimal allocation of deal money to the different distribution channels.

Exhibit VII. Functional relationship models

A. Relationship between chocolate weight percentage and sales



B. Relationship between deal level and sales response of different channels



Profit-forecasting model

At some point, the various functional relationships must be put together into a model for analyzing the sales and profit consequences of a proposed marketing plan. Let us first look at a graphical method of integrating major relationships in the marketing model. Then, in the following section, we will use this to develop a computerized version of the marketing model.

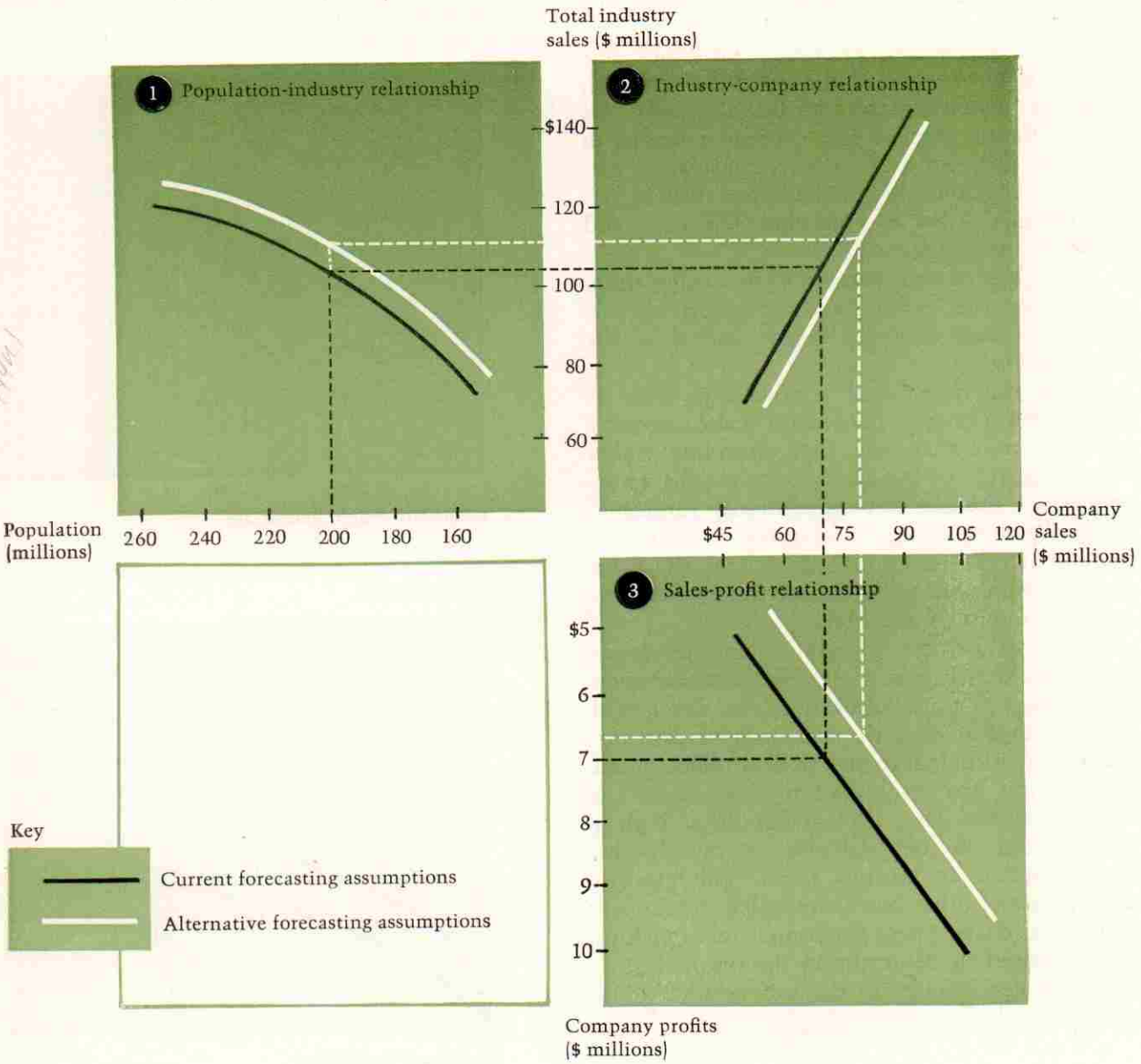
The graphical-analytical device is shown in *Exhibit VIII*. It has been adapted for the candy company example from an idea of Robert S. Weinberg's.[3]

