Elements of a planning and modeling system

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ABSTRACT

Today there are nearly two thousand corporations in North America and Europe either using, developing, or experimenting with some form of corporate planning model. With the emergence of this new and rather substantial interest in the methodology of corporate planning modeling, there appears to be a definite need for a conceptual framework which can be used to design and implement computer based planning and modeling systems.

In this paper we describe a collection of elements which we believe to be of critical importance in designing a corporate planning model. Our objective is to develop a set of criteria for not only designing a planning and modeling system, but a set of criteria which can also be used to facilitate the evaluation and comparison of alternative planning and modeling systems.

There are nearly 50 planning and modeling software packages on the market today. These include systems such as BUDPLAN, COMOS, and SIMPLAN. This paper attempts to provide the reader with a convenient check-list of possible features to consider in either designing one's own system or selecting an appropriate software package.

INTRODUCTION

A recent survey by Naylor and Schauland confirms the fact that nearly 2,000 corporations in North America and Europe are either using, developing, or experimenting with some form of corporate planning model. For the most part, these models are “what if” simulation models capable of generating alternative futures and scenarios depending on the policy assumptions and external assumptions made by corporate management. Our survey indicated that less than 4 percent of the models in a sample of 346 companies were optimization models. The rest were simulation models.

We believe there are eight basic elements which one must consider in designing a planning and modeling system:

1. Planning System
2. Management Information System
3. Modeling System
4. Forecasting System
5. Econometric Modeling
6. User Orientation of the System
7. System Availability
8. Software System.

PLANNING SYSTEM

The point of departure for any corporate planning model is the planning system itself. That is, the design of the planning system for the organization should be set in place before any consideration is given to the modeling system.

As the most general case let us consider a large, decentralized company consisting of multiple divisions, groups, products, or strategic business units. For simplicity, we shall refer to any such sub-system of an integrated company as a business unit. Each business unit is assumed to be autonomous and is responsible for its own marketing and production activities. Although cash management and overall corporate financial planning are centralized at the corporate level, each business unit is responsible for its own income statement.

At the beginning of the planning cycle, global goals and objectives for the company are specified by top management and interpreted to the business units by the corporate planning department. These corporate goals may take the form of specific target objectives for the company as a whole or for individual business units. Typical target variables may include return on investment (ROI), market share, sales growth, and cash flow, as well as environmental, social, and political objectives.

The corporate planning department designs the report forms to be employed by the business units in
formulating their business plans. Standardized reporting at the business unit level greatly facilitates the consolidation of plans across all business units. However, individual business units are permitted to make their own assumptions concerning marketing and production provided they are explicit about the external assumptions and policy assumptions underlying their business plans. Financial plans at the business unit level follow logically from given assumptions about revenues and costs.

Plans from the business units are transmitted to the corporate planning department for consolidation, review, and evaluation. In the initial stages of the planning process, the business plans will be returned to the business units for modification and reformulation in light of corporate goals. This iterative process will be replicated until all of the business plans have been approved and consolidated into the company's overall corporate plan.

In the following section we shall describe how business planning models can be integrated into the planning process. The integration of planning models into the planning process is perhaps the single most difficult step in the entire process of corporate modeling. Relatively few companies have successfully integrated corporate planning modeling into the planning process. Two notable exceptions are the Wells Fargo Bank and the Central National Bank of Cleveland.

Business planning models

Figure 1 contains a flow chart of a consolidated corporate planning model which is driven by a series of business planning models for the individual businesses of the company. These models may either be used on a stand alone basis at the business unit level or consolidated and used by the corporate planning department, senior financial officers, or the chief executive officer. Each business unit model consists of a front-end financial model driven by a marketing model and a production model.

The objectives of the business unit models are to generate alternative scenarios and business plans based on varying assumptions about business unit policies and assumptions about the external environment of the businesses.

Financial planning models

Each business planning model produces as output data a proforma income statement for the business unit. In cases where the business unit is actually a subsidiary of the parent company, then proforma balance sheets and sources-and-uses of funds statements may be produced as well. Basically, these business financial models can be used to simulate the effects on net profit of alternative business strategies for a given business unit. The validity of the results generated by a business unit financial model will be no better or worse than the assumptions underlying the revenue and production cost projections which feed the model.

