XSIM: A Corporate Financial Model Development Language

William A. Sherden
Dynamics Associates
Cambridge, Massachusetts 02138

ABSTRACT

The corporate financial model is coming into increased usage as a tool for supporting specific decision points throughout the corporation. Attendant with this trend in model building is the growing importance of the model builder's implementation approach which requires he or she to be flexible and selective in the application of methods and computer tools. This paper relates the capabilities of a model development language called XSIM to the growing decentralization of the corporate financial modeling application. Specifically, the use of XSIM to build model systems addresses two key aspects of project implementation: adapting to new applications and accomodating the evolving requirements of a planning system.

I. INTRODUCTION

The past two decades have provided a vast amount of experience in the use and misuse of corporate financial modeling. As indicated by current literature [5] [6], this experience has significantly contributed to the development of a logical framework for successfully implementing this class of models. The all-encompassing and often prodigious financial models developed during the sixties [1] proved to be a grandiose display of adapting operations research technology to financial planning rather than a sincere attempt to advance the future of the sponsoring firms. The current trend in corporate financial modeling reveals a movement away from these large models towards more manageable, "applications-specific" models. This new modeling approach, described by McGinnis [6] as "incremental" and by Bolton [3] as "inside out", brings modeling skills closer to the decision points in a corporation, restoring the promise of the corporate financial model as a decision aid.

The decentralization of financial modeling applications places new demands on the tools for adapting corporate financial models to a wide range of decision environments. Since a successful model always imposes some form of change on the organization which is often resisted, the model designer must choose the best methods and computer tools each unique project. Just as important, this choice of tools and methods must also be flexible enough to evolve with the modeling application. This paper presents XSIM as a financial modeling tool that meets the demands of this new trend in building corporate financial models.

II. XSIM

XSIM was originally conceived in the mid-sixties as an economist's research tool, complete with a time-series file system, statistical analysis and a simulation facility capable of solving large, complex macro-economic models. Since its inception, XSIM has undergone approximately fifty man-years of development conforming to the analytical requirements of practitioners in corporate planning and security analysis. Since 1970, XSIM users have implemented corporate financial models drawing on XSIM's wide range of capabilities to fulfill the varying needs of each application.

A description of XSIM's model development capabilities is most clearly accomplished by breaking the language into its conceptual components. A framework for categorizing the elementary aspects of a corporate modeling system was established by Naylor [7] where he identified the essential components of a corporate planning system as: model logic, report generator, data, data management and statistical analysis. This framework is completed with the addition of tailored "user environments" or customized interfaces between users and modeling systems. The elements of the XSIM language are described below as a development tool that addresses the unique and evolving demands of corporate financial modeling applications. Specifically, XSIM's modeling elements are described in relation to two important facets of implementation:

- Adapting to the specific and unique needs of a corporate financial modeling application;
- Accomodating the changing requirements of a corporate planning system.

III. ADAPTING TO NEW APPLICATIONS

The use of XSIM for developing a modeling system is described below from the perspective of implementing corporate financial models at specific decision points within the corporation. Each application is original in at least two ways:

(1) the nature of the business and (2) the characteristics of the decision setting. XSIM's comprehensive development capability is its most significant asset because it offers flexibility not only in the technical specification of a corporate financial model but also in the "human engineering" requisite for successful implementation of a modeling system.

Choice of Management Science Technique

Before proceeding to describe XSIM's capacity for developing modeling systems, the technical requirements of the corporate financial modeling application should be discussed. While management science techniques continue to flourish, it is generally acknowledged that the present status of managment science techniques far surpasses the practitioner's ability to integrate these techniques into the decision-making process. Recent surveys of financial modeling applications [6] stress that the key to a successful model is supportiveness rather than assertiveness. In other words, successful models, in general, employ simple simulation techniques which are easily explained. In addition, the relative simplicity of discrete versus stochastic simulation in answering "what if" questions also accounts for a majority of the successful corporate financial modeling applications. In accordance with the comparative success of discrete simulation techniques, the use of the term "model" herein refers specifically to the use of discrete simulation in XSIM models.

Speed of Computer Implementation

The need to quickly implement corporate financial models alone justifies the use of a "higher level" computer language in lieu of conventional programming languages like FORTRAN. In order to use a corporate financial model to support specific corporate decision points, one must recognize an important fact: decision settings change quickly. For example, if a model is used to evaluate an acquisition candidate, the implementation time must be sufficiently short to make use of the model while the acquisition decision still exists. As a higher level language, XSIM allows the model developer to significantly diminish the implementation time of a corporate financial model. XSIM's development capability is based on "pre-programmed" routines which aid in specifying models, entering and editing data files, designing report formats, and fulfilling ad hoc needs such as data management requirements and user environments.