Quadrant I shows the relationship between population and the total sales of chocolate-covered soft-centered candy bars. (We are assuming for the sake of illustration that the only important environmental variable is population. If two or more environmental variables are involved, a weighted combination of them may be portrayed on this axis, or a mathematical analysis can be substituted for the graphical one.)

The functional relationship shows that sales

3. "Multiple Factor Break-Even Analysis: The Applications of Operations-Research Techniques to a Basic Problem of Management Planning and Control," *Operations Research*, April 1956, pp. 152-186. (This idea has an even earlier origin in macroeconomic literature for analyzing equilibrium levels of investment and savings.)

Exhibit VIII. Profit-forecasting and -planning model



tend to increase with population, but at a decreasing rate. The part of the curve describing candy consumption for stages where the U.S. population was under 200 million is historically derived through least-squares regression analysis. The part of the curve showing sales for future sizes of the U.S. population is extrapolated and is influenced by anticipated cultural and economic trends. The curve indicates that a population of 200 million consumes approximately $105 million of soft-centered candy bars.

Quadrant 2 shows the relationship between total sales of soft-centered candy bars and company sales. When industry sales are $105 million, this particular company enjoys sales of $70 million, i.e., a market share of 67%. The part of the curve toward the lower level of industry sales is derived from historical information; the part toward the higher levels of sales is extrapolated on the assumption that there will be no dramatic changes in company and competitors' marketing efforts.

Although the function is linear, it does not necessarily indicate that the company expects its market share to remain constant. This would be true only if the line started at the 0,0 origin of this quadrant (not shown). Actually, the line indicates that the company expects its share of

market to fall slightly as total sales increase. For example, when industry sales are $140 million, the expectation of company sales is $90 million, or an estimated market share of 64%, as compared with 67% now.

Quadrant 3 shows the relationship between company sales and company profits. Here, again, the company assumes that the relationship is basically linear. At the present time, profits are $7 million on company sales of around $70 million, or 10%. If company sales go up to $105 million, the company expects profits of approximately $10.2 million, i.e., 9.7%.

This kind of graphical device, which assumes that all the underlying relationships have been combined and expressed in terms of three basic relationships, allows us to visualize the effect of a particular level of an environmental factor and continued marketing program on company sales and profits. To this extent, it is a forecasting device.

Its use extends beyond this, however, into marketing planning as well. Suppose, for example, that the company expects the new anti-smoking campaign to have a big impact on candy bar sales, shifting the curve in Quadrant 1 higher (see *Exhibit VIII*). Furthermore, suppose the company is considering intensifying its marketing effort to increase its market share even further. The anticipated effect of this on company market share can be seen by shifting the function in Quadrant 2 to the right. At the same time, the company's marketing costs increase, and that shifts the sales-profit curve to the right, as shown in Quadrant 3.

What is the net effect of this complicated set of shifts? The result is that, although sales have increased, profits have fallen. Apparently, the cost to the company of attaining a still higher market share exceeds the profits on the extra sales. The company would be wise not to intensify its marketing effort, at least according to the specific plan it is considering and its estimated effects.

Mathematical profit model

The four-quadrant profit-forecasting and -planning model helps one to visualize the impact of a complex set of developments on final company sales and profits. It is also a very useful device for explaining a forecast or a plan to others in the company. At the same time, however, it is quite limited with respect to the number of factors that can be handled directly. For more detailed modeling, we need a mathematical formulation of the candy company's marketing system.

