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CORPORATE FINANCIAL MODELING: SYSTEMS ANALYSIS IN ACTION

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BACKGROUND OF THIS PAPER

This article is based on research in management science done in the Bureau of Business Research, Graduate School of Business Administration, University of Michigan, under a grant from the Detroit Edison Company for the purpose of developing an operational corporate financial model capable of making accurate and reliable projections of the various financial statements in a way which reflects the effects of significant managerial decisions.

Introduction

Currently a gradual evolution is underway in the nature of business problems that are being assigned to the modern electronic computer. The initial applications generally were of a data processing character, with the specific goal of reducing routine clerical operations to a computerized system that would save manpower, space, and costs. With the increasing sophistication of electronic computers there has developed a corresponding interest in harnessing the power of the computer to aid top management in analyzing complicated business problems and in making far-reaching decisions. Associated with this development has been a gradual increase in the broadening of mathematical concepts which has made mathematical analysis more relevant to the study of important business problems. Indeed, relatively new disciplines or specializations have developed which capitalize on the application of mathematics to business problems, namely operations research and management science.

Apparently, however, the full potential benefits that business can derive from the effective blending of these developments has yet to be realized. A study on computer usage was completed recently by McKinsey & Company, Incorporated, under the direction of Dr. David B. Hertz, a director of the management consulting firm.[1/] The study involved thirty-six major companies in thirteen industries, and it concluded the following: (1) that unless companies go beyond the "super-clerk" uses of computers and

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1/ William K. Stevens, "Computers Held in Need of New Aim," New York Times, June 30, 1968.

and apply them to crucial management and operations problems, increasing computer outlays probably will not be justified; and (2) that the use of computers to solve management and operating problems is a fruitful, though largely unused means of raising profits.

Corporate financial planning and budgeting functions provide two of the most important areas for applying these new mathematical, computer-based means for analyzing significant business problems. In terms of actual or proforma balance sheets, income statements, and cash flow statements, many of the interlocking and complex management and operating decisions of a company are merged together. Like a sequence of related snapshots taken at different intervals, these financial statements attempt to portray a faithful representation of the company's performance over time as it strives to achieve its overall dynamic corporate goals.

Within the context of financial planning and control, the systems analysis approach emerges as a meaningful extension of computer-based mathematical analysis of managerial decision making under risk and uncertainty.

Systems Analysis Approach to Corporate Financial Modeling

In describing these new problem-solving and decision-making tools, Mr. Arjay Miller, formerly President and Vice-Chairman of the Ford Motor Company, defined systems analysis as "a way of looking at problems that forces us to recognize that any action in one part of a complex system has some effect on every other part."[2/] In applying systems analysis to a problem Mr. Miller states, "we must set forth all our objectives and recognize all

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2/ Arjay Miller, New Roles for the Campus and the Corporation, First Annual William K. McInally Memorial Lecture (Ann Arbor, Mich.: Graduate School of Business Administration, University of Michigan, 1966), p. 8.

the elements that influence our ability to attain them," and that "in choosing among alternative courses of action, the costs and benefits of any program must be evaluated simultaneously for all the objectives of the system." An illustration of the interrelations of the main elements of systems analysis for decision making in relation to planning and control systems is shown in the following systems diagram.

