PLAN*IT: SIMULATION APPLIED IN A MARKETING DECISION SYSTEM

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ABSTRACT

PLAN*IT is an on-line strategic marketing planning model geared to multigoal, multiperiod, multiproduct blending of the marketing mix of a manufacturer competing under oligopolistic market conditions and selling through channel intermediaries. This paper describes PLAN*IT's role and benefits in the strategic marketing planning process and examines the essential features of PLAN*IT's underlying mathematical model.

I. INTRODUCTION

System definition is the primary step of simulation model building, if the model is to represent realistically in some simplified manner the operation of a system. As the system to be modeled becomes more complex, realistic representation becomes increasingly difficult. Parsimony is essential if the model is to be tractable. Nevertheless, the modeler must be cautious about eliminating complexity by excluding variables or simplifying their functional relationships. Oversimplification can produce an unrealistically constrained simulation which warps the actual system to the convenience of computational tools or represents a lower level system. Consequently, the model's outputs are useful only in very limited contexts, if at all. Its conceptual, structural and operational inadequacies can shake potential users' confidence in the model.

Planning models must tackle the problem of stating and blending two systems. One is the planning scheme of decision makers. The other is the economic, social, physical, or otherwise system that is to be influenced via the decision makers' planning scheme. This paper explains how PLAN*IT defines and integrates the strategic marketing planning system and the core marketing system. The latter is the network of economic and competitive influences which the decision maker must analyze and influence because they intervene between his actions and the market responses that are obtained.

The strategic marketing decision system is very complex and the potential marketing model user typically is timid about models. Therefore, a decision-oriented simulation must take extreme care to ensure realistic and useful portrayal of the original system of interest to the decision maker. In other words, the simulation must fit into a model which (1) helps capture the complexities of the environment that the decision maker needs to have related and quantified and (2) allows the decision maker to experiment with various levels of exogenous and endogenous variables in a manner with which he is comfortable. Only if these prerequisites have been satisfied can the simulation achieve its objectives of helping the user to

(1) understand the consequences of alternative actions,
(2) appreciate how these actions interact with other systems,
(3) recognize how the systems work together to determine market response, and
(4) gain insights into the systems operation which will improve the effectiveness of subsequent decisions.

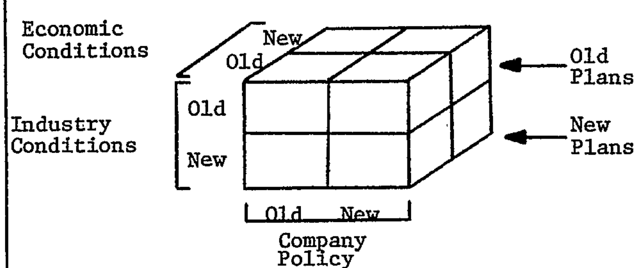
In other words, the model should help the decision maker to reach better decisions and to understand more fully the impacts of his decisions.

II. STRATEGIC MARKETING DECISION SYSTEM

The strategic marketing decision system is that in which the firm makes basic commitments of resources among aggregate components of marketing effort. It is a budget setting and allocation process in the context of multiproduct, multigoal, multiperiod planning. Both the system's complexity and the potential impact of various bordering systems are apparent in Illustration 1 which represents a simplified, single-product case.

ILLUSTRATION 1

Strategic Planning Scheme



The decision maker may have to reconsider old (existing) plans or formulate new plans because of changes in economic or industry conditions or in response to new company goals and/or marketing action constraints. If the firm produces several products, altered conditions or plans affecting one can trigger the need to reconsider all product plans.

This kind of allocation decision is distinct from tactical subdecisions both in scope and in requirement for consistency. Tactical subdecisions, such as media selection or sales force routing, focus on individual actions. While in combination these subdecisions affect the firm's overall marketing efficiency, the aggregate of the tactical decisions need not and generally will not constitute a consistent plan. Furthermore, it is not generally feasible to optimize jointly all tactical subdecisions. In the end, a strategic decision process must develop a consistent, comprehensive plan through successive adjustments between strategic and tactical considerations.

As an illustration of this strategic marketing decision system, assume that at the beginning of an annual planning cycle a marketing manager's superiors pose the three questions below and want answers quickly.