Marketing planning models

Marketing planning models provide the revenue projections which drive the business planning models. Two alternatives are available—forecasting models and econometric marketing models. Forecasting models
are naive, mechanistic, time-series techniques which attempt to forecast next month's sales in terms of last month's sales, sales the month before that, and the month before that. Forecasting models are void of explanatory power and cannot be used to simulate the effects of alternative marketing strategies or alternative assumptions about the national economy on sales or market share. Econometric models, on the other hand, can be used to improve one's understanding of the "market" and to simulate the effect on sales volume, sales revenue, and market share of alternative pricing, advertising, and competitive strategies as well as alternative assumptions about the national or regional economy.

Production planning models

Given a sales forecast for a particular business unit, how much will it cost to produce at a level which will satisfy the demand forecast? That is the raison d'etre for production planning models. A number of companies including Monsanto and Inland Steel use a type of activity analysis approach to production planning modeling which generates the cost-of-goods sold associated with a given demand forecast. A reasonable extension of this approach is for the production model to generate the minimum cost production plan associated with a given level of demand for the products of the business unit. This latter alternative represents a logical interface between mathematical programming and other optimization techniques and corporate simulation models.

Consolidated corporate planning models

As we have previously indicated, the individual business planning models may either be used as planning tools for the separate business units, or consolidated at the corporate level to form consolidated corporate plans. The corporate planning department should have the option to perform "what if" experiments with any of the business unit models on either a stand alone basis or as part of a totally integrated planning and modeling system.

The output reports of a consolidated corporate planning model typically include proforma income statements, balance sheets, and sources-and-uses of funds statements. Our survey indicated that of those firms which have some type of corporate planning model the following applications are the most prevalent: (1) cash flow analysis, (2) financial forecasting, (3) profit planning, (4) budgeting, (5) investment analysis, and (6) merger-acquisition analysis.

In summary, a corporate planning and modeling system should have the ability to integrate finance, marketing, and production at the business unit level and the ability to run the business unit models separately or as part of a consolidated corporate financial planning model. Whether the company engages in "top down" or "bottom up" planning is less important than whether or not the planning modeling system can be easily adapted to the planning system. Regardless of the type of planning system, two features are critical—(1) the ease with which financial, marketing, and production models can be integrated and (2) the ease with which financial consolidation can be achieved.

MANAGEMENT INFORMATION SYSTEM

Given a planning system, the next important element in the development of a corporate planning modeling system is the management information system. We shall define the term management information system to include the following elements: (1) database, (2) database management system, (3) security system, (4) report generator, and (5) graphics.

Database

A decision to develop a corporate planning model is tantamount to a serious commitment to the maintenance of comprehensive internal and external databases. Our database requirements become quite explicit once we settle on the design for a corporate planning model.

Internal data

To develop an annual financial planning model we need at least three or four years of historical financial data. We require even more data if the model is a monthly or quarterly model. Econometric marketing models should have 25 to 30 observations of historical data. While most firms have little or no difficulty meeting the data requirements for financial models, data problems are much more severe in the case of marketing and production models.

External data

Most econometric marketing models attempt to link sales volumes and sales revenues to the national or regional economy in which a particular product is sold. A number of service bureaus offer national historical macroeconomic data and econometric forecasts to their clients. These services tend to be quite expensive and the econometric forecasts offered by the bureaus have not been noted for their accuracy in recent years.

An inexpensive alternative to the use of an econometric forecasting service is to subscribe to the historical database of the National Bureau of Economic Research (NBER). The fee for the NBER database is quite nominal and includes over 2,200 economic time-series. In other words, use the NBER data base to specify, estimate, and validate your econometric
models. Then either make your own assumptions about the economy of the United States or subscribe only to the quarterly forecasts of one of the aforementioned econometric service bureaus. It is possible to purchase the forecasts for considerably less than a "full service" contract from one of these bureaus. The NBER database is available through most timesharing bureaus and can also be installed on the user's in-house computer.