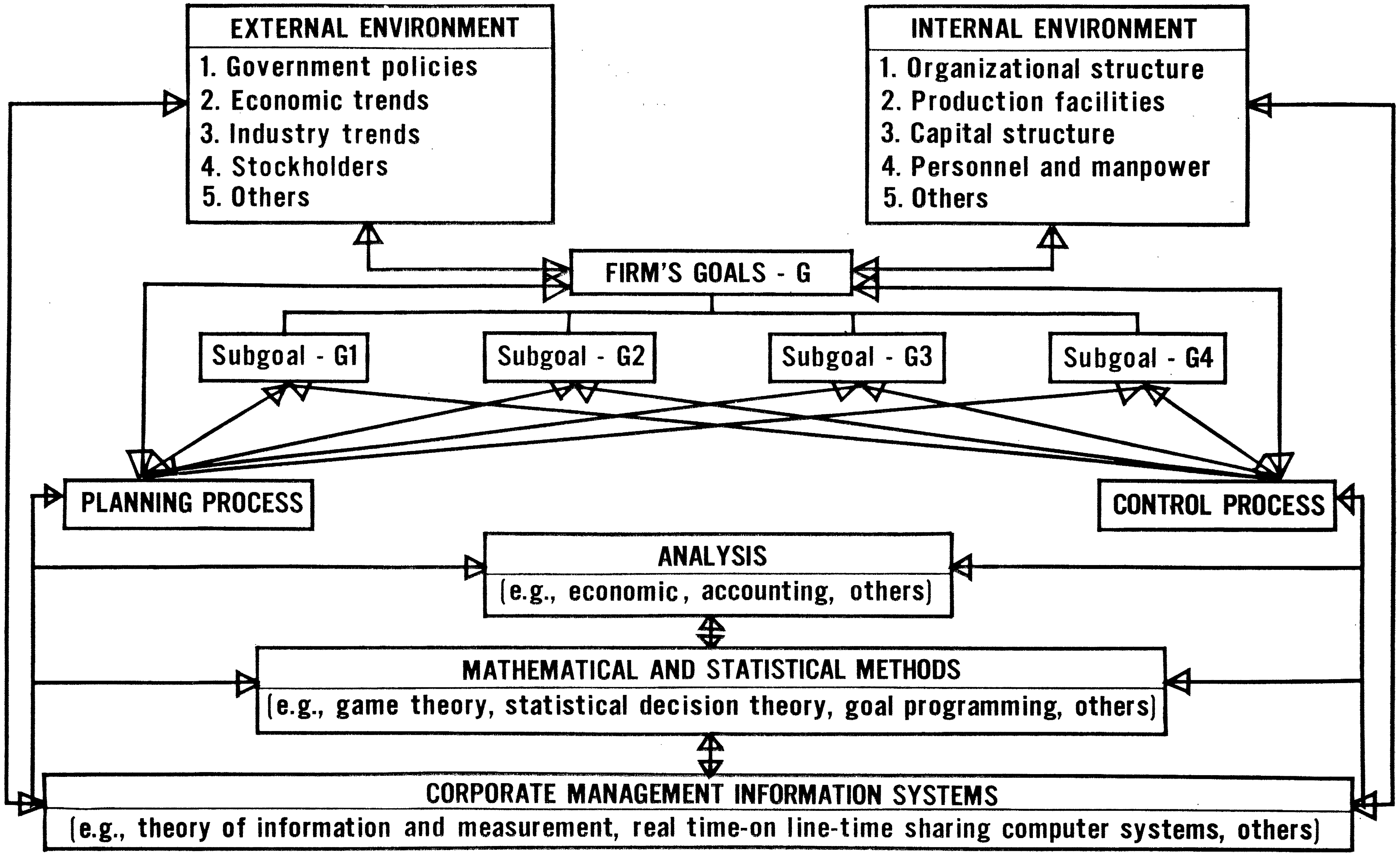
From a viewpoint such as that of Mr. Miller, corporate financial modeling simply is systems analysis in action. Corporate financial modeling is useful to top management only when it is recognized and interpreted within the meaning of the systems analysis approach to business problems. This requires that management and operating decisions, as well as changes in business conditions, be examined in terms of their probable joint effect on the future financial position of the company as a whole rather than on one specific activity or function of the company. Then and only then can costs and revenues associated with various managerial actions and economic changes be evaluated for all the financial objectives of the company.

In order to carry out a large-scale systems analysis of the type involved in corporate financial modeling, a special management science technique called simulation modeling has been developed. In simulation modeling, mathematical, probabilistic and statistical methods are combined, generally with a computer-based representation of the business system being studied, for the purpose of making realistic and valid analysis of the effects of policy, program, operations, and economic changes on the company as a whole without having to disrupt real-world operations.

PLANNING AND CONTROL SYSTEMS FOR ECONOMIC ORGANIZATIONS

ELEMENTS OF SYSTEMS ANALYSIS FOR DECISION MAKING

—Systems Diagram—



Simulation Modeling

The major features of simulation modeling must be delineated rather carefully from other operations research modeling methods. Generally, in the application of management science to business problems the word model refers to an abstraction or representation of an actual situation. These management science models can include both deterministic and probabilistic elements, and they can be so-called mathematical models or merely normative or descriptive models without any mathematical structure.

Nonmathematical operations research models can be physical mock-ups or networks of symbolic, conceptual, or logical elements, while mathematical models are classified by the way in which their solutions can be expressed. Some mathematical models lead to solutions which can be written in closed form as explicit functions like the explicit equation of a line, namely, $y = a + bx = f(x)$. Other mathematical models have solutions which can only be defined by implicit functional expressions like the implicit equation of a line, $f(x,y) = ax + by + c = 0$. Such implicit functional forms for the solutions of a mathematical model are mathematically equivalent to the explicit functional representations of the solutions in closed form (were it possible to so express them).

These distinctions lead to the following classification of the various types of mathematical models found in management science and operations research:

1. Deterministic with solutions in explicit functional forms such as those for the determination of a break-even point, an item's inventory reorder point, or the present value of discounted cash flows associated with a capital investment project

2. Deterministic with solutions in implicit functional forms such as those for the determination of an optimum product mix, optimum transportation schedules or warehouse locations,

or other business problems formulated as deterministic linear programs

3. Probabilistic with explicitly represented solutions such as those found, for example, in single-channel queueing models or single-item stochastic inventory models

4. Probabilistic with implicitly represented solutions like PERT or CPM network management planning models, or financial goal-programming models

A simulation model is a representation of an actual physical, social, or conceptual system in which networks of logical or symbolic elements representing policies, standard administrative procedures, or other programmed decisions are combined with mathematical, probabilistic, and statistical methods. A simulation model is analogous to a mathematical model that leads to solutions which cannot be represented in closed form by explicit functional expressions. Simulation models duplicate certain important features of the actual system modeled, such as responses to decisions or other actions taken whenever repeated iterations of the arithmetic or numerical calculations specified by the model are made. Typically, a management science simulation model will not involve an actual physical mock-up, and in this respect it differs from an engineering simulation model.

