INTERACTIVE BUDGETING MODELS:
A SIMULATION TOOL FOR MIS EDUCATION

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Abstract

A relatively new and innovative educational approach in graduate information systems is discussed. The thrust of the approach is to have student groups design computer-based simulations of the budgeting processes of a firm in the form of an interactive budgeting model. These are applied to the areas of financial planning, control and managerial decision making. Several different approaches were suggested to and adopted by students as main design philosophies including modular planning and a matrix accounting system. The various implemented systems are described and their features are classified.

In its attempts to keep up with practice, the academic world is ever striving to develop improved pedagogical techniques and thus better-prepared information systems students. This paper reports on such a device, an Interactive Budgeting Model (IBM), used in the accounting-information systems program within the Graduate School of Management.

One goal of this program is to expose students to online planning systems as described by Sackman and Citrenbaum[1]. If more and more implemented information systems incorporate online planning and

[1] Sackman, H. and R. L. Citrenbaum (Eds.), Online Planning, Prentice-Hall, 1972.

control features[2], pedagogical adaptation is necessary. In this situation, an educational problem is to expose accounting and MIS students to the methodologies, man-machine interface, complexities and problems of system design in an academic environment. The approach described here is based upon student planning and implementation of a simulated, financially-oriented information system. The financial, budgetary focus of the project narrows the scope of possible projects and also has an additional benefit of requiring an in-depth knowledge of the accounting process (a skill frequently lacking in MIS and MBA students). A matrix accounting model is proposed to form the backbone of the system.

This paper is partitioned into three main sections including this introduction. The following section discusses the concept and implementation features of an Interactive Budgeting Model in terms of its educational objectives, its simulation features and its modeling features. The third main section of this paper describes actual projects designed and implemented by students at UCLA and Ohio State University in three different courses. This summarization is intended to give the reader an idea of the specific features designed into these systems and their shortcomings. In addition, a time series comparison is presented of the features used at UCLA and Ohio State University.

Interactive Budgeting Models

The implementation of an Interactive Budgeting Model is the focus of approximately fifty percent of the student's effort in a graduate class at the masters level at UCLA. This class, called Information Systems for Planning and Control, is oriented towards exposing students to the problems of information systems design and corporate planning and control. This course is the second in a series of three where the first is oriented towards systems theory and the systems approach and the third is oriented towards problems of measurement in information systems.

In response to inadequacies in case, discussion and lecture approaches to the course, a tool was sought that would provide the experience students needed for systems analysis and system implementation of corporate financial information systems. Such a tool should have experiential features in which the student would encounter the problems inherent in systems design and analysis and also which would exhibit planning and control

[2] For example, Redwood, P.H.S., "APL For Business Applications," Datamation, May 1972, pp. 82-84; and "Litton's Electronic Information Machine," Business Week, March 28, 1970, pp. 158-160.

concepts. Such specifications led to the concept of the IBM, an interactive system for planning and control in a simulated environment.

Students were instructed to design and implement a conversational system which would allow a manager to interact with a terminal and assist in management decisions. The nature of this task and the boundaries of the problem were purposefully left ill-defined as the problem specification and contextual design phases are important experiences in the desired educational process. For example, Pounds[3] points out that "seldom if ever, do managers analyze or understand the sources of their problems," and "...the availability of formal problem solving procedures serves only to highlight those parts of the manager's job which these procedures do not deal: problem identification, the assignment of problem priority and the allocation of scarse resources to problems." Therefore, in an education process, accurate definition of a problem may hinder education in an area where the manager often is lacking.

Beginning with an ill-defined problem specification, students were then given several basic references[4] that may be useful in constructing their IBMs and were told that some quantitative techniques such as PERT, linear programming or regression may be profitably incorporated in the model.

The first two or three weeks of the class were then dedicated to teaching an appropriate interactive computer language. At UCLA, APL was used. This powerful interactive language is easy to learn and students, working in groups, tend to make up for their individual deficiencies.

Interactive computing and debugging permits students to obtain fast and accurate performance feedback on the main features of their models. In designing their system, the following were suggested as minimal design criteria:

1. Security features
2. File management of historical accounting data
3. A useful interactive decision aid
4. Planning and control features
5. Modular approach, matrix accounting structure.

Also, a list of possible modules for the IBMs were given to the students:

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[3] Pounds, W. F., "The Process of Problem Finding," The Industrial Management Review, Vol. II, No. 1, Fall 1969, pp. 1-21.

[4] Mattessich, R., Accounting and Analytical Methods, Richard D. Irwin, Homewood, Illinois, 1964; Butterworth, J. W. "The Accounting System as an Information Function," Mimeograph, University of British Columbia, June 1970; Ness, D. N., "Interactive Budgeting Models: An Example," Working Paper, M.I.T.