To exemplify the advantages of pre-programmed routines, consider that the corporate financial model is the only class of models that contains relationships common to all applications because all U.S. firms must adhere to standard accounting and tax principles established by governmental and advisory agencies. Standard relationships such as depreciation are common to all corporate models; so, the time and resources of the model builder are used more efficiently when they are applied to the unique aspects of the corporate modeling project. To address this need, a library of financial functions has been added to XSIM. In addition to standard functions, many relationships exist that are peculiar to the corporation itself. A corporation may have, for example, a standard way of computing various rates of return for evaluating projects. XSIM provides the user with the ability to pre-program these "corporate specific" subroutines and to add them to the modeling function library.

Adapting the Corporate Financial Model to the Decision Setting

Since the introduction of a corporate financial model changes the previous decision making setting, it is desirable for a corporate financial model to change so as to conform to the existing decision process as closely as possible. A new decision tool need not and should not introduce different reports or foreign terminology. The purpose of a modeling project should be to introduce a specific change: that is, an enhancement to the existing capacity for decision making. Avoiding unneeded changes requires a generalized approach to implementing corporate models.

XSIM allows the model developer to incorporate existing decision policy into the overall planning system. For instance, XSIM's report generator was designed specifically to provide a format capability for duplicating financial reports. The user has full flexibility in the choice of line items, spacing, headings and the use of characters and symbols throughout the report. In addition, considerable design emphasis has been placed on the simplicity of specifying report formats. Where possible, XSIM automatically controls report formats by centering titles, controlling column spacing, inserting commas and enclosing negative numbers in parentheses. With automatic format design and special options such as indenting and footnotes, the XSIM user can easily simulate customary financial reports.

Graphic display of information has long been crucial in decision making environments. In the past, however, the ability to produce graphic formats has largely resided in the corporate graphics department or with an outside service, which often causes considerable time delay between the generation and presentation of corporate planning information. The expansion of XSIM to include high quality graphics has eliminated this delay; the results of a financial simulation can be graphically displayed within the XSIM environment. The graph formats available in XSIM are time-series, plots, scatter plots, bar charts, histograms, and pie charts. Given these graph formats, XSIM users may select from three graphic technologies: terminal graphics, high resolution terminal graphics and continuous pen (flat bed) graphics.

Algebra - A Common Language For Model Specification

The use of algebraic equations to specify model logic enables the XSIM model developer to implement the new modeling application quickly and to avoid

the common pitfall of supplying the decision maker with a "black box." In specifying corporate financial models, XSIM provides an ideal compromise between flexibility and speed of implementation. Conventional programming languages such as FORTRAN provide maximum attainable flexibility but they greatly expand the implementation period. Therefore, because speed of implementation is of paramount importance, these conventional languages are of little value in building financial models. At the opposite extreme are the "canned packages" which offer quick implementation, yet fail to accomodate a wide variety of applications. XSIM is a compromise between these extremes because most accounting identities and financial relationships can be simply written in XSIM as algebraic equations which require very little in the way of the model developer's math or programming background.

Another significant barrier for the model developer is the determination of the order of the model's relationships. While each individual relationship may be easy to specify, the order in which relationships must be solved is often complex. XSIM addresses this problem by automatically reordering the relationships within a model, therefore, relationships in an XSIM model can be specified in any order. This reordering facility allows the XSIM user to input a sequence of equations which is intuitive from a financial point of view, and then to depend on XSIM to order the equations in a mathematical sequence.

The necessity for the decision maker to understand and, thus, to trust a model can not be overstressed. A major facet of XSIM's underlying design philosophy is the preservation of clarity in its modeling code. It is a common practice for XSIM model developers to rely on the original XSIM model logic to comprehend and, ultimately to use the model with confidence. Just as XSIM's algebraic model specification serves as a basis for developing unique applications, this approach also serves to "self document" a model.

Accomodating the Needs and Skills of Different Users

Since the development and use of corporate financial models involves many individuals with diverse backgrounds and interests, the designer of a modeling system must provide "user environments" suitable for each new application. A "user environment" is an interface between the model user and the modeling system, and it has the potential of providing an optimal combination of ease-of-use and flexibility. For instance, the model developer requires a high degree of flexibility to develop and to validate a corporate model. Usually he is skilled in working with the modeling language and, therefore, ease of use is of little concern. On the other hand, the time-constrained corporate decision maker would most likely forgo flexibility in favor of ease of use. In the latter case, a user environment can promote the ease-of-use of a modeling system by translating user inputs into system control commands and model parameters which are necessary to perform a simulation.