Simulation modeling has been applied successfully to the study of physical processes as well as to the study of policy analysis.[3/] Some applications to physical processes have involved simulating petroleum loading facilities, plant layout designs, warehouse facilities, and automated packaging facilities. Applications to policy analysis have involved simulating consumer behavior in marketing decisions, risk analysis techniques in

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3/ Austin C. Hoggatt and Frederick E. Balderston, eds., Symposium on Simulation Models: Methodology and Applications to the Behavioral Sciences (Cincinnati, Ohio: South-Western Publishing Co., 1963).

capital investment decisions, production scheduling and inventory control policies, and regional plant location decisions. Generally, however, these applications of simulation modeling have not been oriented toward the systems analysis approach that is required for corporate financial modeling.

The emerging role of simulation modeling in decision making can be attributed to the following characteristic features of this management science technique. Simulation provides a means for experimenting, evaluating, and predicting the consequences of changes in policy or market conditions without the risk of actually having to implement these new or modified operations or procedures before knowing how such changes will affect the whole system. In addition, simulation modeling provides a basis for demonstrating a new management idea and determining the probability for success of alternate ideas or different courses of action. It permits management to gain a better understanding of the present system with and the important relations between different parts of the operation. Thus management is aided in deciding upon areas in which material improvement may be realized through the application of managerial efforts.

Corporate Financial Simulation Models

A basic objective behind the development of a mathematical, computer-based simulation model of a company's financial operations is to enhance management's ability to appraise the financial effect of alternate management decisions or economic conditions on the firm's financial statements. Achieving this objective would provide an opportunity for general improvement in managerial effectiveness. A financial simulation model can be used to evaluate the effects of many dynamic influences on today's operations. Some of these are:

- Sales promotions and their effects on revenues and expenses
- Structural changes in tax and other relationships as application of the "new economics" attempts to manipulate the economic climate
- Inflationary trends on long-term internal relationships
- Changes in capital expenditure programs which are brought about by outside influences
- Different possible wage settlements during negotiation periods
- Alternative policies on dividend payout ratios and debt-equity structures
- Alternative policies on short-term debt and daily cash management

Almost all of the influences above, of course, are not new; and all large companies have always been faced with studying their effects and then determining the best possible course of action relative to these influences.

As these influences become more dynamic and larger in scope, a means must be developed which enables plans for long-range programs, including changes in economic conditions affecting a company, to be altered in endless variety. These plans should be altered in a way which permits the impact of such program revisions and operating alternatives to be systematically analyzed without disrupting actual business operations. This can be achieved by using the computer to simulate statistically the way in which a company accounts for revenues and expenses, thereby giving management greater control over financial operations and permitting a greater certainty in decision making under conditions of risk and incomplete information.

Financial Models for an Electric Utility

The electric utility industry has always been heavily oriented to investment. Today, with the fast growth rate of customers, high money costs, increased taxes and operating expenses, new uses for electricity, and the increased use of electrical equipment both in the home and in industry, the importance of systematic financial planning is becoming increasingly critical in top-level decision making. Announcements indicating billion dollar five-year capital investment programs are becoming the rule rather than the exception.

Added to the accelerated programs is the complication of even larger projects requiring several years to complete. Nuclear power plants in the 1,100 megawatt size, requiring seven years to plan and install and costing in excess of $200 million a piece, are a way of life.

What does this all lead up to in the area of financial planning? Just as the large modern power plants cannot be designed and built along the lines of the much smaller and less complex plants of years ago, past methods of forecasting, planning, and controlling the required financial resources of an electric utility are no longer adequate in terms of today's dynamism.

Instead, electric utilities must apply a systems analysis approach in meeting these dynamic and expanding requirements in the areas of budgeting and financial planning and control. New computer-assisted methods for management science ranging from computer adaptation of manual budgeting systems[4/] to computer-based goal-programming financial optimization models[5/] for control, and computer-based econometric financial simulation models for forecasting, planning, and analysis must be developed and used as part of the systems analysis approach for solving these business problems.

4/ Richard Mattessick, "Budgeting Models and System Simulation," Accounting Review, XXXVI (July, 1961), 384-97.

5/ Y. Ijiri, F. K. Levy, and R. C. Lyon, "A Linear Programming Model for Budgeting and Financial Planning," Journal of Accounting Research, II (Autumn, 1963), 198-212.

When financial forecasting, planning, and control for an electric utility are approached from a systems analysis point of view, a financial model consisting of the basic building blocks and relationships shown in Figure 1 emerges. Such a model is a practical means by which accounting and financial executives can establish capital requirements and financial policy for effectively managing long-range capital expenditures programs geared to dynamic industry and patterns of company growth.

Since electric utilities are, by nature, capital-intense business enterprises whose financial bearings are profoundly affected by tax and depreciation calculations, a tax module and a depreciation module appear as separable submodels in an electric utility financial model. In addition, an econometric forecasting module, simulation and goal-programming optimization modules, and modules for the basic financial statements complete the model's structure.

Further structuring of a financial model through a systems analysis approach involves the sequence of steps which follow in the next paragraphs.