1. Output module
   Display of financial statements, projected budgets, network schedules, selected display of underlying planning assumptions (e.g., rate of growth)

2. Input module
   Reading and storing information
   Building data bases
   Retrieving information

3. Performance analysis modules
   Calculating performance analysis ratios
   Preparing output and management exception reporting

4. Incorporating transactions
   Measurement of economic events
   Periodic reporting

5. Building and using management science functions
   L.P., statistical analysis, graphics, charts, discounting

6. Control and security features

7. Specific planning and forecasting aids
   Regression, exponential smoothing, consensus (Delphi) techniques

8. Programmed decision rules
   Exception limits, cash constraints

As is demonstrated in a following section of this paper, these suggested module specifications inspired a large variety of IBMs.

In implementing the tasks involved in constructing such an IBM, the student groups had to consider a series of system design problems including problem and project specification and management. These are discussed from a pedagogical viewpoint.

First, the student team had to decide on what type of organization and which specific planning and control problems they wanted to model. Some chose a simplified model of an entire firm or department and concentrated on implementing several management science techniques. Others decided to simulate a small part of a large system and attempted to attack its problems extensively. Part of the learning gained from this step in the model development is the need to specify, limit and dissect the possible problems to be tackled. A main cause of difficulty and frustration in such projects was tackling too large a problem and the eventual difficulty of implementation within time constraints.

MIS classes usually draw students with a variety of backgrounds including accounting, computer methods, marketing and behavioral science. Such heterogeneity results in a labor distribution problem. Frequently, students specialize such that those interested in computer methods concentrate on programming while accounting majors study information flows and reporting techniques. In contrast some groups divide programming tasks evenly among their constituents. Either approach frequently generates serious coordination problems as certain parts of the project are completed on schedule and others are not.

Once a group settled on a problem area, problem focus was needed. Groups frequently tried to overachieve and during the later stages of the project began to realize that their objectives were not realistic and should be redefined. Part of the difficulty of the instructor's task was to warn students about such risks without undercutting the learning potentiality of these experiences.

The experience that an IBM project lends to the students in terms of group processes is certainly an important educational aspect in MIS education. Although there was a definite task and deadlines and assignments in the beginning of the course, there was often too many ideas and little consistency among them. Also there were emerging leadership patterns and conflict for leadership roles. Evidence of this was that groups sometimes could not reach consensus and attrition occurred. Management and coordination problems always seemed to occur. Students frequently experienced the point that Argyris[5] makes "... the introduction of a sophisticated information technology is as much an emotional human problem that requires interpersonal competence (as well as technical competence) and that requires knowledge about the human aspects of organizations such as personality, small groups, intergroups and living systems of organizations norms."

[5]Argyris, Chris, "Management Information Systems: The Challenge to Rationality and Emotionality," Management Science, Vol. 17, No. 6, February 1971, pp. B-275-292.

The Underlying Matrix Accounting Structure

The IBM concept has been suggested[6] as a technique to design surrogate information systems and decrease software development costs. In this era of rapid change in which education has lagged technological development, new tools for education are needed. Many principles in the design of large scale software information systems are not theoretically sophisticated and may even be counterintuitive in nature due to the intricate interconnection of different system components.[7] The same may also be true in the design and integration of large scale systems where a large number of components interact and factors are interconnected. In such a situation the utilization of simulation technology for education and for the design of large scale software systems seems to exhibit great value.

[6]Vasarhelyi, M. A., "Simulation - A Tool for Pre-Implementation Testing of Large Scale Software Systems," Winter Simulation Conference, 1971.

[7]Forrester, Jay W., "Alternatives to Catastrophe - Understanding the Counterintuitive Behavior of Social Systems," Technology Review, January 1971.

The matrix approach to accounting is suggested as the backbone of the IBM for several reasons, some of which have been alluded to earlier. Essentially a matrix model reveals the entire (wholistic) impact of each actual (or planned) accounting transaction on the entire set of financial reports or budgets. Thus the student must relate to the entire financial system and the impact of planning assumptions and decisions upon this system.

The matrix accounting approach considers entries in the firm's chart of accounts as a vector of period transaction amounts (T) multiplying an incidence matrix (I) composed of zeros and plus or minus ones.[8] The vector is equivalent to the possible accounting actions in the firm and the incidence matrix indicates which of the accounts of the firm are affected by such financial transactions. All account balances (B) at the end of period t are given by the identity $B_t=T_tI+B_{t-1}C$, where C is a matrix which closes nominal accounts. For a computerized system t may represent "real time," a day, a week or whatever and T may be projected (for planning) or actual financial transactions. The matrix approach can be extended to include policy changes in the firm.

[8]Butterworth, J. W., op. cit.

Such a methodology allows users to design and, through a simulation, consider the effects of policy changes over projected, proforma or budgeted financial statements. Interesting effects can be obtained by augmenting such models with OR techniques and interrelating interactive policy changes with partial optimization of system parameters. The utilization of simple linear projections can be made more realistic by the utilization of exponential, logarithmic or exponentially smoothed functions. Clearly, however, the monitoring features of interactive simulation are advantageous as the type of projections can be adapted to the realistic overview of the manager. Such powerful tools have been utilized in the construction of IBMs as are described in the next section of this paper.