(1) We expect a downturn in economic growth. Should the overall level of marketing effort be raised? maintained? lowered? for which products?
(2) We expect our major competitor to reduce prices of products j and k by 5%. What will that do to performance of our product line? of products q and r in our product line?
(3) Could our marketing effort be allocated more effectively? Should some of our advertising effort be reallocated to personal selling? Should some of our product q effort be shifted to product r? What trade-offs are there between sales and profit and what actions are least subject to such trade-offs?

This is a challenging, but not atypical, situation. The manager's ultimate task is to finalize a period-by-period strategic marketing plan for the products under his purview. Developing such a plan will involve testing several possible plans under various assumptions regarding economic and industry conditions. Given these assumptions, the manager must search for the plan which will result in very satisfactory overall product-line performance as measured against the firm's multifaceted goal structure and within stated policy constraints.

Clearly the results of the decision process are critical to the firm's long-term success. All too often, however, the decisions come late after tedious manual analysis or speedily off the cuff. Rarely can the answers to the questions or final plans be pretested under market conditions.

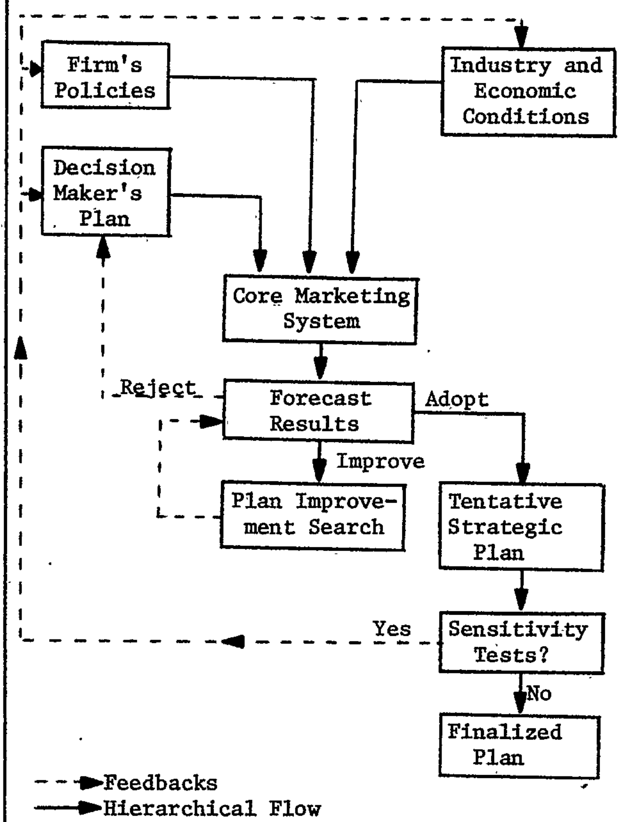
III. ROLE OF PLAN*IT IN THE STRATEGIC MARKETING DECISION SYSTEM

Despite the obvious need for models to help managers in such situations and the existence of numerous tactical decision models, little research on strategic marketing decision models has been published (1, 2, 11, 16, 18). PLAN*IT helps bridge this gap. The program enables the first-level marketing manager (e.g., a product manager) to bring in-depth analysis and testing against simulated market conditions to bear quickly and effectively on the aforementioned kinds of questions. The model is an interactive computer program for on-line forecasting, strategic plan development, policy formulation, and sensitivity testing.

Illustration 2 summarizes the decision system. It represents an iterative decision process with feedbacks. Hierarchically, the prerequisites to planning are the firm's policies and anticipated industry and economic conditions.

ILLUSTRATION 2

PLAN*IT's Strategic Marketing Decision System



The policies are the firm's objectives, planning horizon, and constraints in terms of minimum and/or maximum levels of effort and results. The second step is for the decision maker to try an old or newly formulated marketing plan which, together with competitors' past results, determines the level of contribution to the firm's objectives. The third step is to either adopt the plan or to try to improve it with PLAN*IT's plan improvement search model that will be described later. A decision maker may be concerned that a plan which yields excellent results under one set of policies, competitive actions, or economic conditions will be unacceptable under others. Sensitivity analysis enables the decision maker to determine the plan's desirability under many conditions. As stated at the outset, asking, "what if" questions is an essential part of managerial decision making that must precede the fourth stage, adoption of a finalized plan. In its present form, PLAN*IT permits such analysis for various policies and economic conditions. Later versions will include sensitivity tests based on changes in competitor's marketing decision rules.