Step 1--the organization stage. In this stage, the original objectives and scope of the simulation study should be determined. Such questions as why the model is being developed, the purpose for which it will be used, what functions should be included in its scope, and what timing is required in the study should be answered. These answers should be reviewed to ensure that the proposed model will meet the needs of those who will later use it as an aid in decision making. This step also involves the development of a complete block diagram for each of the three financial statements to be simulated, and a step-by-step description of the way in which the different account schedules are aggregated to form the financial statements. Interfaces within and between the various financial statements should then be documented.

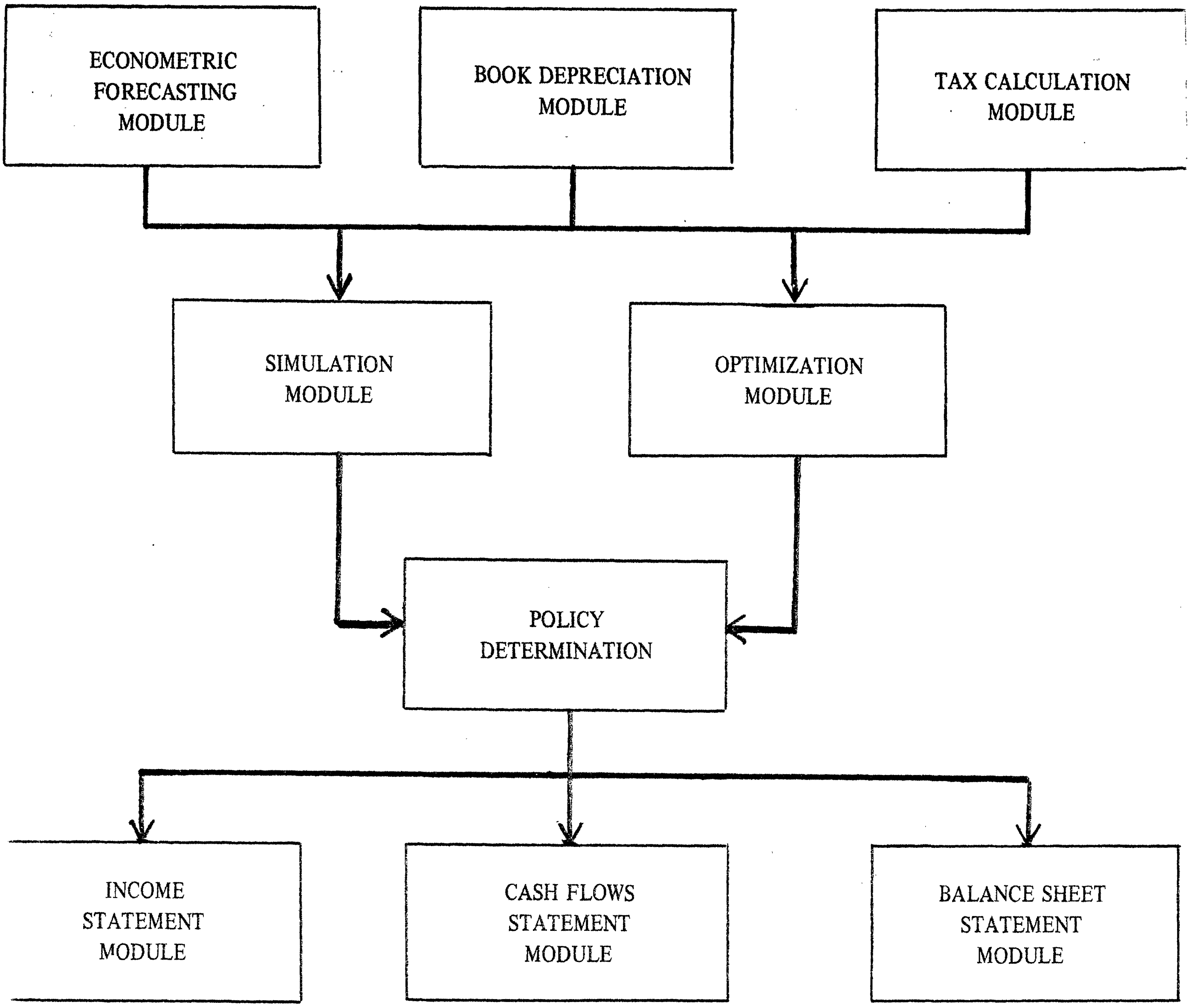

Fig. 1. Modules in electric utility financial model.

Initially, these block diagrams should be sufficiently detailed so that the important accounting, financial, and operating alternatives facing a company are included as model parameters. Then, by restricting the alternatives considered, these block diagrams can be aggregated to form the block diagrams for a more general simulation model which would reflect the priorities established for these alternatives. This can be done by blocking out certain components of the more detailed block diagrams or by restricting certain model parameters to specific values.

Step 2--the data gathering stage. One of the first tasks in this phase is to gather facts on existing forecasting methods. Interviews should be conducted with those involved in forecasting, and flow charts should be constructed to show the development of existing financial forecasts in the company. Furthermore, information should be gathered on possible new approaches to forecasting. For these purposes, it is best to form a team consisting of representatives from the financial and accounting areas as well as the systems study area of the company.