**Database management system**

Not only should a planning and modeling system have databases, but it should also have a flexible, easy-to-use database management system for reading data into the system, storing it, and making it readily available for modeling and report generator. At last three different approaches to database management have emerged among the numerous planning and modeling software systems which are currently available—(1) matrix, (2) row-column, and (3) record-file.

**Matrix**

PSG II, a FORTRAN based planning system as well as several APL based planning and modeling systems use matrices to read data into the system. Both database management and modeling functions are carried out using matrix manipulations. If the user is a scientific programmer, matrix manipulations should cause no problems. However, many corporate planners and financial analysts are neither mathematicians nor scientific programmers and may find matrix manipulations difficult, if not impossible to use.

**Row-column**

Other planning and modeling systems such as FORESIGHT make use of row numbers and column numbers to create databases, formulate models, and generate reports. While the row-column number approach may have some appeal to accountants who are accustomed to working with financial spreadsheets, the user must keep track of the row and column numbers. Furthermore, econometric and production data do not necessarily lend themselves to this restricted notation.

**Record-file**

Other planning and modeling systems like SIMPLAN make use of records as the basic unit of data. A record is a time series variable such as SALES, COST, or PROFIT. A record has a name, an abbreviation, a value, units, and a security level which determines who has access to which SIMPLAN records. A record-file is a collection of SIMPLAN records. Each business unit may have one or more SIMPLAN files. For example, for a given business one file may contain actual historical data. Another file may contain budgeted, projected, or simulated series. Variance reports and validation runs are particularly easy to implement with the multiple file concept.

**Security system**

There should also be some means of controlling who has access to which files, records, models, and reports within the planning and modeling system. Division managers should be able to access their own databases, models, and reports, but not those of other divisions or the entire corporation. Corporate management should, on the other hand, be able to access the corporate database as well as all division databases, models, and reports. A built-in security system makes all of this possible.

**Report generator**

The front-end of any planning system is a set of financial reports. Therefore, it follows that a report generator should be an integral part of any planning and modeling system. Basically, management should be able to have any type of report format it desires. That is, the report generator should not impose any restrictions on the type of report which is produced by the system.

The report generator should be flexible and easy-to-use. Some report generators are so easy-to-use that typists with no previous programming experience can be taught to produce financial reports with little or no effort.

Of the 50 planning and modeling software packages available today, over two-thirds of them are primarily report generators. That is, they can produce financial reports and do financial consolidations, but have very limited database management, modeling, and econometric features. PROPHIT II, FAL, FORESIGHT, and INFOTAB are examples of financial report generators. Although financial report generation and financial consolidations are important elements in a planning and modeling system, there are other important elements to consider. Unfortunately, a number of users of systems which are primarily report generators have found themselves locked into expensive outside timesharing charges only to realize, when it is too late, that they need additional database management, modeling, econometric, and forecasting features which are not available in their financial report generator. Although simple financial modeling and report generation are ideal starting points for those who are just beginning to develop a planning and modeling system, beware of dead-end systems which can only do report
generation and are not available for installation on your in-house computer.

In summary, in selecting a report generator, make sure that the planning and modeling system of which it is a part has the flexibility and features which you will need in the future as well as the present.

Graphics

An increasing number of planning and modeling software packages now offer graphics as an alternative way of displaying output data and corporate plans. The graphical display of sales, cost, and profit trends can be an effective way to present planning data to top management.

MODELING SYSTEM

Given the discrete nature of business planning data, virtually all corporate planning models take the form of finite difference equations. In this section we shall describe five modeling features which the user may want to include in a planning modeling system: (1) recursive models, (2) simultaneous models, (3) logical models, (4) risk analysis, and (5) optimization.

Recursive modeling

Most of the financial planning models which have been developed to date are recursive or causally ordered models. That is by placing the equations of the model in the proper order it is possible to solve each equation one at a time by substituting the solution values of previous equations into the right-hand side of each equation. Recursive models have the computational advantage that you do not have to resort to matrix inversion or some other simultaneous equation technique to solve the system of equations. Below is an example of a recursive financial model.