Implemented Models

At this time, ten student IBMs have been designed. In the remaining part of this paper, these systems are summarized and contrasted. Focus is placed upon the underlying computer language and system characteristics and upon implemented simulations and man-machine considerations.

The projects will be discussed in terms of the three different classes where this technique was utilized. Computer capabilities and environmental factors were somewhat different for each class, thus providing an interesting comparative, longitudinal study. The first projects were developed during the spring quarter of 1971 at UCLA only four months after APL had been "brought up" on campus. The IBMs were implemented on the university's IBM 360/91 using APL which, at that time, had neither file nor fast formatting capabilities. As APL was the only interactive language available at UCLA, language choice was not a problem.

The second set of projects were developed at Ohio State during winter quarter, 1972. At that time, computing was carried out on an IBM 370/165 and the Time Sharing Option (TSO) was up and running. Although BASIC and TSO FORTRAN and PL/1 were available, all student groups selected the CPS (Conversational Programming System) language which is essentially an interactive subset of PL/1. In comparison to UCLA, the main constraints of the OSU system capabilities were: 1) limited selection of business oriented preprogrammed subroutines, 2) in comparison to APL, CPS is a less powerful language and requires considerably more code, and 3) relatively slow response times. On the positive side, the OSU system was more stable and provided file capabilities so necessary for any realistic financial data base.

The third set of projects were developed during spring quarter 1972 at UCLA. This group used the same computing hardware previously described except by this time a preprogrammed fast formatting routine and file capabilities were available.

In terms of overall results, the scope, insight and technical quality of the IBMs was quite impressive, even for groups of graduate MIS students. This is evident in the sample material that follows. As expected, most problems were related to intragroup conflict or inability to establish realistic project goals and scope. The rather tight schedule facing the students was as follows:

Course Week	Topic and Assignment
1	General, but purposely vague, description of IBM concept, project requirements, and possible design criteria
1,2, & 3	Review (learn in many cases) appropriate computer language
3	Project plan and description, including PERT-type schedule, due and presented during class (this of course facilitated cross fertilization of ideas)
6	Oral report on progress and problems
9	Class demonstration of completed IBMs
10	Written reports including sample output, documentation and project critique

Project Summaries

As one would expect, a wealth of data exists on the ten projects. In an attempt to reduce these data. a taxonomy of each IBM is included in Table I. The taxonomy includes available computer system capabilities, description of the simulated entity, IBM modules, planning and control features, system features and problems.

Upon examining this summary, the following patterns emerged. First, the latter IBMs are more sophisticated than the earlier ones. Probably this was due to an increasing ability on the instructor's part to describe alternatives. Another factor was the improved system capabilities, particularly file management.

Although simulation modules were suggested either to incorporate environmental uncertainty or to test strategy alternatives, no group implemented such a module due to its intrinsic complexity. More importantly, design of the man-machine interface was neglected. For example, the conversational features of the executive modules were generally inadequate. This is disconcerting as a suggested systems criterion was "a useful interface decision aid," i.e., user oriented. One explanation is that in the initial stages of such projects, participants tend to be "systems biased" and thus they focus on implementing the forecasting, accounting, data base and reporting systems. Such oversights and biases were fed back to the groups as part of the learning process.

Sample Interactive Budgeting Models

A sample of some of the IBM materials follow. These include a project plan (Exhibit 1), a CPM-type schedule for an IBM (Exhibit 2) and sample output of two systems.

TABLE I

TAXONOMY OF PROJECT CHARACTERISTICS

Computer System and Options	Organization Description: Simulation of Real or Ficticious Firm	System Modules (*indicates planned but not implemented)	Other Planning and Control Features	Design Features and Problems, Miscellaneous Data
		Class 1, UCLA, Spring 1971		
IBM 360/91 APL without fast formatting options 32K workspaces	Group 1 Ficticious TV manufacturer with 3 production lines (Risk Inc.)	Operational Control Optimization of production re L.P. Effect on budgets, sales forecasts Management Control (MC) Retrieval of current financial statements Stochastic sales forecast Ratio analysis of financial budgets Strategic Planning (SP) Present value analysys of investments GNP based long run sales forecast	User can resort to and test a variety of planning assumptions. Overall function TOT integrates other modules and facilitates comparison of forecasts derived from SP and MC including implications.	System Requirements Needed more than 1 workspace, WS FULL ERRORS Use of preprogrammed LP and REG library routines. Developed from total systems philosophy. What-if (sensitivity) analysis implemented.
	Group 2 Ficticious, Small retailer	Sales forecasts and derived financial budgets Financial reporting Control (planned only)	Planning: Complete transaction based financial plans (flexible horizon)	1 workspace No file or security considerations Output fairly well formatted Control features (module) incomplete Limited decision aid Sensitivity aid
	Group 3 Ficticious, Plate Glass Co., focus on 5 process production dept.	Forecasting Sales, Cash Flow (4 periods) I/S and Balance Sheet Sales forecast based on macro economic data, historical company data, e.g. UCLA business forecast		1 workspace Poorly formatted output Internally (WS) managed data file