A simplified version of such a model is shown in *Exhibit IX*. The starting point for any marketing planning model is an equation that expresses profits as a function of the variables under the company's control. Equation #1 shows a profit equation for Company i where profit is gross profit margin $(P - c)$ times quantity (Q), minus the fixed costs (F), advertising and promo-

Exhibit IX. Mathematical sales and profit model

#1 Company i's profit equation

$$Z_{i,t} = (P_{i,t} - c_{i,t})Q_{i,t} - F_{i,t} - A_{i,t} - D_{i,t}$$

#2 Company i's sales equation

$$Q_{i,t} = s_{i,t}Q_t$$

#3 Industry sales equation

$$Q_t = m_t k_t N_t \text{ , where . . .}$$

m_t = parameter

$k_t = 24(1 - .25^t)$

$N_t = 200(1.03)^t$

#4 Market share equation

$$s_{i,t} = \frac{R_{i,t}^{e_{R,i}} P_{i,t}^{-e_{P,i}} (a_{i,t}A_{i,t})^{e_{A,i}} (d_{i,t}D_{i,t})^{e_{D,i}}}{\sum_i [R_{i,t}^{e_{R,i}} P_{i,t}^{-e_{P,i}} (a_{i,t}A_{i,t})^{e_{A,i}} (d_{i,t}D_{i,t})^{e_{D,i}}]}$$

$Z_{i,t}$ = Profits in dollars of Company i in year t

$P_{i,t}$ = Average price per lb. of Company i's product in year t

$c_{i,t}$ = Variable cost per lb. of Company i's product in year t

$Q_{i,t}$ = Number of lbs. sold of Company i's product in year t

$F_{i,t}$ = Fixed costs of manufacturing and selling Company i's product in year t

$A_{i,t}$ = Advertising and promotion costs for Company i's product in year t

$D_{i,t}$ = Distribution and sales force costs for Company i's product in year t

$s_{i,t}$ = Company i's average market share in year t

Q_t = Industry sales of soft-centered candy bars in year t

m_t = Soft-centered candy bar poundage as a share of total candy poundage

k_t = Per-capita candy consumption in lbs. in year t

N_t = Millions of persons in U.S.A. in year t

$R_{i,t}$ = Preference rating of Company i's product in year t

$a_{i,t}$ = Advertising effectiveness index

$d_{i,t}$ = Distribution effectiveness index

$e_{R,i}$, $e_{P,i}$, $e_{A,i}$, $e_{D,i}$ = Elasticities of preference, price, advertising, and distribution, respectively, of Company i

tion expenditures (A), and distribution expenditures (D). It is possible to spell out the profit equation in greater detail, but this form will suffice for illustration.

Typically, the most difficult variable to estimate is company sales (Q_i). The model builder's skill comes into play here as he tries to formulate an explanatory and predictive equation for company sales. Equation #2 is such an equation. It appears that the model builder took the easy way out by defining company sales as the product of company market share (s_i) and total sales of soft-centered candy bars (Q). However, when doing this, it is necessary to account for the two new variables, total sales and market share.

To explain total sales, we formulate the relationship shown in Equation #3. Total soft-centered candy bars sales are the product of the population (N), the per-capita candy consumption rate in pounds (k), and the ratio of soft-centered candy bar sales to total candy sales (m). But now it appears that we have traded the variable Q for three new variables. Fortunately, the three variables are fairly easy to account for exogenously. The ratio of soft-centered candy bar sales to total sales is a fairly stable number. The per-capita candy consumption rate is expected to rise asymptotically in the United States from its present level ($t = 1$) of 18 pounds per capita to 24 pounds per capita, which happens to be the per-capita candy consumption level of the highest candy-consuming country in the world, Great Britain. The population itself (N) is rising at the rate of 3% a year.

The other variable in the company's sales equation, market share, is typically the hardest of the elements to formulate; yet it is crucial in that it will reflect all of the assumptions about the company marketing decision variables.