1 SALES = A - B * PRICE
2 REVENUE = PRICE * SALES
3 CGS = .60 * REVENUE
4 PBT = REVENUE - CGS
5 TAX = .50 * PBT
6 NPR = PBT - TAX

In this example, the selling PRICE is given. A and B are parameters and

SALES = Sales volume (units)
REVENUE = Sales revenue
CGS = Cost of goods sold
PBT = Profit before taxes
TAX = Taxes
NPR = Net profit

But in many financial models it is impossible to express the logic of the model as a series of recursive, causally ordered equations. It is for this reason that a corporate modeling system should include the capability to solve simultaneous equation models as well as recursive models.

Simultaneous models

Consider the following five-equation financial model.

1 INT = .12 * Debt
2 PROFIT = REVENUE - CGS - INT - TAX
3 DEBT = DEBT (-1) + NDEBT
4 CASH = CASH (-1) + PROFIT + NDEBT
5 NDEBT = MBAL - CASH

Profit (PROFIT) in Equation 2 is defined as sales revenue (REVENUE) less cost of goods sold (CGS), interest (INT), and taxes (TAX). But INT depends on total indebtedness (DEBT) in Equation 1. From the balance sheet total debt in Equation 3 for this period is equal to last period's debt DEBT (-1) plus new debt (NDEBT). New debt is defined in Equation 5 as the difference between the cash balance (CASH) and the firm's minimum required cash balance (MBAL). CASH in Equation 4 is the sum of last period's CASH, PROFIT, and NDEBT.

Although this model is quite simple it is, nevertheless, a simultaneous equation model. It is impossible to solve the model recursively merely by placing the equations in the correct order. Solution of this model requires the use of a technique capable of solving simultaneous equations. This model may either be solved through matrix inversion techniques or some other generalized technique such as the Gauss-Seidel method which is suitable for both linear and nonlinear simultaneous equation models.

As you can see from our example model, it is indeed quite likely that we will encounter simultaneity even in quite simple financial models. Very few of the financial modeling software packages have the ability to solve simultaneous systems of equations. CUFFS, SIMPLAN, and XSIM are exceptions to this rule. SIMPLAN and XSIM can handle linear and nonlinear simultaneous equation models. CUFFS can solve linear models.

Simultaneous equation problems can also arise in econometric marketing models where two or more products are either complements or substitutes. Many banks have developed a special type of financial planning model known as an asset-liability model. Most of these models have been formulated as recursive models. Yet logically this is totally absurd, for the very nature of a bank's assets and liabilities is a simultaneous jointly determined structure. For example, demand deposits and time deposits are substitutes and both are likely to be correlated with various loan demand equations. Loan demand depends on interest rates and interest rates depend on the supply and demand for loans. Consumer loans and mortgage
loans may be substitutes for one another. To attempt to model the asset-liability structure of a bank with a recursive model makes little or no sense. It is not surprising to find that a number of banks have encountered serious difficulties in attempting to validate recursive, bank planning models. The financial structure of a bank is simply not recursive.

Logical models

The ability to check whether or not cash balances or inventory levels have dropped below some predetermined minimum level is another important element of a planning modeling system. Logical commands such as an IF statement or a GO TO command are desirable features for a planning modeling system.

Risk analysis

A strong case can be made for treating some of the external variables in a corporate planning model as random or probabilistic variables with given hypothetical or empirical probability distributions. This type of analysis is known as risk analysis. Risk analysis is useful in testing the sensitivity of the planning model to random shocks and perturbations, constructing confidence intervals, and testing hypotheses. But our survey of 346 corporations indicates that of those firms which have some form of corporate planning model, only 6 percent make use of risk analysis.

There are two major reasons why risk analysis has been used so seldom with planning models. First, use of risk analysis with corporate planning models is prohibitively expensive. Plan on multiplying your computer bill for the deterministic version of your model by a factor of 100 if you use risk analysis. Second, risk analysis is difficult to explain and interpret to management.