TABLE I (CONTINUED)

Computer System and Options	Organization Description: Simulation of Real or Fictitious Firm	System Modules (*indicates planned but not implemented)	Other Planning and Control Features	Design Features and Problems, Miscellaneous Data
	Group 3 (Continued)	Process cost analysis (including change of costing rates) (cost and transfer price) Variance analysis of budget to historical and actual to budget (both absolute and relative)		
		Class 2, OSU, Winter 1972		
IBM 370/165 CPS language (Conversational Processing System, subset of PL/1) Operated under TSO	Group 1 Real Highway Construction Company focus on contract bidding- cost control and performance analysis. Simplified contract developed.	*L.P. generation of optimal bid Base generation and management Data base retrieval of cost and interactive bid generation Cost measurement, variance reporting and data base update		Significant code was required, especially for file management. Integration was not accomplished. Significant file loss problems were encountered. Response time was a problem, particularly to retrieve file data.
Some File Capabilities, Limited Preprogrammed Public Routines	Group 2 A-Loss Co. Ficticious, sing single product manufacturing company.	Sales forecast Financial forecast (overall budget) Transactions (accounting) Control and performance reports Executive (overall integration and sensitivity analysis and security)	Sensitivity of budget-to-budget assumptions (e.g. collections schedule) Management by exception	System derived constraints: Quarterly updating Maximum of 30 accounts and 20 transactions Maximum of 5 systems functions Other desirable features: Dating function Audit trail Security log.
	Group 3 MBA Co., Real Ohio non-ferrous jobbing foundry	Data base (actual historical data) *Integrated cost control system Accounting module Regression analysis and forecasting	Monte Carlo Simulation of financial results with interval estimates.	Information needs derived from management needs. Design focus on what-if capabilities. Integration of modules never really completed.

TABLE I (CONTINUED)

Computer System and Options	Organization Description: Simulation of Real or Fictitious Firm	System Modules (*indicates planned but not implemented)	Other Planning and Control Features	Design Features and Problems, Miscellaneous Data
	Group 3 (Continued)	Budgeting Interactive Control (executive) Report generator		Significant file errors and loss.
		Class 3, UCLA, Spring 1972		
IBM 360/91 APL/360 with PLUS/FILE option and fast formatting (ΔFMT) 48K workspaces	Group 1 Real Organization AISRP Research Center, UCLA	Security Budgeting Control	Comparative budgets (updated vs original)	Simplified funds-oriented accounting structure
	Group 2 Real firm construction contracting, fictitional data	Executive Planning Transactions Control	Regression forecast of So. California construction. Cash focused financial control.	Designed re interview of management's information needs. Desirable additions include user-control over forecast parameters, explicit sensitivity comparisons.
	Group 3 Real problem, planning and control system for movie production	File creation (selection of movie activities and levels) File Update (actual data) Cine-budget Printout	PERT/Cost schedule Progress and variance reports Completion performance reports	Extensive file utilization.
	Group 4 Real organization, Health research project management	Security Executive query Data base management Management module	1-year program budget, 5-year program forecasts Minimal control implemented	Program budget (PPB) orientation Focus on information retrieval rather than decision aid Significant module interface problems System output bound.

EXHIBIT 1

Project Plan, Group 2, Spring 1972, UCLA

OBJECTIVE

The objective of our project is to design an interactive budgeting and control system to meet the information needs of the President of an insulation contracting firm.

SCOPE OF OUR DESIGN

The system that we are designing is concerned mainly in providing the President with information to help him in the area of management planning and control. It designed around an analysis of his major decisions in that area, the process he used to make those decisions, and the information he feels he required. Since the manner in which each branch is handled is similar, we have designed the system with reference to only one branch with the assumption that by duplication it could easily be expanded to handle all the branches. We have broken the system into five major modules which are described below.

MAJOR MODULES AND THEIR FUNCTIONS

Forecast Module

The forecast module is to be used to estimate quarterly sales for the next 12 months. This will then be broken down into monthly sales. The method of linear regression is to be applied, utilizing those factors that we feel are appropriate - interest rates, building permits,etc. Sensitivity analysis will be available to the manager. Using sales forecast as a basis we will then be able to forecast other accounts and prepare budgets.

Transactions Module

The Butterworth Matrix System of accounting will be used in this module to handle the traditional accounting transactions and produce the monthly and yearly financial reports.

Control Module

This module will produce the needed reports to show variances from the budgets or standards. Certain general reports will be produced automatically at the end of each month or whenever desired, and other more detailed reports will be available on request.

General Reports to Be Produced

Variation in Income statement and Balance Sheet accounts as compared to budget - monthly and year to date.
Cash forecast for next three months
Signed sales contracts for next three months as compared to estimated sales for next three months.
Profit as compared to budget and previous year.
ROI as compared to expected standard
Changes in current ratio
Changes in working capital
Accounts Receivable and Inventory turnover as compared to standard
Inventory level as compared to standard

Security Module

This module will handle security procedures to insure that it cannot be accessed by unauthorized individuals.