The next section discusses the core marketing system (cms), its inputs and outputs. It is followed by a section describing the PLAN*IT-aided plan improvement search process.

IV. CORE MARKETING SYSTEM

MACROECONOMIC AND INDUSTRY-SPECIFIC DEMAND DETERMINANTS

The first two inputs to the cms are forecasts of exogenous macroeconomic and industry-specific demand determinants. The forecasts are prepared by Chase Econometric Associates, Inc. (3, 4), a well-known research/consulting organization. The decision maker may decide to accept the raw forecasts or to use forecast regions as inputs to PLAN*IT. If he has reason, such as a desire to perform sensitivity tests, the decision maker can modify the forecasts according to his subjective judgments.

DECISION MAKER'S SUBJECTIVELY DEVELOPED PLANS

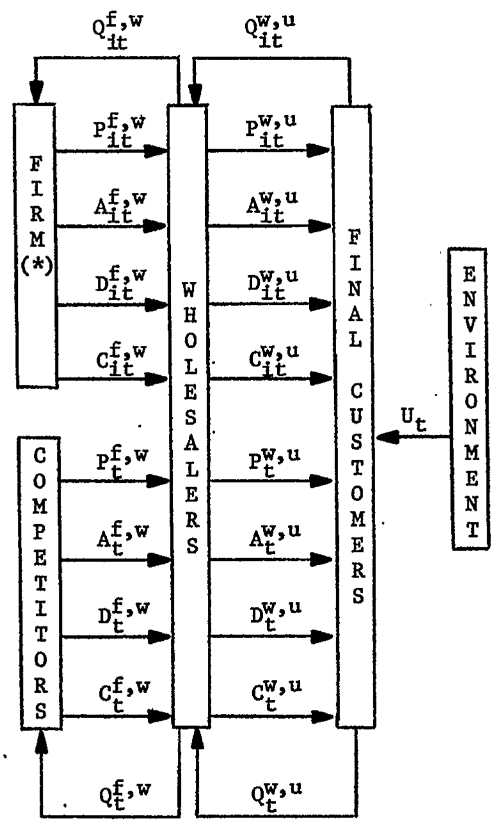
The third component of PLAN*IT is the decision maker's subjectively developed marketing plans comprising decisions on levels of such marketing action variables as price, advertising, personal selling and customer service levels. Plan inputs typically occur several times during the planning process. Generally, however, the first plan input will be either an old plan (e.g., last period's plan) which the decision maker wished to test under new conditions or a new plan which he develops subjectively as a starting point for further analysis.

CORE MARKETING SYSTEM SIMULATION (CORSIM)

PLAN*IT's fourth component is a cms simulation (CORSIM) (12). Illustration 3 is a simplified CORSIM diagram. Table 1 defines the variables. CORSIM is a set of three types of equations: channel throughput equations, sales response equations, and marketing decision rules. These equations represent the actions and reactions of the firm, its competitors, distributive intermediaries, and final customers. In this simplified illustration, all competitors have been aggregated into a single sector. The firm is assumed to sell through wholesalers to final users. It is also assumed that final users are industrial concerns that buy the products as inputs to their own manufacturing processes. Of course,

ILLUSTRATION 3

PLAN*IT's CORSIM Model



(*)Input by the decision maker.

more complex competitive and channel structures can be considered within the CORSIM logic.

Channel Throughput Equation

It can be shown that a product's total factory sales are equal to channel inventory accumulation plus final customer demand. Thus,

$$\begin{aligned} Q^{f,w}_{it} &= \Delta I^{w}_{it} + Q^{w,u}_{it} \\ &= (Q^{f,w}_{it} - Q^{w,u}_{it}) + Q^{w,u}_{it} \qquad (1) \end{aligned}$$

This allows the model to be equivalently expressed in terms of sales or inventory changes at any level in the channel. This flexibility facilitates data collection and allows estimation of channel inventory accumulation/depletion, a variable that is very important in predicting short-term variations in sales potential and in formulating marketing strategies. Furthermore, the throughput equation (1) helps to identify three sources of factory sales: short-term changes in total channel inventory, changes in the firm's share of channel inventory, and the level of final customer demand.