Step 3--the analysis and synthesis phase. From the documentation obtained in steps 1 and 2, the inputs and outputs of financial forecasts are identified and various simulation techniques considered. Then a concentrated effort to gather data should begin. Historical records must be obtained together with supporting accounting records for each item in the balance sheet, for items involving receipts and disbursements, and for items in the income statement. A data bank should be formed which includes all historical data available. From these data, a series of algebraic and regression equations representing the various parameters contained in the cash flow, income statement, and balance sheet can be developed for use in the simulation model. At the end of this phase, a manual calculation should be made using these regression and algebraic formulas. The results should be reviewed by top management to ensure that the model will achieve the desired objectives for budgeting, forecasting, and financial planning and control.

Step 4--the programming phase. In this phase the block diagrams which correspond to the alternatives to be simulated should be developed into detailed flow diagrams according to the accounting identities that form the linear relationships characterizing the model. The necessary computer programs should be written in order to obtain a computer-based financial simulation model.

Step 5--the model validation stage. To ensure accuracy, the model should be validated by using history from several previous years as input and then by using the computerized model to simulate the financial statements for these and subsequent years. From such validation, refinements might be incorporated into the simulation model before it is considered operational. Moreover, as data become available from future periods and as experience is gained through using the model in various studies, the refinement and validation phase should be carried out on a continuing basis.

The Detroit Edison Company Financial Model

As with most electric utilities, the Detroit Edison Company is involved in very large and dynamic expansion programs. To help keep management informed of fast-changing financial conditions, Detroit Edison, working with the University of Michigan's Bureau of Business Research, has developed and is operating a computerized econometric financial simulation model for use in forecasting and as an aid in planning and controlling financial policies of the company.[6] The systems analysis approach was employed throughout the development of this financial model.

First, the historical methods of manually forecasting financial statements, conducting capitalizing and expensing studies, and making book and tax depreciation studies were documented. From this documentation, input and output parameters which determine the financial statements were identified. From these and other studies, the following specifications for the model were determined: the model must be operational, reasonably accurate, a proper reflection of reality, and must provide for the actual interfaces found in Detroit Edison's situation; it must also be flexible enough to allow for the potential development of a more complete corporate financial model without unnecessary backtracking and revisions. These requirements were conceptually expressed in terms of an econometric financial simulation model.

This computer-based financial simulation model is econometric because it involves a series of statistical regression relationships allowing regional economic influences as well as national economic trends to be related to the projected annual income statements, cash flows statements, and balance sheets for each year being simulated. Moreover, by using these

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6/ The Detroit Edison Study Team consisted of R. Gates from the Plant Accounting Department, R. Mayotte from the Control Department, and R. Landback and D. Achtenberg from the Administrative Systems Planning Department. The normal steps for conducting a major administrative systems study by the systems analysis approach were followed. Primary responsibility for development of the forecasting relationships used in the model was undertaken by the University of Michigan Research Team; and, in addition, Professor R. L. Brummet, W. A. Swinyard, and W. J. Wrobleski worked closely with members of the Detroit Edison Team in providing counseling and consultation in connection with the other aspects of the study.

econometric relationships, any specified number of years of company financial operations can be simulated depending on the objectives of the study being made. If a seven-year capital expenditures program is being analyzed, a seven- or ten-year annual simulation can be conducted. If accelerated plant depreciation methods are being studied, a fifty- or one-hundred year simulation can be made corresponding to the anticipated economic life of the generating station or other electric plant equipment being studied.

In addition, this model is an optimizing model in the sense that, by simulating internal financial interrelations of the company, the effects of alternate policy and operating decisions on the financial performance of the company may be obtained. By applying these relations to duplicate the financial performance of the company, management can select those policies or operating decisions which yield the best simulated financial performance for the company over the time span being considered.

The Detroit Edison financial simulation model is modularly constructed to allow flexibility in extending it to a more complete corporate simulation model which would develop monthly as well as annual simulations. Furthermore, the model could provide for the use of judgmental or personalistic probabilities representing management's assessment of the trends of economic factors in simulating the financial performance of the company. An extended simulation model could also generate probability rankings for the likelihood that a particular simulated financial forecast will actually occur. In addition, because it has modules as model components this model may be linked directly to other econometric models of the stock, bond, or money markets or to a corporate-wide management information system with on-line, real-time, or random-access satellite computer consoles or terminals. Such extensions have been carefully planned for the systems analysis used to develop the current corporate financial model.

Nature of Simulated Variables and Relationships Used in the Model

Besides the interrelated computer modules for book depreciation studies, tax studies, studies of plant retirements and additions, and simulation of the company's basic financial statements, the Detroit Edison financial simulation model employs two kinds of simulated variables and two kinds of simulated relationships. The simulated variables, outlined in Figure 2, can be described as exogenous and endogenous or policy factors, while the simulated relationships are either exact mathematical relations or econometric equations.

Exogenous variables are those factors acting on or affecting the financial performance of the company which are determined externally or beyond the immediate control of management. These variables chiefly describe the market environment of the company or fiscal and monetary factors associated with the national economy. Specifically, some of the exogenous variables appearing in the Detroit Edison financial model are: coal prices, rate schedule, number of customers, kilowatt-hour sales, short-term borrowing rate and investment rate, and federal income tax rate.

