SIMPLAN: MOVING SIMULATION INTO THE BOARD ROOM

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INTRODUCTION

In many organizations, a primary obstacle to the productive use of simulation techniques is the difficulty in communicating the nature of the underlying process to a programmer or analyst. Often, only one or two people understand the organization's simulation requirements for a particular project, and these people seldom have sufficient expertise in data processing areas to implement the desired modeling system.

If the model could be constructed directly by the people who are to be the end users of its output, more satisfactory and accurate results can almost always be obtained. One method of accomplishing this is through a modeling language which can be learned quickly and easily by people with no prior computer background.

Many planning and modeling groups have succeeded in this type of endeavor by using SIMPLAN as a vehicle for their model building. SIMPLAN is a general-purpose planning, budgeting, forecasting, and modeling system which has seen considerable use in many types of simulation projects over the last four years. A number of SIMPLAN users are highly-placed corporate executives -- in many cases, the same executives who initially requested that a simulation model be built. In one particular case, an on-line simulation model developed with SIMPLAN is used to respond to a wide variety of "What if...?" questions during board meetings by allowing the board members to quickly and easily change the underlying assumptions and see the revised results within minutes.

By "moving simulation into the board room," a number of significant benefits are realized:

> Since the model is built by people who are experts in the area being modeled, development time is reduced and accuracy is enhanced.
>
> Since high-level executives can look at and understand the relationships expressed in the model, they have a much higher level of confidence in the simulation's results.
>
> Project funding, resource allocation, and user satisfaction are all improved due to significant direct involvement in the project by the end user.
>
> Programmers and analysts are available to do jobs which truly require their particular expertise, rather than having to spend time trying to interpret requirements for the simulation user.

The primary purpose of this paper is to illustrate those aspects of SIMPLAN which allow it to perform this function, and to examine the types of simulation projects which are most likely to be enhanced through executive involvement.

MODEL-BUILDING WITH SIMPLAN

The first step in building a model is to create a database containing the input (exogenous) variables used by the model. This is simplified for the user by SIMPLAN's data management facilities. For example, if a user wishes to add the following data to his SIMPLAN database,

Item	1974	1975
Accounts Receivable	$1,170.25	$1,292.08
Accounts Payable	$690.47	$720.25

he does so by entering the following SIMPLAN commands:

```
create accounts-receivable=ar
1974=1170.25 1292.08
```

```
create accounts-payable=ap
1974=690.47 720.25
```

These commands create two new records in the user's SIMPLAN database named "Accounts Receivable" and "Accounts Payable." For convenience in referring to these records, they have been assigned the abbreviations AR and AP, respectively. Each record contains time series data for the years 1974 and 1975. These series will remain stored in the database until the user requests SIMPLAN to remove them.

Once all of the input data are stored, the next step is to create the desired model. There are two primary types of equations which are used in financial simulation models: definitional equations and behavioral equations. A definitional equation expresses an identity, such as, "Profits are defined as the difference between revenues and expenses." In SIMPLAN, this is expressed as

```
PROFITS=REVENUES-EXPENSES
```

where PROFITS, REVENUES, and EXPENSES are records in the SIMPLAN database. Policy statements, such as "We will maintain our inventory at a level equal to 25% of our projected sales," are also definitional in nature.

A behavioral equation is one which expresses the predicted behavior of a series. This prediction may take the form of a trend forecast or an econometric relationship. A simple trend assumption would be that sales will continue to grow at the same rate as they have in the past. This is a logarithmic trend, since a constant rate of growth is assumed. A large number of alternative types of trends may be assumed, depending on the appearance of the historical data. An econometric equation, on the other hand, attempts to explain the behavior of a variable in terms of other variables, such as "Sales volume is positively influenced by increases in disposable income and negatively influenced by increases in retail price."

In SIMPLAN, a behavioral equation is generated automatically by a variety of available statistical techniques. The user need only specify the type of equation he assumes to be most valid and, in the case of an econometric equation, the variables which he believes influence the behavior of the variable being predicted. For example, the SIMPLAN command

```
tlog sales
```

(where "tlog" stands for "trend, logarithmic") causes the following actions to take place automatically:

The time series containing historical sales data is retrieved from the database.