TABLE 1

Glossary of Variables

Marketing Tools		
	A	Promotion dollars spent, including advertising, publicity, and trade shows
	P	Net price (for simplicity, discount structures are not considered here)
	C	Customer service level, days delay in serving orders
	D	Personal selling
Other Variables		
	Q	Sales
	U	Economic demand potential
Superscripts		
	f	Factory
	w	Wholesaler
	u	Final customer or user
	f,w	Factory to wholesaler
	w,u	Wholesaler to user
Subscripts		
	t	Time period
	i	Variables related to the firm
No subscript:		variables related to the aggregate of competitors

Sales Response Equations

The sales response equations describe the effect of marketing effort and economic factors on the flow of goods through the channel. The firm's sales of a brand in a product market are a fraction of market potential determined by the firm's current marketing effort relative to competitors and relative to its own previous effort. With the time subscript deleted for simplicity, that fraction is

$$MS_i^w = \beta_{0i} \cdot \left[\left(\frac{P_i}{P}\right)^{\beta 1i}\left(\frac{A_i}{A}\right)^{\beta 2i}\left(\frac{D_i}{D}\right)^{\beta 3i}\left(\frac{C_i}{C}\right)^{\beta 4i}\right] \cdot \left[\left(\frac{P_i}{P_{i_{-1}}}\right)^{\beta 5i}\left(\frac{A_i}{A_{i_{-1}}}\right)^{\beta 6i}\left(\frac{D_i}{D_{i_{-1}}}\right)^{\beta 7i}\left(\frac{C_i}{C_{i_{-1}}}\right)^{\beta 8i}\right] \quad (2)$$

β_{0i} is the equilibrium market share that would be attained when all ratios are unity.

In a one-product marketing problem the sales equation at wholesale may be expressed as

$$Q_i^w = MS_i^w \cdot U \quad (3)$$

Presumably U would incorporate the effects of competition from related products with which the firm does not compete directly. MS_i^w, of course, incorporates the effects of marketing effort for rivals' directly competing products. Factory sales to wholesalers are made up of two components: wholesalers' sales to final users, and wholesale inventory accumulation or depletion

$$Q_i^{f,w} = Q_i^{w,u} + \Delta I_i^w \quad (4)$$

Factors that lead to inventory change are mainly marketing effort level and change (e.g., a price cut may lead to inventory accumulation) and actual or expected economic changes. A simple expression would be

$$Q_i^f = MS_i^f \cdot Q_i^w \cdot \frac{U}{U_{-1}} \quad (5)$$

In a multiproduct market, sales of one brand k will affect and be affected by the firm's effort for other products and competitors' effort for their brands of those products. Effective demand at the factory level for brand k is equal to expression (5) times adjustments for gains of sales from other brands and losses to those brands. The gains are

$$\prod_{j \neq k}^{N}\left[\left(\frac{MS_{ik}^f}{MS_{ij}^f}\right) \cdot \left(\frac{Q_{ij}^w}{Q_{ik}^w} \cdot \frac{U_j \; U_{k-1}}{U_k \; U_{j-1}}\right)\right]^{\theta_{ikj}^f} \quad (6)$$

θ_{ikj}^f is the degree of gravitation from j to k. Thus if $\theta_{ikj}^f = 0$, nothing will be gained. The losses to other brands are

$$\prod_{j \neq k}^{N}\left[\left(\frac{MS_{ik}^f}{MS_{ij}^f}\right) \cdot \left(\frac{Q_{ij}^w}{Q_{ik}^w} \cdot \frac{U_j \; U_{k-1}}{U_k \; U_{j-1}}\right)\right]^{\theta_{ijk}^f} \quad (7)$$

where θ_{ijk}^f is the degree of gravitation from k to j. Therefore, the factory sales equation becomes

$$Q_{ik}^f = \left(MS_{ik}^f \; Q_{ik}^w \; \frac{U_k}{U_{k-1}}\right)^{[1 + \sum_{j \neq k}^{N}(\theta_{ikj}^f - \theta_{ijk}^f)]} \cdot \prod_{j \neq k}^{N}\left(MS_{ij}^f \; Q_{ij}^w \; \frac{U_j}{U_{j-1}}\right)^{(\theta_{ikj}^f - \theta_{ijk}^f)} \quad (8)$$

It is widely assumed that equations for channel members' and competitors' sales are not estimable because of a lack of data. However, approximate measures of both levels of marketing effort and sales can be obtained if the firm makes a concerted effort to tap internal and external information sources. For example, salesmen may have first-hand knowledge of competitors' typical prices, sales to final customers, rates of sale at the wholesale level, and of how rapidly jobbers and wholesalers are accumulating or depleting inventories. Clearly much of these data are subject to error. However, the problems of measurement are neither new nor unique to marketing research. Similar data problems exist in macroeconomic research, where commonly accepted measures of economic activity are much less than precise (10, 11).