There are several ways to formulate the equation for market share.[4] Equation #4 is one example. It shows market share as the ratio of the weighted value of the company's marketing mix to the sum of all candy companies' weighted marketing mixes. The weighted value of a marketing mix is the product of the company's effective preference level, price, advertising, and distribution raised to their respective elasticities. Further refinements can be introduced to reflect the carryover effects of past promotions. The market share model, whatever its form, must synthesize the functional relationships described earlier.

4. See, for example, Doyle L. Weiss, "The Determinants of Market Share," *Journal of Marketing Research*, August 1968, p. 290.

Additional refinements can and should be introduced into this model. For example, cost per pound (c) may not be constant but, rather, may vary with the scale of sales (via production), the preference rating for the company's product (to the extent that this involves better quality ingredients), and time itself, because of inflation. This means some formulation of $c = f(Q,R,t)$ would be desirable. Furthermore, fixed costs may not be independent of the level of sales and production, and therefore some formulation of the form $F = g(Q)$ might be necessary. These and other refinements are introduced as part of the evolution of the model into an increasingly accurate instrument for forecasting and planning.

The model not only must be formulated, but also must be fitted and updated according to the best available information and statistical techniques. Objective data are preferred, but, when they are not available, carefully collected subjective data may be used. The effect of uncertain data inputs on the results can be tested through sensitivity analysis.

Computer model & output

At some stage the model should be programmed for the computer and made available to management, preferably on an on-line basis. Marketing planners should be able to sit at a terminal, type in the latest research data, along with specific proposed settings of the marketing decision variables, and get back an estimate of the plan's expected sales and profits. The computer program should also contain, if possible, a subroutine which can search for the best plan possible.

For an illustration of the print-out from one such computer program, see *Exhibit X*. The particular model that underlies this output is much simpler than the one discussed earlier. Instead of using a sales model to derive sales estimates from planned levels of marketing decision variables, management supplies subjective estimates of sales.

The print-out shows the inputs and expected payoffs for a seven-year plan being considered for a cereal product. (This plan calls for the continuation of the past marketing strategy; other plans were also considered.)

The first item printed out is the calculated internal rate of return after taxes for the particular plan. (The computer program is set up