Endogenous variables, on the other hand, are those factors acting on or affecting the financial performance of the company which are determined internally and are directly controllable by management immediately or within a short time period. These variables generally are of a policy nature. Endogenous variables appearing in the Detroit Edison financial model are: number of operating and maintenance employees, total construction budget, power pooling expenses or capacity changes, kilowatt-hours supplied to or from external sources, per share common stock price at the time of issue, debt structure including debt-to-equity ratio, minimum cash balance,

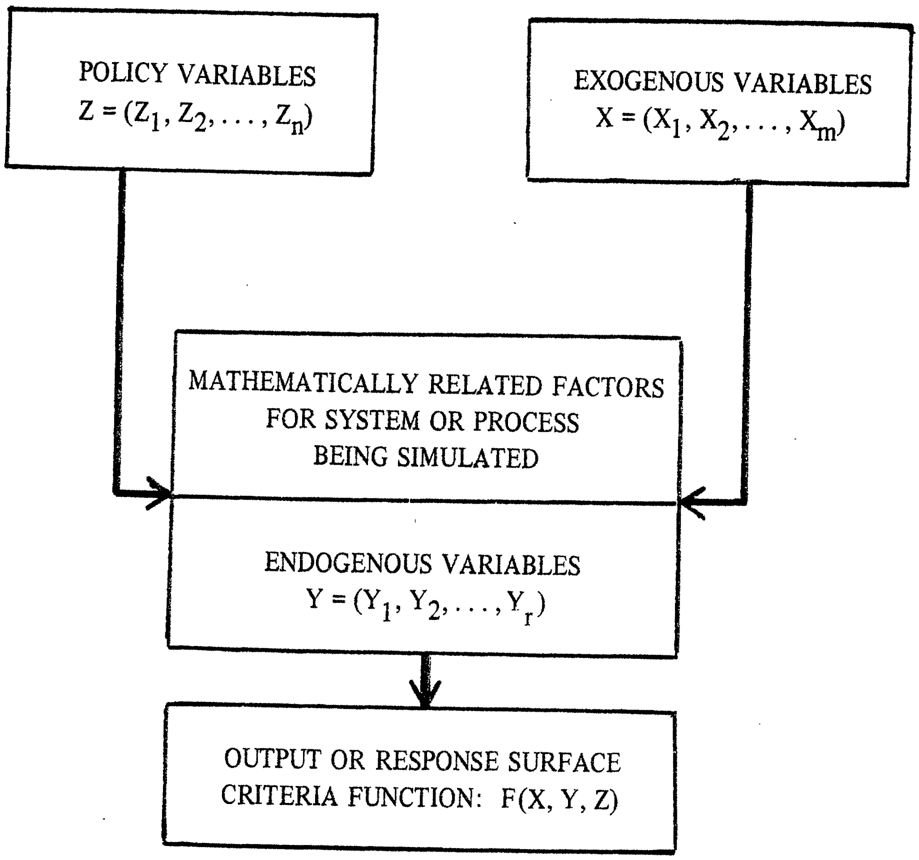

Fig. 2. Variables simulated in Detroit Edison's financial model.

dividend payout ratio, short-term debt limit, miscellaneous deductions for federal income taxes, depreciation methods, and other endogenous factors which reflect policy considerations related to various management and operations decisions.

In addition, there are other endogenous factors which are influenced by management and operations decisions over a longer time span, but essentially these factors must be viewed as fixed or exogenous variables over the immediate future. Some of these endogenous variables are generating capability, pounds-of-coal burned per kilowatt hour generated, and BTU per kilowatt hour generated.

Finally, the Detroit Edison Company financial simulation model uses as model input parameters certain exogenous and endogenous variables which describe the financial position of the company at the beginning of the period of time to be simulated; data from the previous year's balance; and income and cash flows statements such as the beginning year's retained earnings, reserves, and cash balances.

Each of the exogenous or endogenous variables mentioned is either forecast within the simulation model for each year to be simulated or specified externally as an input parameter. In turn these data are used by the computer to generate the simulated mathematical or econometric relationships needed to project the company's financial statements.

The exact mathematical relationships appearing in the Detroit Edison simulation model are definitional and are generally specified according to current accounting practice, tax laws, or other parafinancial considerations. The following is an example of such an exact, definitional mathematical relation: $\underline{A} = \underline{K} \times \underline{B}$ where $\underline{A}$ denotes federal income taxes to be paid, $\underline{B}$ denotes taxable income, and $\underline{K}$ denotes the federal income tax rate.

The econometric relations used in the Detroit Edison financial model are used to develop some of the simulated account balances for the various financial statements. These econometric equations were developed from a rigorous statistical analysis of the company's historical development and financial performance over a sixty-year period.7/ An example of an econometric regression relationship is the simulation of salary and wage expenses. Salary and wage expenses are derived from a multiple regression equation of the form,

$$\underline{y} = \underline{a}_o + \underline{a}_1 \underline{x}_1 + \underline{a}_2 \underline{x}_2 + \underline{a}_3 \underline{x}_3 + \text{ERROR-OF-FORECAST},$$

7/ The forecasting relationships used in the simulation model for the cash flows, income, and balance sheet statements involve linear and nonlinear regressions using concurrent, leading, and lagged variables as well as exponential smoothing methods. In addition, the depreciation studies use regression analyses as well as more traditional forecasting techniques which are based on stable percentage allocation methods.