User environments are constructed by combining XSIM's modeling commands with its programming facility. Programming statements for prompting, error checking, calling sub-routines and performing other conventional programming functions control the sequence of simulation activities. To generate and display simulation results, the user need only "converse" with the operating environment by responding to a sequence of prompts or "requests" for information. For example, when a simplistic operating environment is invoked, it could perform the following activities: (1) set up the working environment by providing access to data and establishing defaults, (2) issue a sequence of prompts for input, (3) read the user specified options and input assumptions, (4) "filter" and check for errors, (5) initiate the simulation, and finally, (6) employ pre-formatted report generators to display the simulation results. In effect, the operating environment restricts XSIM's flexibility to simplify the use of a corporate model for the inexperienced user and, thus, expands the number of potential model users.

The user environment described above is extremely simplistic, and does not present the full potential or range of possible modeling systems. For example, XSIM user environments in the form of tailored "languages" which consist of a small number of control commands specific to the application have been designed. These tailored command "languages" serve users who prefer more freedom yet who also have a limited knowledge of XSIM, computers, and modeling techniques.

IV. ACCOMODATING THE EVOLVING REQUIREMENTS OF A PLANNING SYSTEM

While the initial implementation of a corporate financial model employing one of the many "high level" modeling languages may be successfully accomplished, the ability of these languages to accomodate continuous change in a decision setting is another matter. Continued use of a corporate financial model necessitates adapting the model to a changing decision environment. Often, requests for changes to be made to an existing model reflects a desire for the model to keep pace with an evolving decision environment. Whenever these proposed changes are not met with quick and comprehensible modifications to the modeling system, the continuing value of the model is diminished. The flexibility of XSIM's model development capabilities is described below in terms of aiding the model builder to respond to the changing needs of a corporate financial modeling application. In particular, the following three common forms of change to a modeling application are discussed:

- expansion of model content;
- data management complexity;
- introduction of econometrics.

Expansion of Model Content

While fluctuations in corporate decision processes can require an alteration to a financial model, often experience gained from using the model generates ideas for change. Generally, these modifications to the model are based on new

insights and learning, which can be enhanced by the clarity of XSIM's model code.

An increase in the size and complexity of the corporate financial model is the most common result of changes. For example, the aggregation of product lines may be broken down, thus expanding the size of the model logic. A growth in the complexity of a corporate financial model will occur in the logic for individual line items or in the relationships between line items. This latter form of complexity refers to interdependencies, or simultaneity, between the model's line items. A frequent example of simultaneity found in corporate financial models is the interdependent relationships between interest expense, profitability, and debt financing.* If the modeling language currently in use forces stringent restrictions on either the size or the complexity of a model, then the corporate financial model will languish behind the expanding needs of the decision maker. Since XSIM was originally conceived to build large, complex econometric models, it enables the model developer to simply modify a corporate financial model regardless of the resulting complexity or size of the model. For example, XSIM is capable of reorganizing a model to accomodate new equations whether or not the changes to the model introduce simultaneous relationships. First, simultaneous equations are automatically identified and grouped together as "blocks". These blocks are then ordered in the manner in which they must be mathematically solved, thus, freeing the model developer from having to manually restructure the model.

Another form of change to a corporate financial model is the reorientation of a model for "goal seeking", or, in other words, to determine the inputs required to achieve specified target outcomes. For example, consider a typical "sales-driven" corporate model that is used to determine profitability, cash flow, and required financing based on sales projections. In XSIM, this model could be reoriented or "inverted" to solve for the sales volume necessary to achieve a performance goal such as a growth rate in earnings per share. The XSIM invert facility automatically restructures, or "inverts", a model to create a "goal-driven" version of the original model. In using inverted models, the XSIM user can directly address a wide variety of corporate simulations by translating corporate goals into projected operating requirements.

Data Management Complexity

At their inception, financial modeling projects require little data management and a modeling language needs to store only data files for input assumptions and generated results. Few projects remain this simple. As a modeling project evolves, the many dimensions of business planning data introduce data management complexity in a number of ways, such as:

- Line items - sales, tax, working capital...
- Time - months, quarters...
- Scenario - pessimistic, optimistic, most likely...
- Type - actual, forecast variance...
- Organizational structure - divisions, strategic business units.

