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INCORPORATING DECISION SUPPORT SYSTEMS INTO MANAGEMENT SIMULATION GAMES: A MODEL AND METHODOLOGY

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ABSTRACT

In an attempt to overcome some of the limitations and criticisms of simulation games, a model was developed linking a simulation game (IMAGINIT) with a decision support system (IFPS) for use in Business Policy courses. The procedure provides students with a methodology (student generated) that should improve their decision making and strategic planning.

INTRODUCTION

Although simulation games have been used in collegiate schools of business for two decades, they have been subjected to extensive and often critical reviews (Neuhauser, 1976; Wolfe, 1976; Frazer, 1978). A fairly frequent theme of criticism has centered upon the lack of a model or system allowing game participants to better utilize and integrate the data generated (Hand and Sims, 1975; Lill, et al., 1980). Wolfe (1976) stated that:

The use of simulations does not appear to encourage a deliberate and objectively analytical approach to strategy making and organizational structuring nor does it lend to the generation of systematic control or management information systems (p. 54).

It seems ironic that on the one hand simulation games are designed to replicate (in various degrees) a real- world managerial system, yet on the other hand do not provide a means of massaging data as done in the real world. It is the authors' contention that this missing link may account for a good deal of the criticism by both simulation game players and administrators.

There is no question that students can be subjected to a great deal of information overload and uncertainty in many simulation games. Certainly some of this is necessary and intentional in say, a business policy course if it is to be consistent with AACSB guidelines. Yet even with one decision variable the student may be faced with hundreds or even thousands of potential combinations. One approach is to simply expect (or demand) that the student will apply the decision-making tools he/she has learned in business school. To utilize many of these tools (even with computerized assistance) requires a great deal of time and effort which may become secondary to the immediate time demands for understanding the games' mechanics, group decisions, and broader planning. Another pitfall is that many students have never used these tools in an applied environment. The problem is exacerbated by the fact that complex simulation games make it impossible, impractical, or very costly to generate numerous simulations utilizing different decision values on a completely interactive basis.

In order to overcome some of these limitations, the authors have designed a model incorporating a decision support system into a total enterprise simulation game which more closely reflects what managers are doing in today's business world.

SIMULATION GAME

The simulation game utilized is THE IMAGINIT MANAGEMENT GAME (Barton, 1978) which one of the authors has administered in business policy and strategy courses for the past eight years. IMAGINIT is a fairly complex, interactive, total business simulation game. The game has a high degree of uncertainty requiring considerable skill in the decision-making process.

In the business policy course, the game is played on a team basis and typically consists of a "practice" play with three simulated periods and then a "real" play with ten simulated periods utilizing a different version of the game. In the past, students were required to prepare pro-forma income statements and cash budgets before submitting their decisions. The intent being to get them closer to a "what-if" mode of thinking and analyzing cause-effect relationships both on strategic and tactical variables. The results always appeared quite mixed; some groups did actually prepare multiple versions based on different values and assumptions while others conducted superficial analyses. When asked to supply a rationale for their decision, the frequent response was "we didn't assess the potential impact of the change." Clearly, the need exists for an improved methodology.

DECISION SUPPORT SYSTEM

The use of DSS by numerous managers is well documented in the literature. For example, Klein (19s2) reported that s5% of the largest firms in the United States utilized computer based financial modeling and that the most frequently used tool was "what-if" analysis followed by sensitivity analysis. Furthermore, of the typical corporate departments, these tools were most frequently used by the strategic planning group. However, it is extremely difficult if not impossible for decision makers to construct experiments which exactly replicate various phenomena under examination. That is, the manager/decision maker does not have the equivalent of the scientist's laboratory. Fortunately, it is possible to utilize modern computer technology to emulate some of the numerous variables and parameters which effect one or more related decisions. Although the laboratory provided by DSS tools are not as realistic or nearly as perfect as the laboratory of the

scientist, it is a step in the right direction and will continue as the technology is improved and integrated into executive support systems (Hayen and Callen, 1983).