Executive Module

This module will tie in all the other modules and make them part of an integrated system that is easy to use and change.

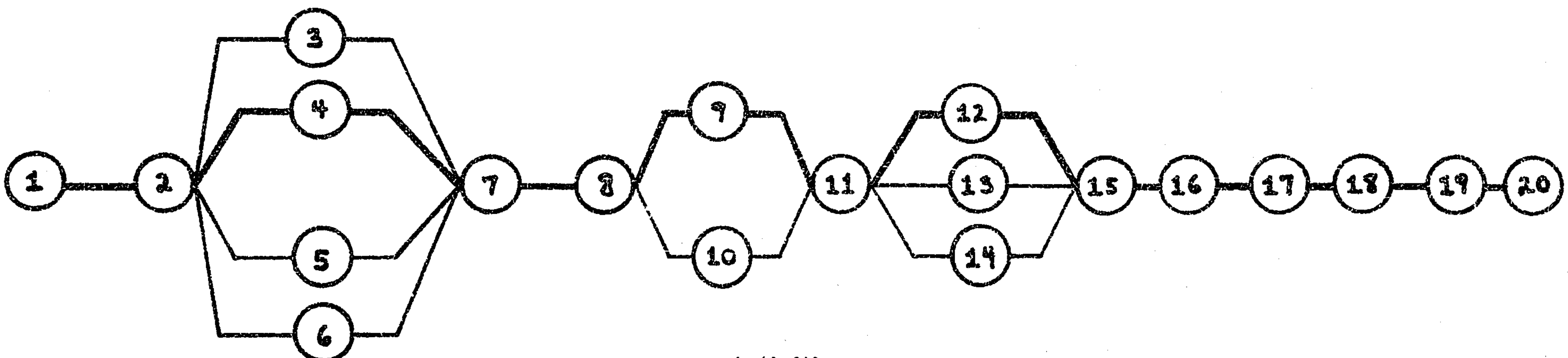
EXHIBIT 2

Group #1 IBM Project,

CPM Chart

Spring 1971, UCLA

Critical Path = 42 Days



Activities

1. Begin project
2. Establish initial IBM concept
3. Build data bases
4. Design operational control module
5. Design management control module
6. Design strategic planning module
7. Consolidate modules into IBM concept
8. Resolve discrepancies
9. Initial logic of interactive linkage
10. Enrich initial concept
11. Finalize IBM concept
12. Finalize operational control module
13. Finalize management control module
14. Finalize strategic planning module
15. Consolidate modules
16. Finalize interactive linkage
17. Test IBM
18. Debug model
19. Prepare final report
20. Turn-in report

Of the many interesting projects, the following one was selected as it is representative of an early project and includes a rather descriptive executive module.[9] Upon initiation the following (Exhibit 3) is received by the user.

EXHIBIT 3

```
THIS IS AN INTERACTIVE BUDGET MODEL FOR RISK INC.
THE MODEL DOES MANY MAGICAL AND EROTIC THINGS, AS FOLLOWS:

PRIOR YEAR BALANCE SHEET: TYPE BAL70
PRIOR YEAR INCOME STATEMENT: TYPE INCOME70
CURRENT DATA:
   TO ANALYZE CURRENT OPERATIONS YOU MUST SUPPLY CERTAIN VARIABLES.
THIS ALLOWS YOU TO ENTER WHAT YOU THINK THE ACTUAL FIGURES ARE, OR
ENTER THE POTENTIAL VALUES.  IT IS SUGGESTED THAT YOU BEGIN BY ENTERING
THE ACTUAL VALUES AND THEN VARYING ELEMENTS AS DESIRED TO OBSERVE THE
EFFECT ON THE OVERALL PICTURE.
THIS MODEL IS DIVIDED INTO THREE BASIC MODULES:
   OPC - THIS MODULE CONCERNS PRODUCTION ELEMENTS AND EFFECTS ON COST
OF GOODS SOLD.  TYPE OPC FOR THIS MODULE ALONE.
   MC - THIS MODULE PROVIDES BALANCE SHEETS, INCOME STATEMENTS, SALES
FORECASTS, ETC.  TYPE MC FOR THIS MODULE ALONE.
   SP - THIS MODULE CONCERNS STRATEGIC PLANNING AND PROVIDES LONG RANGE
PLANNING TOOLS.  TYPE SP FOR THIS MODULE ALONE.

EACH MODULE WILL DESCRIBE ITS VARIOUS FEATURES FOR YOU WHEN CALLED.

IN ADDITION, YOU CAN GET A BROAD OVERVIEW BY TYPING TOT.  USING THIS
YOU CAN FOR EXAMPLE VARY PRODUCTION COSTS AND IMMEDIATELY SEE THE EFFECTS
ON INCOME WITHOUT HAVING TO CALL EACH MODULE SEPARATELY.

YOU MAY BEGIN NOW -- HAVE FUN.
```

Given a general overview of the system the user is ready to begin. For the neophyte, historical financial statements are available such as last year's income statement:

```
SALES                        2700400
                           ------------

COST OF GOODS SOLD           1326000
SELLING, ADMIN EXPENSE       481000
INTEREST EXPENSE             13000
EARNINGS                     880400
TAXES ON INCOME              396180
                           ------------

NET INCOME                   484220
                           ============
```

Note that formatting options were not available to this group and thus the units in the preceding statement do not line up. To access the operating modules of this system, further documentation is needed. The various modules were accessed as displayed in Exhibit 4.