To develop these econometric relations, 500 separate regression analyses were made. Of these, 373 were related to investigating monthly and annual forecasting equations for the cash flow, income, and balance sheet statements. The remaining 127 regressions were related to investigating annual forecasting equations by account for retirements and plant-not-in-service. These equations are used to obtain forecasts of book depreciation expense. In addition, numerous stable percentage computations were made on expenditures by year for each account and used along with these regression equations to forecast book value.

Among the 373 regression analyses for the three financial statements, 86 annual and 55 monthly forecasting equations were studied for the cash flow statement, 130 annual and 24 monthly forecasting equations were derived for the income statement, and 48 annual and 30 monthly forecasting equations were examined for the balance sheet statements. In addition, several second-order exponential smoothing equations were studied as alternative methods for forecasting various account balances associated with the cash flow and income statements.

Excluding the tax and depreciation simulation modules, 84 regression or exponential smoothing equations and 125 exact mathematical relationships are now being used in the simulation model for the balance sheet, income, and cash flows statements.

where $\underline{y}$ denotes salary and wage expenses, $\underline{x}_1$ denotes total kilowatt-hour sales, $\underline{x}_2$ denotes plant investment, $\underline{x}_3$ denotes the number of operating and maintenance employees, and $\underline{a}_o$, $\underline{a}_1$, $\underline{a}_2$, and $\underline{a}_3$ are coefficients determined by mathematical methods of statistical analysis.

With the aid of a computer, such mathematical and econometric relationships as these can be simulated, together with the various exogenous and endogenous variables, so that alternate management and operations decisions can be appraised in terms of their financial effect on the company. Besides enhancing management's ability to appraise alternatives and their financial consequences, the model provides a means for making timely revisions of long-range programs and for discovering the probable effects of these revisions on other operating alternatives.

Data and Computational Flows

The actual data and computational flows for the computer program used by the Detroit Edison Company to simulate the effects of these exogenous and endogenous variables, and the different mathematical and econometric relationships on the company's projected financial statements, are shown in Figure 3 in simplified form.8/

To use the model, data from the previous year's financial statements as well as forecasts of certain independent variables for each year to be studied are supplied as computer inputs. In addition, the model is programmed to accept "optional" input data whenever it is desirable to override

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8/About four man-years (four men for nine months and one man for one year) went into the systems analysis phase of the model development. In addition, about three man-years of programmer time were required for development of the detailed computer program. The computer program is written in FORTRAN and is run on an IBM Model 360/50 computer. Running time varies according to the number of years to be studied and whether or not detailed calculations are made using the tax and depreciation modules. As an example, a ten-year detailed forecast of the balance, income, and cash flow statements which uses simplified tax and depreciation calculations requires less than sixty seconds of computer time.