An all too common example is the "stand-alone" corporate financial model that, at some point in time, must be split into two or more models of dissimilar business units - for example, domestic and foreign markets. What was originally a straight-forward modeling exercise can easily become unwieldy if consolidation is necessary and must be accomplished in a language that lacks data management capabilities.

XSIM's data management capabilities are based on two key components: a flexible data file system and an extensive library of powerful routines for data-manipulation. Together, XSIM's routines and data file system enable the model builder to perform a wide range of ongoing and ad-hoc data management activities. A sample of these data management possibilities are:

- Converting monthly data files to yearly data files and vice versa.
- Restricting read and/or write access to XSIM data files for specific users.
- Ordering corporate data files (e.g. earnings for all divisions) based on a ranking scheme (e.g. high to low).
- Identifying desired subsets of data files (e.g. those data files that require updating).
- Copying all or a part of an XSIM database to another database or to another user.
- Collecting all data files that share a naming convention (e.g. data files whose names begin with the letter "A").

The data management requirements of corporate financial modeling projects can grow to enormous proportions, especially the modeling applications in decentralized firms. While conceptually simple, these data management activities can present major hurdles in the continuing process of implementing the modeling system. These difficulties become acute when an attempt is made to expand the modeling system using a modeling language that has little or no data management capabilities.

* Interest expense is increased due to additional debt financing which reduces profitability and increases the need for debt financing, and so on.

Continued success in adapting the corporate financial model to an ever-changing decision environment is highly dependent upon the ability of the modeling language to manage the firm's multi-dimensional planning data.

Introduction of Econometric Analysis

The incorporation of econometric analysis into a financial model is frequently an enhancement to a project. Since corporate decisions are supported from both a marketing and a financial perspective, econometrics can easily be introduced into a financial modeling application. For example, assume that a model is used to examine the financial future of a business unit at the same time that a marketing department forecasts the sales of the business unit's product lines. While a total integration of the marketing group's econometric analysis with the financial group's corporate model is unnecessary, independence of the two efforts is illogical.

Expanding a financial modeling application to incorporate market analysis is a change to which most financial modeling languages cannot adapt. At best, the compatibility of the financial model and the econometric analysis is complicated by the use of different computer languages; at worst, the compability is limited by the use of different services. Given XSIM's origin as a development tool for building econometric models, econometric analysis is a central element of the language capability. XSIM's econometric capabilities are based on the combination of its statistical analysis routines and the availability of XSIM economic databases offered by such services as Chase Econometrics and Merrill Lynch Economics. XSIM can be used to develop macro-economic, industry, and product line forecasting models by drawing upon such statistical capabilities as multiple regression and Box-Jenkins time series analysis.

V. CONCLUSION

XSIM is a "high-level" planning language that provides a wide range of capabilities for developing modeling systems. As a model development tool, XSIM uniquely combines flexibility and ease-of-implementation. Based on an algebraic modeling code, report generators, and a data file system, the XSIM user can quickly adapt his or her modeling approach to the requirements of each application. In addition to these basic elements of a modeling system, tailored user environments can be created to enable a broad class of users to make use of the corporate financial model.

While many "high-level" languages are useful to initiate a financial modeling project, modeling applications often expand beyond their capabilities. The ability to adapt to the growing demands of a modeling project is XSIM's most unique asset. An increase in size or complexity of a financial model, an emergence of data management requirements, and the introduction of econometric analysis are sources of change that are easily accomodated by an XSIM modeling system.

BIBLIOGRAPHY

(1) Gershefski, G.W. "The Development and Application of a Corporate Financial Model," in Management Science, Vol. 16, No. 6, Feb. 1970.

(2) Hall, William K. "Strategic Planning Models: Are Top Managers Really Finding Them Useful?" Journal of Business Policy, Vol. 3, No. 2, 1973.

(3) Hayes, Robert H. and Nolan, R.L. "What Kind of Corporate Modeling Functions Best?" Harvard Business Review, May-June, 1974.

(4) Little, John D.C. "Models and Managers: The Concept of Decision Calculus." Management Science, April 1970.

(5) Lorange, P. and Vancil, R.F. Strategic Planning Systems. Prentice-Hall, Englewood Cliffs, N.J., 1977.

(6) McInnes, J.M. "An Organizational Perspective on the Use of Simulation Methods in Planning and Control Process." Summer Computer Simulation Conference, 1977, Proceedings.

(7) Naylor, Thomas H. "Elements of a Planning and Modeling System." AIFPS Conference, 1976, Proceedings.