The use of DSS generators provides the decision maker with tools to improve the quality, effectiveness, efficiency, and productivity in structured decision tasks. The components of the system allow the manager to assess, "what has been," "what is," "what does it mean," and to perform "what ifs" and "risk analysis." The "what has been" and the "what if" component is accessed through the data base system, while the "what does it mean" component is approach-. ed through the statistical analysis. The "what ifs" and "risk analysis" are approached through the modeling system. If the decision maker does not require much data and the statistical analysis is not too complex, then the modeling system may perform all three functions.

In this paper, the authors illustrate the use of a DSS generator called the Interactive Financial Planning System, (IFPS) which was developed by Execucom Corporation of Austin, Texas. The use of IFPS provides students with the ability to analyze systematically both tactical and strategic variables of a simulated business without the cumbersome paper work normally encountered in such projects. It is difficult to incorporate and illustrate to students the use of computer technology in many areas of business but DSS provides the student with a portfolio of computer tools which can improve the quality and quantity of decisions in a short period of time. The student also develops an understanding of the risk and returns associated with these systems. Clearly, students make decisions not IFPS.

What is IFPS?

IFPS is a decision support system generator. It has been developed over the last several years and is used by more than four hundred major U.S. corporations and over one hundred and fifty universities. It is one of the more popular and widely used planning systems. IFPS is not what is commonly referred to as a spreadsheet language which is available on many micro computers. IFPS is a sophisticated computer based financial modeling or planning and budgeting system. Some of the major features of IFPS are:

(1) User friendly,
(2) User interface is simple and natural,
(3) English syntax of language and supports the use of common business terminology,
(4) Easy to learn and master,
(5) Non-procedural language,
(6) Dynamic versus static system, i.e., the system accommodates diverse levels of proficiency; and,
(7) IFPS has demonstrated its maintainability, reliability and availability.

LINKING IFPS AND IMAGINIT

The incorporation of IFPS and the IMAGINIT Game is a relatively simple task. Both IFPS and IMAGINIT are written in FORTRAN. The task of joining the systems is merely a process of passing data between IMAGINIT and IFPS. IMAGINIT requires the decision maker or decision group to provide various decision values which are inputted to the simulator then entered into the IMAGINIT simulation game. The data items are the various decision variables which the student/group must determine from period to period. This process continues interactively for a number of predefined periods. The ultimate goal being to maximize the firm's wealth in a competitive environment.

IFPS is utilized by the student/group each period to examine various alternatives in terms of tactical and strategic variables. Each period's output variables which are normally printed and distributed to the student/group are written to a file and this data is passed to IFPS as a data file. The data is then accessed by an IFPS model. The latter may be a pro-forma income statement, cash flow budget, sources and uses of funds statement, or a balance sheet model. This is determined by the students proficiency and creativity with respect to the DSS generator - IFPS.

The student/group is able to experience the use of a DSS generator and focus their energies on various aspects of the game without the drudgery of numerous mundane hand calculations. That is, the student/group concentrates on elements of the data base and their relationship with other variables in terms of complex interactions which would be difficult to illustrate without numerous additional experiments and experiences. In other words, IMAGINIT creates the data base consisting of finance, production, marketing, personnel, and other data. IFPS provides a data base management and model system for the decision maker to effectively explore alternatives.

Perhaps the most important phenomena is that students will develop their own models, and develop an understanding of the relationship of key variables. If a student can develop an IFPS model of a particular phenomenon (for example a cash flow projection), the student/group then understands the phenomenon and develops a deeper understanding of the problem.

OPERATING THE SYSTEM

In order to utilize the DSS generator, the student merely accesses the university's computer where IFPS resides. (Appendix I) The student/group logs onto the system and enters a single command which executes IFPS. The student/group then provides IFPS with a file name where one or more predefined models have been developed. The student/group is able to explore numerous alternatives and combinations of alternatives on all IMAGINIT variables for each of their decision periods (a group/ student which has no experience with IFPS can utilize a command file procedure which determines all values of the variables interactively).