Competitive Decision Rules of Competing Manufacturers and Wholesalers

Modeling the behavior of channel members and competing manufacturers involves the statement of the decision rules that reflect how those entities respond to their own and perhaps others' performance (1, 11, 16). When adaptive rules are used, the results obtained by PLAN*IT's user will depend on the manner in which those entities respond to the user's decisions and to each others'. An example of a decision rule is

$$A^w_{ikt} = A^w_{ikt} \cdot \left(\frac{\theta^w_1 \, P^w_{ik,t-2} \, Q^w_{ik,t-2}}{P^w_{ik,t-1} \, Q^w_{ik,t-1}} \right)^{\theta^w_2} \qquad (9)$$

This rule specifies that current advertising will be increased or decreased to the extent that last period's sales revenue growth objective θ^f_1 was achieved. Equations such as (9) may be estimated by regression analysis or may be specified a priori from marketing intelligence information.

Some doubt the feasibility of specifying decision rules. As with the channel throughput equations, however, the problem is basically one of reconstructing past events and the reasons for them with the aid of salesmen, marketing research reports, and other intelligence information. If parameters such as θ^f_1 and θ^f_2 are not directly estimable, for example, equation (9) can be restated as

$$\frac{A^w_{ikt}}{A^w_{ik,t-1}} = a^w_1 \cdot \left(\frac{P^w_{ik,t-2} \, Q^w_{ik,t-2}}{P^w_{ik,t-1} \, Q^w_{ik,t-1}} \right)^{a^w_2} \qquad (10)$$

Then θ^f_1 and θ^f_2 can be estimated from reconstructed or readily available data on past sales and advertising. The point is that a firm often is unaware of the wealth of information available to it unless it has a direct use for the data. Cases exist in which, at least on a modest scale, such information has been applied systematically to response model building, e.g., (7, 9, 10, 14).

V. PLAN IMPROVEMENT MODEL

PLAN*IT may be applied simply as a deterministic simulation of the cms. The inputs would be macroeconomic and industry demand determinants and the decision maker's subjectively developed strategic marketing plan. The output would be a factory sales forecast which could be compared with company sales goals. In this solution mode, the model would add minimal power to the analysis. Two steps to add power are to include as output, measures of performance such as market share and profit and to provide for sensitivity tests of the effects on the results of unexpected economic or competitive condition changes (i.e., answers to Questions 1 and 2 in Section II). Still more power is added if stochastic features of CORSIM and the variance-covariance properties of exogenous variable forecasts are used to estimate boundaries within which forecast results will lie with a specified confidence level. While PLAN*IT incorporates all of these features, its real value lies in the search capability of the Plan Improvement Model. The model is designed to help the decision maker to work toward improving his initial plan on a more rigorous basis than by intuition and lucky guesses.

One possible way to improve on an initial plan is to replace it with an optimal plan arrived at through optimum-seeking methods. PLAN*IT does not use this method for two reasons. First, decision makers typically do not welcome a manager substitute, partly because the solution ignores hard-to-program considerations. Second, it is extremely difficult to weight and solve for multiple, related, and possibly conflicting goals in a real-world situation. Various parties to corporate-level planning adhere differently to various goals depending upon their organizational responsibilities. Perhaps these roadblocks ultimately can be removed. For the present, changing the management planning process is a higher level challenge beyond the scope of a single simulation modeling project.

In contrast, PLAN*IT helps the decision maker improve a plan only at his initiative and to the degree that he takes advantage of the possibilities offered to him. He can pose two types of questions to PLAN*IT.

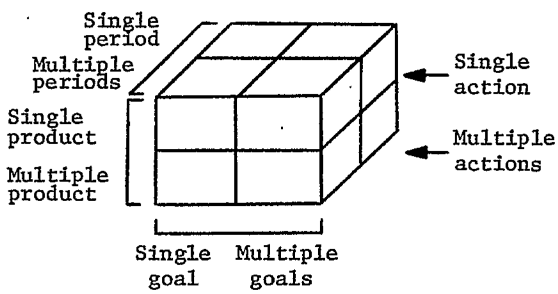
Mode 1: Effects of prespecified changes to a plan. What will happen to performance according to one or more goals if certain changes are made to product or product line plans?