A logarithmic trend is fitted to the existing historical data.

The equation for this trend is printed.

A number of test statistics are printed to help the user decide whether a logarithmic trend is appropriate in this case.

Forecasts are printed for subsequent years.

If, after examining the test statistics and forecast values, the user decides to incorporate this equation into his model, which in this case is named "Sales-Forecasting-Model," he simply enters the command

```
store sales-forecasting-model.
```

To estimate the coefficients of an econometric equation of the form

```
SALES=a*INCOME+b*PRICE+c
```

the user enters the command

```
estimate sales income price
```

Just as in the trend example, SIMPLAN automatically retrieves all necessary data from the database, estimates the three coefficients, and prints the estimated equation and test statistics. If the equation appears to be satisfactory, the user may incorporate it into his model by using the "store" command.

For users whose data require extensive econometric analysis, SIMPLAN also offers two-stage least squares regression, autocorrelation adjustment and analysis facilities, distributed lags, and other statistical techniques. These tools can be used in combination with each other to analyze even the most complex interrelationships among the data.

To summarize the model-building process, definitional equations are entered directly by the user, while behavioral equations are automatically generated by one of the statistical techniques available in SIMPLAN (with the exception of the case in which behavioral equations are generated from knowledge of the system or managerial opinion, such as, "I believe that the prime interest rate will rise by 0.25% next year.").

The following model was built as a simple prototype for a hypothetical television manufacturer. It begins with a market forecast, followed by production and financial segments. Finally, additional line items are calculated for use in the income statement and balance sheet.

```
 10 B@WSALES=.02669*ADVERTISING+.0054*INCOME-
 11  -.4989*COLORSALES-.12095*B@WPRICE-7.36103
 20 COLORSALES=.02369*ADVERTISING+.013*INCOME-
 21  -.22825*B@WSALES-.13336*COLORPRICE+11.209
 30 SALES$=COLORPRICE*COLORSALES-
 31         +B@WPRICE*B@WSALES
 40 COST#OF#GOODS=.6*SALES$
 50 OTHER#EXPENSES=.1*SALES$
 60 INTEREST=SHORTRATE*SHORTDEBT-
 61           +LONGRATE*LONGDEBT
 70 TOT#EXPENSE=COST#OF#GOODS+ADVERTISING-
 71              +OTHER#EXPENSES+INTEREST
 80 PROFIT#BEF#TAX=SALES$-TOT#EXPENSE
 90 IF PROFIT#BEF#TAX 4500
100   TAX=.4*PROFIT#BEF#TAX
110   ELSE
120   TAX=.5*PROFIT#BEF#TAX
130   END
140 NET#INCOME=PROFIT#BEF#TAX-TAX
150 DIVIDENDS=DIV#PER#SHARE*SHARES
160 RET#EARNINGS=NET#INCOME-DIVIDENDS
170 CASH=TOT#LIAB-ACCTSREC-INVENTORY-PLANT-
171      -OTHER#ASSETS
180 IF CASH MINIMUM
190   BORROW=1.33*(MINIMUM-CASH)
200   ELSE
210   BORROW=0
220   END
230 SHORTDEBT=SHORTDEBT(-1)+BORROW
240 ACCTSREC=.1*SALES$
250 INVENTORY=.2*SALES$
260 CURR#ASSETS=CASH+ACCTSREC+INVENTORY
270 PLANT=.95*PLANT(-1)
280 OTHER#ASSETS=OTHER#ASSETS(-1)+40
290 TOT#ASSETS=CURR#ASSETS+PLANT+OTHER#ASSETS
300 ACCTSPAY=.06*COST#OF#GOODS
310 TAX#RESERVE=TAX
320 MISC#ACCRUALS=1.25*MISC#ACCRUALS(-1)
330 CURR#LIAB=ACCTSPAY+SHORTDEBT+TAX#RESERVE-
331           +MISC#ACCRUALS+LONGREPAY
340 LONGDEBT=LONGDEBT(-1)+NEWDEBT-LONGREPAY
350 STOCK$=NOMINAL*SHARES
360 EARN#SURPLUS=EARN#SURPLUS(-1)+RET#EARNINGS
370 TOT#LIAB=CURR#LIAB+LONGDEBT+STOCK$-
371          +EARN#SURPLUS
380 EARN#PER#SHARE=NET#INCOME/SHARES
390 CURRENT#RATIO=CURR#ASSETS/CURR#LIAB
400 PROF#SALES#RATIO=NET#INCOME/SALES$
```