Some analysts use a type of pseudo-risk analysis in which they experiment with "optimistic," "pessimistic," "most likely" values of external variables rather than treating them as random variables.

Optimization

As we have previously indicated, only 4 percent of the users of corporate planning models identified in our survey were found to be using their models as optimization models. Those firms which do not use optimization techniques in conjunction with corporate planning models tend to use them for production planning rather than as global optimization models for an entire business or the corporation as a whole.

Although optimization models are widely used in certain process industries such as oil refineries, rarely are these production scheduling models integrated into a corporate planning model. Virtually every major oil refinery in the world uses mathematical programming to schedule its operations. At this point in time we are not aware of a single oil company which has a linear programming model linked to a corporate planning model.

The difficulty with using optimization techniques to develop optimal plans for a corporation as a whole is a problem of problem definition. Although top management is indeed interested in profits, ROI, discounted cash flow or some equivalent measure of performance, these are by no means the only measures of effectiveness which management uses to evaluate corporate plans. Output of corporate planning models is a vector not a single variable. If the company wants to survive, management must necessarily monitor a whole host of output variables—profit, ROI, market share, sales growth, cash flow, as well as all of the line items of the income statement and balance sheet.

Faced with a multiple output planning problem, optimization techniques which optimize with respect to a single output variable are of limited use to corporate planners. The use of goal programming and utility theory have been suggested as means of quantifying trade-offs among conflicting corporate objectives. The track records of these two techniques as corporate planning tools are not impressive.

Although the energy crisis, shortages of a variety of production inputs, and inflation may cause more firms to utilize optimization techniques for production planning modeling, we do not foresee significant usage of these techniques as global optimization techniques for overall corporate planning. However, we do expect them to be used more often as production planning tools at the business unit level and integrated into business financial models.

Very few of the existing planning and modeling languages have mathematical programming routines incorporated into their structures. COMOS, the planning and modeling system developed by CIBA-GEIGY, does have this feature. Some planning and modeling systems have the ability to interface and exchange files with mathematical programming packages.

FORECASTING SYSTEM

The ability to generate short term forecasts not only for market planning models but for any external variable which appears to have a reasonably stable relationship with respect to time is another important element to be considered for inclusion in a planning modeling system. A variety of short term, "naive," forecasting tools are available ranging from simple time trends to the Box-Jenkins technique in terms of degree of complexity. Although short-term forecasting models have a definite role to play in corporate modeling, they have little or no explanatory power and cannot be used for "what if" analysis.
**Time trends**

Probably the most straightforward forecasting models are simple linear, quadratic, exponential, or logarithmic time trends which express sales volume, for example, as a function of time only. The parameters are estimated by ordinary least squares techniques.

**Exponential smoothing**

Exponential smoothing techniques consist of a set of weighting schemes which assign greater weight to more recent historical observations than those from the more distant past. Again the rationale is the same. To forecast the future all one needs to know is the correct relationship between past sales and future sales. The problem of exponential smoothing is one of selecting the approximate weighting scheme.

**Adaptive forecasting**

Adaptive forecasting models are a collection of techniques which have the ability to “self correct” if the forecast is not tracking the actual behavior of the system. Adaptive forecasting techniques are much easier to use than Box-Jenkins techniques and have been known to perform equally well.

**Box-Jenkins**

Box-Jenkins techniques are the most powerful, most sophisticated, and most difficult to use forecasting techniques available. They are not techniques for amateurs. In fact, the user will probably need a mathematical statistician to hold his hand while using these complex procedures. Through a set of “transfer functions” it is possible to link Box-Jenkins forecasts to a set of external leading indicators.

**ECONOMETRIC MODELING SYSTEM**

If the user wants to do computer simulation experiments simulating the effects on sales volume or market share of alternative pricing, advertising, and competitive strategies, then econometric models are the appropriate analytical tools. Econometric models can also be used to link market forecasts to the national and regional economies. Finally, our understanding of the market behavior of specific products or groups of products can be considerably enhanced through the use of econometric marketing models. But the forecasting accuracy of any econometric marketing model is no better than the accuracy of the policy assumptions and assumptions about the firm’s external environment which underlie the model.