Exhibit X. Sample print-out from computer program

```
        INTERNAL RATE OF RETURN (AFTER TAXES) = 45                PCNT

                                TIME HORIZON = 7                  YEARS

  REMAINING UNDEPR. P&E INVEST. AT BEGIN. YR.1 = 900000           DOLLARS
  REMAINING NO. OF YEARS OF P&E DEPRECIATION   = 3               YEARS
  REMAINING UNDEP. BLDG INVEST. AT BEGIN. YR.1 = 210000          DOLLARS
  REMAINING NO. OF YEARS OF BLDG DEPRECIATION  = 21              YEARS

     DEPRECIATION HORIZON FOR P&E INVESTMENTS  = 10               YEARS
     DEPRECIATION HORIZON FOR BLDG INVESTMENTS = 30               YEARS

     OPPORTUNITY COST (AT BEGINNING OF PERIOD) = 2.E+06           DOLLARS
                                WORKING CAPITAL = 13              PCNT SALES
                SALVAGE VALUE (AT END OF PERIOD) = 10             X EARNINGS

                    1              2              3              4
YEAR          RET.PRICE($)   RET.MAR.(PCNT)  WHOLE.PRICE($)  WHOLE.MAR.(PCNT)
 1969             .577           18             .473            0
 1970             .602           18             .494            0
 1971             .621           18             .509            0
 1972             .639           18             .524            0
 1973             .659           18             .54             0
 1974             .675           18             .554            0
 1975             .698           18             .572            0

                    5              6              7              8
                FACTORY      VARIABLE MAN.  VARIABLE MAN.  VARIABLE MKTG
                PRICE($)       COST($)      COST(PCNT)     COST(PCNT)
 1969             .473           .191           40.4            5
 1970             .494           .196           39.7            5
 1971             .509           .202           39.7            5
 1972             .524           .208           39.7            5
 1973             .54            .214           39.6            5
 1974             .554           .221           39.9            5
 1975             .572           .227           39.7            5

                    9             10             11             12
YEAR          CONTRIB. TO FIXED COSTS AND PROFIT  FIXED MAN.   FIXED MKTG.
                    ($)           (PCNT)          COST($)        COST($)
 1969             .258           54.6           915000         4.25E+06
 1970             .273           55.3           971000         4.9E+06
 1971             .282           55.3           1.028E+06      5.5E+06
 1972             .29            55.3           1.31E+06       5.75E+06
 1973             .299           55.4           1.386E+06      6.25E+06
 1974             .305           55.1           1.471E+06      6.85E+06
 1975             .317           55.3           1.824E+06      7.6E+06

                   13             14             15
YEAR          P&E INVEST.    BLDG.INVEST.   DEPREC.EXPENSE
 1968             850000         0
 1969             0              0              395000
 1970             0              0              395000
 1971             850000         1.E+06         395000
 1972             0              0              213333
 1973             0              0              213333
 1974             850000         1.E+06         213333
 1975             0              0              331666

                   16             17             18             19
                INDEX OF       COMPANY        INDUSTRY       MARKET
YEAR          COMPANY SALES  SLS(UNITS)     SLS(UNITS)     SHARE
 1969             1              3.E+07         1.166E+09      2.6
 1970             1.1            3.3E+07        1.182E+09      2.8
 1971             1.2            3.6E+07        1.198E+09      3
 1972             1.3            3.9E+07        1.215E+09      3.2
 1973             1.4            4.2E+07        1.23E+09       3.4
 1974             1.5            4.5E+07        1.247E+09      3.6
 1975             1.6            4.8E+07        1.265E+09      3.8

                   20             21             22             23
YEAR          MKTG EXP.(PCNT SLS)  P.A.T.(PCNT SLS)  P.A.T.($)   CSH FLOW(A.T.)
 1968                                                            -2.85E+06
 1969             34.9           7.7            1.097245E+06    -353001
 1970             35.1           8.4            1.370807E+06    1.493337E+06
 1971             35             8.8            1.610162E+06    -110272
 1972             33.1           9.9            2.014062E+06    1.953967E+06
 1973             32.5           10.4           2.361914E+06    2.281351E+06
 1974             32.5           10.4           2.591395E+06    667228
 1975             32.7           9.9            2.723974E+06    2.722089E+06
 1976
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to give two other payoff measures—i.e., the present value of the after-tax cash flow, and the sales and market share needed to achieve a 10% ROI after taxes.)

The next line shows that this calculation is for a seven-year planning horizon. Some details are then printed out on the initial value of the undepreciated plant and equipment and building investment devoted to this product line and the remaining number of years of depreciation. The depreciation horizons are also printed out, as well as the current opportunity cost of this investment and its expected salvage value at the end of the period.