Mode 2: Best ways to improving a plan in a prespecified direction. What are the best k changes that can be made to a plan in order to improve performance on one or more product or product line goals?

Illustration 4 shows combinations of conditions for which either of the two questions can be posed.

ILLUSTRATION 4

Plan Improvement Modes



In order to answer these questions it is necessary to obtain the long-term equilibrium solution of the CORSIM equation system (5, 6). The solution, known as the derived reduced form, expresses the long-term ceteris paribus equilibrium value of all equations as a function of economic conditions and user decisions. These equations are used to compute the improvement elasticities for such goals as profit, profit per unit, market share, and wholesalers' inventory accumulation.

Goal-improvement elasticities with respect to marketing actions, as specified by the various combinations in Illustration 4, can be estimated in either of the two question modes posed above. In Mode 1, the decision maker specifies the elasticities he desires and obtains a listing of their individual effects. For example, he may want to know the profit elasticities of increasing all marketing effort by 5%, 10% and 15% for quarters 1, 4 and 6 of the planning period. Upon seeing the results, he might want to determine product-by-product the 5 or 10 changes in marketing actions which would do most to improve product line profit. PLAN*IT might list, "Increase product j price in quarter 1, decrease product j+1 advertising in quarter 3, . . . " The decision maker then would determine the changes he wished to input and whether he wants a new set of forecast results printed out.

The foregoing illustrations show how goal elasticities can be computed for one goal. Where the decision maker seeks, for example, improvement in one product's performance on one goal with the least damage to its performance on other goals and/or other products' performances, PLAN*IT provides estimates of trade-offs of performance on goals (i.e., goal cross-elasticities). Thus in Mode 2 discussed above, the decision maker can request a ranking of actions according to either elasticities or cross elasticities.

All of these performance and elasticity measures and the new forecasts at each stage in the plan modification phase are based on CORSIM. CORSIM is triggered by a set of economic conditions, the firm's plans, the relevant final equations, and repeated sampling from the joint distribution of disturbances. See (8, 15).

Clearly, exhaustive search of all possible combinations shown in the Illustration 4 is out of the question. Selective search, however, is not. For example, a decision maker could conduct a zeroing-in process. First he could determine whether raising or lowering the overall level of marketing effort for the entire product line over the planning horizon will result in sizeable performance gains. Next he could ask the same question for specific products or for specific quarters. In either or both of these steps he can input into the plan the changes being considered or he can request a list of the best marketing mix changes in some chosen intervals like plus and/or minus 10%, 20%, or 30%. The ranking of the best changes is based either on the improvement on single-goal effects (i.e., goal elasticities) or the ratio of one goal to others (i.e., cross-goal elasticities). Once a fairly satisfactory general effort level has been reached his next step would be to make product-by-product (or product line subset by product line subset) changes until a balanced plan has been reached. At this point he can recylce through the entire process in search of further improvement, go to other phases of PLAN*IT, or exit. The model neither imposes a decision sequence on the decision maker nor dictates how the plan will be changed. Rather, PLAN*IT assists the manager in conducting his own planning process. The authors expect, of course, that using PLAN*IT will increase the manager's analytic sophistication.

VI. THE FIRM'S POLICIES

Normally the firm has implicit or explicit guidelines within which marketing effort and results must remain. The limits may be maximum supportable effort or performance levels which are functions of availability of resources for such things as plant, sales force, or channel expansion. Alternatively the limits may be minimum acceptable levels of performance. In addition, a firm's overall goals may dictate balances among support levels for products or product lines. In any case, a plan that violates such constraints will need strong arguments before it gains top management approval.

PLAN*IT provides, at the decision maker's option, a constraint subroutine which he can call during or after his development of a plan. The mechanical act of matching actions and results with constraints and warning the decision maker when he has violated policy represents only part of the value of this device. The policy constraint check subroutine (NO-NO) also provides a rational means of addressing two sets of issues which the firm's policy structure can raise.