**Methodology**

Econometric modeling involves a four-step methodology which will be summarized below. These steps include: (1) model specification, (2) parameter estimation, (3) validation, and (4) policy simulation. Given the present state of development of computer software, it is now possible to implement all four of these steps within the planning modeling system without having to go out of the system to FORTRAN, PL/I, or some other type of subroutines. SIMPLAN and XSIM are among the very few modeling systems which have a fully integrated econometric modeling capability.

**Specification**

Unfortunately, most econometrics textbooks are concerned only with the question of “Given an econometric model, how do we estimate the parameters of the model?” In other words, the entire question of model specification has been assumed away by most textbooks and university courses on econometrics.

The specification of econometric marketing models requires: (1) considerable knowledge of the market of the product or group of products being modeled, (2) familiarity with econometric and statistical methods, and (3) some knowledge of microeconomics and the theory of markets.

If multiple product econometric models are to be developed, we recommend the use of a well designed questionnaire to be used by analysts in extracting relevant market information from product managers. Such a questionnaire can greatly reduce the amount of interaction time between analysts and product managers.

**Estimation**

Single-equation econometric models can be estimated using ordinary least-squares (OLS) regression techniques. Simultaneous-equation models require the use of techniques like two-stage least-squares (TSLS) or other simultaneous-equation estimators. The application of OLS to simultaneous-equation models may yield biased, inconsistent estimates. Most of the planning and modeling software packages include OLS, but very few of them offer TSLS or other simultaneous equation estimators.

**Validation**

The ultimate test of the validity of an econometric model is how well it forecasts the actual behavior of the system it was designed to emulate. This implies solving the model each period for the output variables in terms of given policy variables and external variables as well as lagged values of the output variables gen-
erated by the model in preceding time periods. In other words, the model is viewed as a closed loop dynamic system which is driven by a set of starting values for the lagged output variables and given values for the policy and external variables.

Since econometric models may either be linear or nonlinear and either recursive or simultaneous, some technique like the Gauss-Seidel method is needed to solve the simultaneous equation models. Ideally, simple one-word commands like SOLVE and VALIDATE can be used to solve and validate econometric models. It is also desirable to produce a comparison of simulated and actual values and perhaps compute mean percent absolute errors for each output variable.

**Simulation**

Finally, once we have specified, estimated, and validated an econometric model which we feel we can live with, we are then ready to conduct policy simulations with the model. We simply change the policy variables and external variables and solve for the output variables. Again we need a technique like the Gauss-Seidel method to solve the simultaneous equations.

**Integrated models**

Although estimation, validation, and policy simulation are, in fact, three separate computer programs, it is possible to integrate each of these steps into a single system so that the user can move easily from one step to another. Commands like ESTIMATE and TLS can be used to estimate the parameters with ordinary least-squares and two-stage least-square respectively. In addition, a set of test statistics for each equation will also be produced—R$^2$, t-statistic, F-statistic, standard errors, Durbin-Watson statistics, etc. VALIDATE and SOLVE commands generate the time paths of the output variables for validation purposes and policy simulation.

Some systems also contain a SAVE command which enables the user to save the structural specification and parameter estimates of an econometric marketing model and pass them on to a financial model without ever leaving the system. With this feature, it is quite easy to integrate financial, marketing, and production models. No longer is it necessary to develop econometric models on one system and then re-code them for use on a different system if one wants to use the econometric results for planning. Econometric modeling as well as forecasting modeling can now be fully integrated into the planning modeling system.

**National and regional economic models**

It is also possible to link national econometric models and economic databases directly to a planning and modeling system. For example, Monsanto and Dresser Industries each have the Wharton Econometric Forecasting Model installed on their in-house computer and linked to their business planning models. Hundreds of firms use modeling systems which are linked to the NBER economic database on several timesharing service bureaus.