[9] Gordon, K.A., S. Archuleta, M. Ishii, "The Interactive Budget Model: A Conceptual Study," Term Project, Professor T. J. Mock, Graduate School of Management, University of California, Los Angeles, June 1971.

EXHIBIT 4

OPERATIONAL CONTROL:

```
      OPC
YOU HAVE ACCESSED THE OPERATIONAL CONTROL MODULE.
THIS MODULES FUNCTION IS TO ASSIST IN PRODUCTION PLANNING
USING A LINEAR PROGRAMMING ROUTINE TO MAXIMIZE A PROFIT FUNCTION.
YOU MAY VARY FACTORS OF PRODUCTION SUCH AS LABOR HOURS AND RAW MATERIALS
AVAILABLE.  THE PROGRAM ALSO INTERACTS WITH THE LONG RANGE SALES FORECAST
TO PROJECT PRODUCTION COSTS BASED ON PROJECTED SALES.

TO OPERATE THIS MODULE TYPE SAMCOST
      SAMCOST
THIS PROGRAM WILL CALCULATE THE OPTIMAL COMBINATION OF PRODUCTION
RESOURCES USED IN THE MANUFACTURING PROCESS OF THREE TELEVISION
MODELS:  X1=BLACK AND WHITE, X2=PORTABLE COLOR, X3=DELUX COLOR.
THE OBJECTIVE FUNCTION IS TO MAXIMIZE P=19X1+25X2+27X3, WHERE P
IS THE TOTAL CONTRIBUTION TO OVERHEAD AND PROFIT, AND X1, X2, AND
X3 ARE THE NUMBER OF UNITS TO BE PRODUCED TO MEET THIS OBJECTIVE.
THE OBJECTIVE FUNCTION IS BASED ON THE FOLLOWING DATA:
                                                        X1    X2    X3
    SELLING PRICE PER UNIT                              90    350   425
    VARIABLE COST PER UNIT                              71    325   398
    CONTRIBUTION TO OVERHEAD AND PROFIT/UNIT            19    25    27
CONSTRAINTS ARE BASED ON THE FOLLOWING DATA
WHICH INDICATES THE AMOUNT REQUIRED
TO PRODUCE ONE UNIT:
     LABOR A                                            5     5     3
     LABOR B                                            8     12    14
     LABOR C                                            12    14    14
     MATERIAL D                                         10    12    12
     MATERIAL E                                         15    18    20
     MATERIAL F                                         1     1     1
INPUT PARAMETERS G, H, I, J, K, AND L, THE TOTAL LABOR HOURS
AND MATERIAL UNITS AVAILABLE.
□:
      10000
□:
      18000
□:
      24000
□:
      21000
□:
      25000
□:
      20000
         o
         o
         o
```

EXHIBIT 4 (CONTINUED)

MANAGEMENT CONTROL:

```
    MC
YOU HAVE ACCESSED THE MANAGEMENT CONTROL MODULE.
MODULE FEATURES ARE;
1.  CONSOLIDATED BALANCE SHEET - IN ORDER TO GET CURRENT STATUS
     TYPE BALCUR. IF YOU WANT TO ENTER VARIABLESTYPE BALVAR.
2.  INCOME STATEMENT - IN ORDER TO GET CURRENT STATUS TYPE INCCUR.
    IF YOU WANT TO ENTER VARIABLES TYPE INCVAR.
3.  SALES FORECAST - TYPE FORE AND YOU WILL BE ASKED TO ENTER PROJECTED
    GROWTH RATE AND ACCEPTABLE STANDARD DEVIATION. THE PROGRAM WILL THEN
    PROJECT MONTHLY DOLLAR SALES FOR THE PERIOD YOU SPECIFY AND PROVIDE
    YEARLY TOTALS. YOU MAY THEN SPECIFY PERCENTAGE OF SALES BY MODEL AND
    GET SALES TOTALS BY MODELS, INCLUDING QUANTITY OF EACH MODEL SOLD.
4.  CURRENT RATIO - TYPE CR.
5.  ACID TEST RATIO - TYPE AT.
6.  RETURN ON ASSETS - TYPE ROA.
7.  EARNINGS ON STOCK - TYPE ES.
```