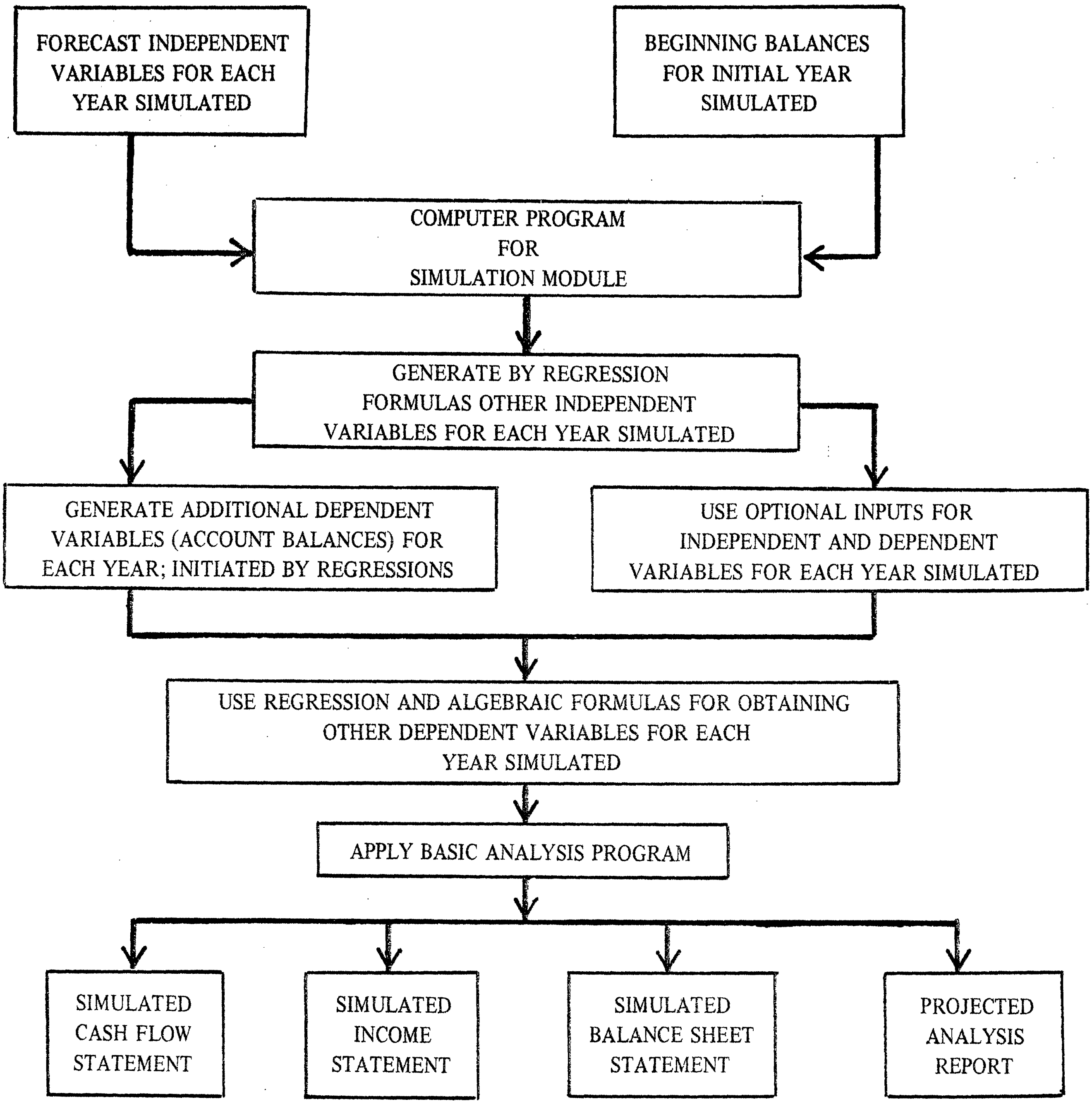

Fig. 3. Block diagram of Detroit Edison simulation model.

any of the dependent variables generated within the model. The output consists of the following reports: input data including regression coefficients used in the model's econometric relationships; external financing schedules; cash flow statements; details of specific cash flow categories; and income statements and details relating to specific income statement categories, balance sheets, and analysis sheets.

Since electric utilities are, by nature, heavily oriented to investment, tax and depreciation calculations have a very profound effect on financial statements. Accordingly, separate submodels giving very detailed calculations in these areas can be used independently or in connection with the basic simulation model.

One advantage of performing a simulation by computer, of course, is that once the computer programs are written, validated, and established as being operational and correct, the large quantities of numerical data required by a financial simulation model having a scope and flexibility comparable to that of Detroit Edison's can be accurately handled and processed by a computer. This is an advantage in that the correctness of arithmetic results developed for management's evaluation is ensured.

An inherent feature of all mathematical models, of course, is the need for a continuing analytical process of validation and refinement. The effort to explain differences between results predicted by the model and the performance that actually materializes can provide deeper insight into the fundamental forces affecting the financial structure of the company. Each state of evolution of the model presents a valuable aid to management in studying alternative programs and their relative effects on the financial growth of the company.

Other Model Advantages and Uses

This model is a first step taken by Detroit Edison in a great and rapidly expanding field of new scientific management techniques. Although these techniques will never be a substitute for good management judgment and although the techniques themselves will never make management decisions, they are one more aid to managers in making today's decisions for tomorrow's results. The experience gained in working to develop this financial simulation model, moreover, is one of the extra dividends which has and will continue to accrue to the Detroit Edison Company over future years.

In a sense, the financial simulation model will always remain dynamic, because new data will continually be added as each twelve months becomes another year of history. Furthermore, all simulated relationships used in the model will be adopted to reflect the most recent financial experience of the company. This first step has built a foundation which will be a basis for developing a more sophisticated corporate-wide information system for managerial decision making.[9/]

9/ The model itself is also a research tool, and will be used as one. A possible future research application of the model, for example, involves Direct Access Teleprocessing (DATP). DATP is a computer technique which allows an inquiry device to be placed on a manager's desk and connected to the computer through a communications channel so that the operator of the inquiry device can put information into or withdraw information from the computer in a random access mode of operation. This application of DATP using the simulation model would be desirable on an experimental basis since the model is a homogeneous system under which guided experience in working with DATP could be gained. By use of this method, for example, a manager could obtain a forecast of the income statements for various income tax rates; and by holding all other parameters constant, a study of the effect of various changes in a given parameter could be conducted immediately without a manager leaving his desk. Such experience with DATP would be valuable in determining the specifications for much larger, more complex DATP systems involving many inquiry devices.

Since the speed of the computer ensures that a simulation can be performed quickly, the time of occurrences of projected future events can be compressed into brief intervals of time so that management has a means for testing and evaluating various plans, actions, and decisions long before important commitments of resources are required. Moreover, since the computer can keep track of many different things going on at the same time, the financial simulation model has permitted management to examine simultaneously the many complex interrelations found in financial planning and control of large-scale capital expenditures programs.

As management becomes increasingly adept at using the model, and as the model itself undergoes refinement resulting from such use, the advantages of the financial simulation model to top management will continue to multiply and make themselves felt throughout the company.

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