**USER ORIENTATION OF THE SYSTEM**

Up to this point we have described a number of basic elements which we believe to be worthy of serious consideration in the design of a planning and modeling system. Various subsets of each of these elements are available in the form of special purpose computer software packages. For example, RAMIS, NOMAD, TOTAL, and INS are all excellent database management systems. FAL, INFOTAB, PROPHIT II, PDS II, and FORESIGHT are all financial report generators. ESP, TSP, ECON, and SPX are econometric and statistical estimation packages. Many of these software packages are quite well suited for special purpose functional applications.

But if our objective is comprehensive corporate planning and modeling then we are likely to require (1) a database management system, (2) a security system, (3) a report generator, (4) a simulation modeling system, (5) a forecasting system, and (6) an econometric modeling system. And, furthermore, it would be extremely convenient to have all of these features linked together as subsystems of a truly integrated planning and modeling system.

**Ease of use**

It is one thing to advocate an integrated planning and modeling system consisting of the six subsystems described in the preceding paragraph, but what if the resulting system is an extremely cumbersome, difficult-to-use system which requires the user to be a senior programmer or computer scientist? Fortunately, recent breakthroughs in computer science and corporate modeling techniques have made it possible to design and implement an easy-to-use planning and modeling system which includes all six of the subsystems described in this paper. More will be said concerning the ease of use of planning modeling systems, when we discuss computer software systems.

**User specified subroutines**

Although we have advocated a planning and modeling system which contains a substantial number of powerful built-in functions and subroutines, we recognize the impossibility of building a system which is all things to all people. There will always be a user who wants some special subroutine to satisfy his own
unique needs. With this thought in mind, an integrated planning and modeling system should be sufficiently open ended to permit the user to write his own sub-

routines in, for example, FORTRAN or PL/1. With

this feature, the user never gets locked into a particu-

lar system.

SYSTEM AVAILABILITY

Corporate planning modeling systems may either be run interactively or in batch either on the user's in-

house computer or on an outside service bureau. Al-

though computer service bureaus, particularly time-

sharing bureaus, may provide a convenient vehicle for

the development and testing of individual business

unit planning models, putting an integrated compre-

hensive total corporate planning model and database

up on an outside service bureau is likely to be pro-

hibitively expensive. The disk charges for the cor-

porate databases alone will be enormous. Over the long

run, we believe that most of the really serious cor-

porate planning and modeling systems for large compa-

nies will be implemented on in-house computers rather

than on an outside bureau. However, smaller firms

which are equivalent to single business units in our

Figure 1 flow chart, will still find service bureaus to be

the most cost effective alternative for doing financial

planning and modeling.

Interactive

All things being equal, it is difficult to argue against

the merits of interactive computing for corporate

planning and modeling. The benefits of conversational

computing to planning are obvious and well docu-

mented in the literature. But interactive computing

can be quite expensive even on in-house computers, if

one considers the opportunity cost of alternative uses

of computer central processing units. Therefore, we

recommend interactive computing during the model

debugging stage and when the timeliness of alternative

plans and scenarios justifies the premium charges for

interactive computing.

Batch

Batch computing is more appropriate for creating

large historical databases and doing multi-scenario

production runs where the user is not faced with an

urgent deadline to make a decision.

SOFTWARE SYSTEM

What about the task of programming a corporate

planning and modeling system? Basically, two al-

ternatives are available. The system can either be

programmed in a general purpose scientific language

like FORTRAN, PL/1, or APL or it can be coded in a

planning and modeling language like BUDPLAN,

COMOS, or SIMPLAN.

There are at least two major benefits associated

with the use of one of the scientific programming

languages. First, they are extremely flexible. That is,

every feature which we have proposed for a planning

and modeling system could be coded in FORTRAN,

PL/1, or APL. Indeed, our survey showed that 50 per-

cent of the corporate models in our sample had been

written in FORTRAN. Second, these languages are

quite well-known, particularly FORTRAN.

But there are some very serious limitations to the

use of scientific programming languages for corporate

planning models. First, corporate planners and finan-
cial analysts may not be familiar with any of these

languages since they may not have previous computing

experience. Second, database management and report

generation are not the main strengths of FORTRAN

and APL. (PL/1 admittedly has some features which

facilitate file manipulation and report generation.)