The first issue is that of goal limit consistency and feasibility. Suppose that repeated systematic search via the goal elasticities results in plans that represent reasonable levels of performance on nearly all goals with a fairly high probability of occurrence (e.g., with .9 confidence), but which fail to satisfy some policies. The analysis through PLAN*IT would suggest that the unsatisfied constraints should be questioned and perhaps reset. The second issue is that of assessing the opportunity cost of modifying an attractive plan to fit policy constraints. The decision maker would begin the analysis by inputing a plan he is willing to recommend and receiving the results. Next he would use the PLAN*IT plan improvement model to modify the initial plan until the actions and results were close to the firm's constraints. Finally, after comparing goal performances under the initial, intermediate, and constraint-fitting plans (which will show performance sacrifices required to meet policy constraints), management would decide whether and by how much to modify policy.

IV. CONCLUSION

At the outset, PLAN*IT was described as interactive and on-line. It must be both, if it is to be useful in the marketing decision making system. Marketing decisions often require considerable experimentation and typically must be made quickly.

PLAN*IT also incorporates a flexible structure because the marketing decision system which it represents can operate in a variety of sequences. The model is flexible enough to allow decision makers, each with a slightly different decision making style, to manipulate forecasts and marketing action variables and to receive various outputs in the sequences they desire.

The task of applying simulation in a marketing decision system goes beyond the prerequisite of realistic representation of the system. The model must also be useful, if the sizable cost of building it is to be justified. One aspect of usefulness is bringing substantial analytical power to bear on the manager's decision making problems. Another critical aspect is motivating the manager to use the model. PLAN*IT is designed to be both a powerful and a comfortable tool.

BIBLIOGRAPHY

1. Amstutz, Arnold E., Computer Simulation of Competitive Market Response. The M.I.T. Press, Cambridge, Mass., 1967.
2. Brown, David E., "The Xerox Planning Model," presented at the American Management Association Seminar on Corporate Financial Models. December 1968, New York.
3. Chase Econometric Associates, Inc., Summary of Equations: Short Run Industry Model. Bala Cynwyd, Pa., 1973.
4. ______________, The Chase Econometrics Macroeconomic Model. Bala Cynwyd, Pa., 1973.
5. Christ, Carl F., Econometric Models and Methods. John Wiley, New York, 1966.
6. Cord, Stanton G., and Luis V. Dominguez, "PLAN*IT I: Technical Description," unpublished research paper, Graduate School of Business, Indiana University, Bloomington, Indiana, 1973.
7. Cyert, Richard M., and James G. March, A Behavioral Theory of the Firm. Prentice-Hall, Englewood Cliffs, N.J., 1963.
8. Evans, Michael K., and Lawrence R. Klein, The Wharton Econometric Forecasting Model. Economics Research Unit, Department of Economics, Wharton School of Finance and Commerce, Philadelphia, 1967.
9. Frederick, Donald G., "An Industrial Pricing Decision Using Bayesian Multivariate Analysis," Journal of Marketing Research, Vol. 8, No. 2, 1971, pp. 198-203.
10. Howard, John A. and William M. Morgenroth, "Information Processing Model of Executive Decision," Management Science, Vol. 14, No. 7, 1968, pp. 416-428.
11. Kotler, Philip, "Competitive Strategies for New Product Marketing Over the Product Life Cycle," Management Science, Vol. 12, No. 4, 1965, pp. 104-119.
12. ______________, Marketing Decision Making: A Model Building Approach. Prentice-Hall, Englewood Cliffs, N.J., 1971.
13. Little, John D.C., "A Model of Adaptive Control of Promotional Spending," Operations Research, Vol. 14, No. 6, 1966, pp. 1075-1097.
14. ______________, "Models and Managers: The Concept of a Decision Calculus," Management Science, Vol. 16, No. 8, 1970, pp. 466-485.
15. Naylor, Thomas H., Computer Simulation Experiments with Models of Economic Systems. John Wiley, 1971, New York, Chapter 12.
16. Tuason Roman V., "Experimental Simulation on a Pre-determined Marketing Mix," unpublished doctoral dissertation, Graduate School of Management, Northwestern University, Evanston, Ill., 1965.
17. Urban, Glen L., "A Mathematical Modeling Approach to Product Line Decisions," Journal of Marketing Research, Vol. 6, No. 1, 1969, pp. 40-47.
18. ______________, "A New Product Analysis and Decision Model," Management Science, Vol. 14, No. 8, 1968), pp. 490-517.