One advantage of using this type of corporate model is that it can be understood by people who were not involved in its construction, even if they do not have any formal SIMPLAN training. This makes it much easier for management to have a high level of confidence in the model. The simplicity of the model-building process also makes it feasible to construct smaller models to address individual problems, rather than attempting to produce "the corporate model." This enhances a project's chance of receiving management approval.

It should be noted that the preceding model must be solved simultaneously, due to the interdependence between lines 10-11 and 20-21. This can be done automatically with SIMPLAN.

OTHER ASPECTS OF SIMULATION WITH SIMPLAN

Flexibility, power, and efficiency in model-building are undoubtedly the most important criteria for determining whether any modeling language can fulfill an organization's simulation needs; however, many projects have either failed or never been started due to a number of other management concerns which SIMPLAN is designed to address.

Reporting

A model is much more readily accepted when it is capable of presenting its results in a format with which top management is already familiar. All model results produced by SIMPLAN can be automatically stored in a SIMPLAN database, from which they can be accessed by the SIMPLAN report generator. This is a powerful facility which is capable of exactly duplicating virtually any report currently in use within the organization. This means that the executives who want to examine and use the simulation results need not go through any training or orientation processes in order to decipher an unfamiliar print-out. This is a very important aspect of getting high-level executives actively involved in simulation and modeling. In addition, since a SIMPLAN report definition is even more straightforward than a model, the user can immediately make any modifications he might want in his report format, rather than accepting a suboptimal result because of time pressure on the programming staff or secretarial pool. Since the reports are completely independent of the models, the user has total control over the amount and type of printed output he receives.

Security

Many executives are hesitant to approve a simulation project due to the sensitive nature of much of the data needed for an effective model. Most modeling languages offer the user one of the following choices:

Leave all of the data totally unprotected.

Totally protect all of the data.

Rely on the security features provided by the operating system or time-sharing bureau.

The first option, leaving all of the data unprotected, is clearly unacceptable for a large number of projects. The second option, protecting all of the data, is not much better, since each person who needs access to any part of the data is given total freedom to do what he will with any of the data. The third option, relying on security features outside of the language, has all of the problems inherent in the previous scheme and, in addition, removes the responsibility for security control from the modeling group. Clearly, in the absence of a better security control facility, many otherwise quite valuable modeling projects will not be approved by management.

SIMPLAN provides a powerful and versatile security control facility which is directly controllable by the modeling project leader. Certain sensitive data, such as salaries or future pricing plans, can be restricted to only a few selected users. Public data, such as Gross National Product forecasts, can be made accessible to all. Other data may be stored at a level somewhere between these two extremes.

SIMPLAN security can also be used to control access across divisional lines. A division manager may be given total access to all data pertinent to his division, but be restricted from the same items in other divisions. Alternatively, a user may be allowed to print and use certain data without being able to modify it. This is very useful for items such as "official" forecasts or budget figures.

Even in organizations where security is not a predominant concern, the data protection facilities in SIMPLAN can prove very valuable. These same facilities can prevent a user from inadvertently destroying the master copies of his data. Many projects have been delayed significantly due to the unintentional erasure of critical data.

SIMPLAN also provides security control for models and reports, so that only certain users may be allowed to print sensitive reports or run restricted models. Further, a user may be allowed to solve a model without being able to modify or examine its contents.

In summary, management tends to be very comfortable with the idea of using SIMPLAN for simulation projects due to its ability to offer any level of security control which might be desired.

Consolidation

In a large number of projects, one of the primary goals is to develop projections for a number of divisions or profit centers, and then to consolidate these into group and corporate totals. SIMPLAN provides two significant advantages in this area: First, a model is normally constructed so that its logic is independent of the division or profit center for which it is being used. In this way, one common model can be developed to perform all calculations which are handled similarly in each division. Only those items which differ significantly among divisions need be specified individually. Second, SIMPLAN contains a number of data management commands which can perform consolidations and/or eliminations independent of the model logic. This enables the user to obtain trial consolidations as they are needed without having to rerun a series of models. No "standard chart of accounts" or similar structure is required for consolidation in SIMPLAN. Divisions can be added to or deleted from the calculations as required.