Third, these languages offer little assistance in either

formulating or coding corporate planning models, since

they are general purpose scientific languages. Fourth,

it is the rule rather than the exception for top man-

gement to make frequent changes in their require-
mements in terms of report formats, policy assumptions,

external assumptions, types of consolidations, etc.

Mergers and acquisitions occur, new products are in-
troduced, and old products are dropped. These types

of changes are not easy to implement with scientific

programming languages. A major reason for the de-
mise of most of the large-scale models developed in

the 1960's was their lack of flexibility. Without excep-
tion, the Sun Oil, Xerox, and New York Times models,
as well as several others, were all written in FORTR-

AN. When Sun Oil merged with another oil

company, the model was dropped rather than re-pro-

gramming it in FORTRAN. Fifth, even if the model

builders are accomplished programmers, econometric

modeling is very difficult with scientific programming

languages.

Some have suggested that APL will be the wave of

the future for corporate modeling. Although APL is

by far the most powerful scientific language available
today, it has some unique disadvantages which are

likely to render null and void the fantasy of corporate

managers sitting at their APL terminals doing cor-

porate planning. First, APL assumes the user is pro-
centric at mathematics including matrix algebra. This

assumption simply does not hold up in the real world.

Very few managers have ever been exposed to matrix

algebra. Second, the special characters and mathe-
matical operators of APL are likely to be foreign to

most managers, financial analysts, and corporate plan-
ers. In summary, APL is a fantastic language for

computer scientists and mathematicians, but its utility

as a corporate planning tool is severely limited.
The alternative to scientific programming languages is to use one of the new planning and modeling languages designed specifically to facilitate the formulation and coding of corporate planning models. Among the benefits to be derived from using one of these planning and modeling systems are the following. First, they are easy to use. To do financial modeling with a system like SIMPLAN, the user must be familiar with high school algebra, accounting, and finance. The user need not be familiar with modeling or computer programming. Second, some of these systems provide a conceptual framework for planning and modeling which makes it much easier to develop the model in the first place. Third, with a select few of these systems, it is possible to have all six of the following subsystems integrated within the planning and modeling system: (1) database management, (2) security, (3) report generation, (4) simulation modeling, (5) forecasting, and (6) econometrics. Fourth, many of these planning and modeling systems are quite flexible. Changes in databases, models, and reports are easy to implement. Fifth, even if the model builders are senior programmers, econometrics, forecasting, and risk analysis are much easier to implement with one of these systems than with a scientific language.

Of course, the advantages of these planning and modeling software systems must be weighed against their costs. First, these systems are not available free of charge to the user. That is, the user must pay a fee for the use of one of these planning and modeling systems. A limited number of these systems can be licensed for use on in-house computers. These include BUDPLAN, FORESIGHT, FP-70, PSG II, and SIMPLAN. Nearly all of these systems are available on a surcharge basis on various timesharing service bureaus. Second, since the computer is doing the work of many programmers, the computer running costs will definitely be higher than say similar models programmed in FORTRAN, but the human costs should be considerably less.

SUMMARY AND CONCLUSIONS
With nearly 2,000 companies now experimenting with some form of planning model, it is not surprising to observe that many of these companies began using a particular modeling system without giving much thought to the long-run implications of the system which was selected. It is not uncommon to find one division of a company using FAL, another using PROPHIT II, and a third using a FORTRAN model running on yet a different service bureau's computer. At the same time, the corporation maintains a corporate database as well as databases for each division on the in-house computer. Corporate planning may also subscribe to one or more outside econometric forecasting services.

In other words, it is not unusual to find large companies subscribing to as many as six different modeling services with exact duplicates of the corporate database running on the in-house computer as well as on outside service bureaus.

With a little thought and careful planning, it is possible to design an integrated planning and modeling system which will satisfy corporate management as well as the management of all of the business units. Financial, marketing, and production planning models can all be developed within one system which is linked to a national econometric database. And, finally, the system can be implemented on the company's in-house computer thus eliminating outside timesharing charges and the costly duplication of databases.

In summary, time spent on the design of a company's planning and modeling system may be time well-spent.