The rest of the print-out shows the expected or planned year-to-year levels of important variables that ultimately affect the internal rate of return. Column 1 shows the retail price per unit, which is expected to rise from $.58 to $.70 in the course of seven years. Column 2 shows that the retail margin for this product (18%) is not expected to change. Column 3 shows the resulting wholesale prices. Since this company sells direct to the retailers, there is no wholesale margin (Column 4), and the factory price (Column 5) is the same as the wholesale price.

Column 6 shows estimated variable manufacturing costs, and they too are expected to rise over the period, from a present level of $.19 to $.23 in 1975. The ratio of variable manufacturing costs to factory prices is shown in Column 7, followed by the planned ratio of variable marketing costs to factory prices (Column 8). Subtracting variable manufacturing and marketing costs per unit from the price, the result is the contribution to fixed costs and profits, which is shown in dollar and percentage form in Columns 9 and 10 respectively.

The next step calls for estimating fixed manufacturing costs and fixed marketing costs over the next seven years, which are shown in Columns 11 and 12. The symbol E+06 is computer print-out shorthand and means that the reader should move the decimal place, in the associated number, six places to the right. Thus $1.028E+06 means $1,028,000. Columns 13 and 14 show the anticipated investments in plant, equipment, and building over the next seven years, and Column 15 shows the estimated total depreciation expense.

We now arrive at the estimated sales and profits. Columns 16 and 17 show management's estimates of sales (in percentage and in unit terms, respectively) over the next seven years. The figures indicate that management expects company sales (in units) to rise at the rate of about 10% a year, on the basis of its planned levels of marketing expenditures. Column 18 presents management's estimates of industry sales for the next seven years.

The figures in Column 19, market share, are derived by dividing estimated company sales (Column 17) by estimated industry sales (Column 18). We see that management expects market share to grow from 2.6% to 3.8% over a seven-year period. Column 20 expresses total marketing expenditures (Columns 8 and 12) as a percent of sales, and this percentage is expected to fall. Examining this more closely, we see that management expects sales to rise faster than marketing expenditures; hence it is assuming an increase in marketing productivity.

Columns 21 and 22 are a derivation of the implied yearly profits after taxes in percentage and dollar terms. The computer program uses the following formula to calculate dollar profits after taxes:

$Z = (1 - T)(CQ - F - D)$, where

Z = Profits after taxes;
T = Tax rate;
C = Contribution to fixed costs and profit;
Q = Sales in units;
F = Fixed manufacturing and marketing costs;
D = Depreciation.

For example, the profits after taxes for 1969 are: (1 − .4944)[($.258)(30,000,000) − $5,165,000 − $395,000], or $1,097,245.*

Column 23 shows the results of the conversion of profits after taxes to cash flow after taxes. The formula for cash flow can be expressed as: $L = Z + D - W - Y$, where

L = Cash flow after taxes;
Z = Profits after taxes;
D = Depreciation;
W = Working capital in dollars (i.e., working capital as a percent of sales, times wholesale price, times sales in units);
Y = New investment expenditure.

For example, the cash flow after taxes for 1969 is: $1,097,245 + $395,000 − [.13($.473)(30,000,000)] − 0, or −$353,001.*

Having calculated the cash flow after taxes, the computer now calculates the internal rate of

*This figure is the computer output and differs slightly from the arithmetic result of the formula as presented, because of certain simplifications of input data.

return implicit in the cash flow in Column 23. This is found by taking the opportunity cost at the beginning of the period and searching for the interest rate that would discount the future cash flows so that the sum of the discounted cash flows is equal to the initial opportunity cost; this rate turns out to be 45%.

Thus computer programs such as this one enable the marketing planner to determine the financial consequences implied by a particular set of costs, investments, and sales. He can easily calculate the impact on profit of any alterations in his data or assumptions. This particular computer program could be improved further by:

- Including separate estimates of each marketing decision variable, rather than lumping them together as total marketing expense.
- Incorporating a sales model that estimates sales analytically from the marketing plan variables and from environmental and competitive assumptions, instead of requiring direct estimation.
- Introducing a subroutine for planning territorial allocations of the marketing budget.
- Introducing risk explicitly into the program by including pessimistic, optimistic, and normal estimates.
- Introducing a profit-maximizing algorithm which will search for the best marketing plan in the light of the assumptions and data.

Concluding note

In this article I have outlined one rational approach to building a model for determining and evaluating marketing strategies. With such a model for a given product within its total environment, the marketing executive can experiment with any number of detailed plans to determine the best one. While computerized models will not guarantee success in marketing, they are likely to produce better results than intuition alone.

Marketing plans will always be subject to unknown risks and so must be tempered by the judgment and experience of the decision maker. But a systematic analysis of market forces and their probable effects on a particular product will go a long way toward keeping the risks within tolerable limits.

[For the Appendix, please turn to page 168.]