FORE ROUTINE (SALES FORECAST) IN MC MODULE:

```
    FORE
SALES FOR 1970 WERE 2,700,400. FORTY-FIVE PERCENT WERE PORTABLE COLOR,
THIRTY-FIVE PERCENT WERE DELUXE COLOR, AND TWENTY PERCENT WERE BLACK AND WHITE.
ENTER BELOW FIGURES FOR PROJECTED SALES GROWTH (PERCENT YEARLY), ALLOWABLE
DEVIATION (FOUR FIGURE INTEGER), AND LENGTH OF FORECAST IN YEARS.
PROJECTED GROWTH RATE:
⎕:
    .05
DEVIATION:
⎕:
    1000
FORECAST PERIOD (INTEGER REPRESENTING YEARS):
⎕:
    2
                               SALES FORECAST
                     (BASED ON 5 PERCENT SALES GROWTH)

YEAR : 1
JAN  236290
FEB  236302
MAR  236105
APR  236772
MAY  236279
JUN  236052
JUL  235876
AUG  236733
SEP  235859
OCT  236286
NOV  236170
DEC  236063
TOTAL SALES: 2834787
```

EXHIBIT 4 (CONTINUED)

STRATEGIC PLANNING:

SP
YOU HAVE ACCESSED THE STRATEGIC PLANNING MODULE.
THIS MODULE OFFERS LONG RANGE PLANNING TOOLS FOR THE FIRM.
MODULE FEATURES ARE:
1. *PRESENT VALUE OF INVESTMENTS - TYPE ISHII3SP1*

2. *LONG RANGE SALES FORECAST (BASED ON GNP) - TYPE ISHII4SP2*

THESE FEATURES WILL BE DESCRIBED FOR YOU WHEN CALLED.

OVERVIEW OF TOTAL SYSTEM:

TOT
THIS MODULE OFFERS A TYPE OF OVERVIEW OF THE SYSTEM THROUGH USE OF THE THREE BASIC MODULES. IT IS USED TO COMPARE THE LONG RANGE SALES FORECAST BASED ON GNP AND THE FORECAST BASED ON PERCENTAGE SALES GROWTH. THE RESULTS OF THESE FORECASTS ARE THEN USED IN THE PRODUCTION PLANNING MODULE, AND FINALLY A PROJECTED INCOME STATEMENT IS PRODUCED.

TO OPERATE THIS MODULE TYPE TOT1

Contrasting the above first generation IBM with a third generation (class) results in some interesting insights, particularly in terms of system sophistication and improved output features. Consider an IBM designed to aid the financial planning, scheduling and control of the production of a motion picture.[10] The essentials of this project centered around a PERT/Cost schedule of the activities. The system included budget projections and critical path (Exhibits 5 and 6), an updating routine and subsequent project performance reports.

[10] Tompkins, G. E., H. D. VanHolth, S. E. Velasco, J.C.G. Gaspar and K. D. Prado, "An Interactive Budgeting Model for Producing a Motion Picture," Term Project, Professor T. J. Mock, Graduate School of Management, University of California, Los Angeles, Spring 1972.

EXHIBIT 5

Sample Budget Projections
(for "The Brazilian Connection")

TITLE: THE BRAZILIAN CONNECTION
DATE OF REPORT: 06/10/1972
INITIAL BUDGET

ACTIVITY CODE	*ACTIVITY NAME*	*UNIT PRICE (DOLLARS)*	*QUANTITY*	*DURATION (DAYS)*	*SUB-TOTAL 2 (DOLLARS)*	*SUB-TOTAL 1 (DOLLARS)*	*TOTAL (DOLLARS)*
1.1.0	*STORY PURCHASE*	100,000.00	1.0	0.0		100,000.00	
1.2.0	*SCRIPT WRITER*	100.00	1.0	15.0		1,500.00	
1.0.0	*STORY AND SCRIPT*						101,500.00
3.0.0	*DIRECTOR*	300.00	1.0	120.0			36,000.00
4.1.0	*CAST*	200.00	5.0	60.0		60,000.00	
4.2.0	*EXTRAS*	20.00	10.0	20.0		4,000.00	
4.0.0	*CAST AND EXTRAS*						64,000.00
6.1.1	*DIRECTOR PHOTOGRAPHY*	100.00	1.0	80.0	8,000.00		
6.1.2	*OPERATORS*	30.00	5.0	80.0	12,000.00		
6.1.0	*CAMERA*					20,000.00	
6.2.1	*RECORDIST*	30.00	2.0	50.0	3,000.00		
6.2.0	*SOUND*					3,000.00	
6.3.2	*ELECTRICIANS*	30.00	2.0	80.0	4,800.00		
6.3.0	*LIGHTING, ELECTRICAL*					4,800.00	
6.4.1	*MAKE-UP,HAIR DRESSERS*	40.00	2.0	60.0	4,800.00		
6.4.0	*MAKE-UP,HAIR DRESSING*					4,800.00	
6.7.1	*EDITOR*	100.00	1.0	30.0	3,000.00		
6.7.2	*NEGATIVE CUTTER*	30.00	3.0	30.0	2,700.00		
6.7.3	*MUSIC, SOUND EDITOR*	75.00	1.0	10.0	750.00		
6.7.0	*EDITORIAL*					6,450.00	
6.0.0	*OPERATING STAFF, CREW*						39,050.00
7.1.1	*CAMERA EQUIP. RENTALS*	10,000.00	5.0	0.0	50,000.00		
7.1.0	*CAMERA*					50,000.00	
7.2.0	*SOUND EQUIP. RENTAL*	5,000.00	2.0	0.0		10,000.00	
7.3.1	*LIGHTING RENTAL*	3,000.00	5.0	0.0	15,000.00		
7.3.0	*LIGHTING RENTAL*					15,000.00	
7.4.0	*MAKE-UP,HAIR DRES.EXP*	2,000.00	1.0	0.0		2,000.00	
7.6.0	*EDITORIAL EXPENCES*	10,000.00	1.0	0.0		10,000.00	
7.0.0	*OPERATING EXPENCES*						87,000.00
8.0.0	*LABORATORY EXPENCES*	5,000.00	1.0	0.0			5,000.00
9.0.0	*MUSIC EXPENCES*	3,000.00	1.0	0.0			3,000.00
						BUDGET TOTAL	335,550.00