Another significant aspect of consolidation in SIMPLAN is its generality. Once a logical group has been established, new members of the group are recognized by SIMPLAN automatically as they are created. Thus, a command can be issued which says, in effect, "Give me the total of all expenses related to truck sales." The user need not specify how many, or which, items are to be aggregated.

One final problem frequently encountered in simulations is that of changing time frame requirements. Often, quarterly or annual results are desired even though the model and database were originally designed to handle monthly data. In SIMPLAN, commands are available to convert time series from one periodicity to another with ease. An entire database containing monthly data can be aggregated into quarters and/or years with one command.

External Databases

Often, a modeling project will require data from one or more external databases -- either those already existing within the company, such as accounting tapes, or those available from other sources, such as Chase, Wharton, or DRI. SIMPLAN, by virtue of its data management facilities, allows a user to transfer data to his model from a wide variety of sources.

Going in the other direction, it is often desirable for other systems and programs to be able to access data which is maintained by SIMPLAN. This is equally easy.

External Subroutines

One argument frequently used by management when opposing a new simulation project is, "We already have a program which does most of that. Why re-invent the wheel?" The problem with the existing program is often that it is cumbersome and inflexible, or that it is not designed for interactive use. With SIMPLAN, existing programs may be integrated into the system as user-written subroutines, making it unnecessary to duplicate any existing functions. The user still obtains the benefits of a generalized interactive modeling system, without abandoning previously-developed systems.

Ease of Use

Many features have already been illustrated which contribute to SIMPLAN's ease of use. In addition to these, several other factors

increase the likelihood that management can make direct use of simulations run under the control of SIMPLAN.

All SIMPLAN input is free-format; that is, the user need not be concerned with beginning the command in a certain column, or with whether a space is allowed before a "plus" symbol. All of the user's input is in either common algebraic notation (in models only) or English-language commands. No use is made of "operation codes" or other artificial constructs.

SIMPLAN is designed to be run equally well in interactive (conversational) or batch mode. The user input, commands, and procedures are identical in either type of operation; thus, when quick response and flexibility are required, such as during initial model development or management meetings, the system can be run interactively. When a more leisurely pace is acceptable, such as for routine monthly updates, the SIMPLAN session can be submitted as a batch job. This often enables the user to achieve significant cost savings, in addition to easing the load on the computer.

In many cases, management is unwilling to approve the use of a modeling language on a commercial time-sharing service because of prior projects in which processing charges became excessive as the model was more heavily used. While this is not normally the case with SIMPLAN, an alternate route is available should costs increase. A user can begin his simulation work on a time-sharing network with a minimal commitment of resources. Once the model is developed and proven effective, processing may continue on the service bureau or be transferred to the in-house computer system. In several cases, SIMPLAN users are doing both types of processing concurrently.

TYPICAL SIMPLAN APPLICATIONS

The typical SIMPLAN user works either for one of the Fortune 1300 companies or in the public sector (including educational institutions). Very few smaller companies have yet recognized the benefits which can be derived from a formal planning and modeling process.

The types of functions for which SIMPLAN has proven most beneficial include

- Data Collection and Management
- Forecasting and Econometric Analysis
- Model Specification and Validation
- Reporting
- Consolidation
- Allocation
- Policy Simulation
- Financial Analysis.

The types of projects which have been most successful in SIMPLAN include

- Pro Forma Financial Projections
- Budget Development and Analysis
- Acquisition Analysis
- Capital Investment Analysis
- Marketing and Production Planning
- National and Regional Economic Projections
- Strategy and Policy Design and Analysis.

The users involved in these projects include programmers and systems analysts, financial and operations research analysts, and, most significantly, middle and top management. It is executive-level involvement which has been the strongest contributing factor to the success of simulation and modeling projects using SIMPLAN. Today, more and more companies are learning that the road to effective planning includes "moving simulation into the board room."