EXHIBIT 6

Initial Critical Path for "The Brazilian Connection"

THE BRAZILIAN CONNECTION

BEGIN OF PROJECT 06/10/72
END OF PROJECT 10/22/72

ACTIVITY	*PRECEDING ACTIVITIES*	*DURATION*	*SLACK*	*LAST DATES BEGIN*	*LAST DATES FINISH*	
120		15		06/10/72	06/24/72	*CRITICAL*
300	120	120		06/25/72	10/22/72	*CRITICAL*
410	120	60	20	07/15/72	09/12/72	
420	120	20	60	08/24/72	09/12/72	
611	120	80		06/25/72	09/12/72	*CRITICAL*
612	120	80		06/25/72	09/12/72	*CRITICAL*
621	120	50	30	07/25/72	09/12/72	
632	120	80		06/25/72	09/12/72	*CRITICAL*
641	120	60	20	07/15/72	09/12/72	
671	410 420 611 612 621 632 641	30		09/13/72	10/12/72	*CRITICAL*
672	410 420 611 612 621 632 641	30		09/13/72	10/12/72	*CRITICAL*
673	671 672	10		10/13/72	10/22/72	*CRITICAL*

* *PATH*	*PERTAINING ACTIVITIES*	*DURATION*	*SLACK*	*LAST DATES BEGIN*	*LAST DATES FINISH*	
1	120 300	135		06/10/72	10/22/72	*CRITICAL*
2	120 410 671 673	115	20	06/30/72	10/22/72	
3	120 410 672 673	115	20	06/30/72	10/22/72	
4	120 420 671 673	75	60	08/09/72	10/22/72	
5	120 420 672 673	75	60	08/09/72	10/22/72	
6	120 611 671 673	135		06/10/72	10/22/72	*CRITICAL*
7	120 611 672 673	135		06/10/72	10/22/72	*CRITICAL*
8	120 612 671 673	135		06/10/72	10/22/72	*CRITICAL*
9	120 612 672 673	135		06/10/72	10/22/72	*CRITICAL*
10	120 621 671 673	105	30	07/10/72	10/22/72	
11	120 621 672 673	105	30	07/10/72	10/22/72	
12	120 632 671 673	135		06/10/72	10/22/72	*CRITICAL*
13	120 632 672 673	135		06/10/72	10/22/72	*CRITICAL*
14	120 641 671 673	115	20	06/30/72	10/22/72	
15	120 641 672 673	115	20	06/30/72	10/22/72	

Results and Student Feedback

Two sources of data and experiences exist from which the pedagogical effectiveness of the IBM concept may be evaluated. First is the instructor's longitudinal observations over the three classes and comparison with previous courses. From this perspective the IBM simulation seems to be an improved educational aid for the various reasons given in the text of this paper including most importantly:

1. Its experiential nature

2. Reliance on group projects which reflect needed interpersonal and interdisciplinary approaches to system design

3. Replication of real world complexity, time pressures and technical difficulties

4. Ability to obtain an overview and understanding of the entire budgeting system.

Another source of feedback was student course evaluations that were collected in two of the courses. Although such appraisals are the result of a single exposure to the course and although student opinions are anything but consistent, the following critical and supportive quotes do lend positive evidence as to the overall usefulness and difficulties of the IBM in MIS education:

Critical

"Learned nothing about systems - only APL"

"Too much time was required with respect to coding"

"The IBM project was trying to cover too much material"

"Students tend to underestimate the effort involved in such a project"

"I learned nothing about planning and control ... too much time was wasted on the IBM"

Supportive

"IBM was creative and practical application of course subject matter"

"The IBM ... proved to be quite a meaningful education experience"

"Contributed much to my understanding of the budgeting process"

"An enjoyable learning experience"

"I especially liked working on the project although it does become time-consuming"

"Great learning experience"

"IBM was an excellent idea"

"The IBM was a demanding and interesting experience ... most of the (course) concepts acquired could be used in its design"