Appendix II represents the IMAGINIT pro-forma income model designed by the authors. Appendix III illustrates an example of how students use IFPS. The first illustration is an example of a new set of student decisions and the resulting pro-forma income statement. The second illustration is "what-if" where we have changed the price of one of the products and determined the effect on net earnings. Students can also perform sensitivity analyses by specifying percentage changes in price and the resulting impact on net earnings (Appendix III). The final example we have chosen to show is a goalseeking situation where students can specify the desired or target net earnings. The IFPS model then calculates the value of the variable, ceteris paribus, necessary to achieve this result (Appendix III).

SUMMARY

While we have shown only a few examples of IFPS operations on an IMAGINIT game data base, the potential exists for many more operations. For example, IFPS allows for Monte Carlo risk analysis which would be useful as a strategic planning tool.

Hopefully, the methodology of combining an active student generated data base in the form of a simulation game with a DSS will go a long way toward improved decision making. Other potential benefits include improved strategic planning and moving closer to a "pro-active" mode of planning rather than "re-active."

At the present time, the authors have had limited student use of the process. However, indications are that students will now have the opportunity to improve considerably their simulation game performance and learn more from this added experiential experience.

APPENDIX I

IFPS Model PROFORMA for IMAGINIT Game

1) Logon to SSS (see class handout with illustration)

2) Execute IFPS

```
$MCR IFPS

INTERACTIVE FINANCIAL PLANNING SYSTEM - V 9.10

ENTER MODEL AND REPORT FILE NAME

?IMAGINIT                    --M&R FILE
```

3) Access IFPS model called PROFORMA with data files

```
?MODEL PROFORMA USING IMAGDATA,IMAGPAR
```

4) Solve model as illustrated in class notes and handouts. You may perform what if's, sensitivity analysis, modify data files, goal seeking, etc.

5) To leave, (exit) IFPS enter the following command:

```
?QUIT
```

6) To log off the SSS system enter the following command:

```
$logoff
```

IF YOU HAVE PROBLEMS PLEASE CONTACT ME OR THE IFPS CONSULTANT

APPENDIX II

IFPS MODEL PROFORMA For the IMAGINIT GAME

```
601  SALESMEN COST A1 = EXPECTED SALESMEN COST A1
611 SALESMEN COST A2 = EXPECTED SALESMEN COST A2
621 SALESMEN COST B1 = EXPECTED SALESMEN COST B1
631 TOTAL SALESMEN COST = SUM( L601 THRU L621)
641 *
651 ADVERTISING COST A1 = EXPECTED ADVERTISING COST A1
661 ADVERTISING COST A2 = EXPECTED ADVERTISING COST A2
671 ADVERTISING COST B1 = EXPECTED ADVERTISING COST B1
681 TOTAL ADVERTISING COST = SUM(L651 THRU L671)
691 *
701 *
711 RESEARCH AND DEVELOPMENT COST A1 = EXPECTED R AND D COST A1
721 RESEARCH AND DEVELOPMENT COST A2 = EXPECTED R AND D COST A2
731 RESEARCH AND DEVELOPMENT COST B1 = EXPECTED R AND D COST B1
741 TOTAL RID COST = SUM(L711 THRU L731)
751 EMPLOYEE FRINGE BENEFITS  A1 = STANDARD LABOR HOURS A1 * FRINGE BENEFIT RATE
761 EMPLOYEE FRINGE BENEFITS A2 = STANDARD LABOR HOURS A2 * FRINGE BENEFIT RATE
771 EMPLOYEE FRINGE BENEFITS B1 = STANDARD LABOR HOURS B1 * FRINGE BENEFIT RATE
781 *
791 TOTAL EMPLOYEE FRINGE BENEFITS = SUM(L751 THRU L771)
801 *
811 OPERATIONS RESEARCH = EXPECTED OPERATIONS RESEARCH EXPENDITURE
821 *
831 ADMINISTRATIVE OVERHEAD = ESTIMATED ADMINISTRATIVE OVERHEAD COSTS
841 *
851 INTEREST  = ESTIMATED INTEREST EXPENSE
861 *
871 PROFIT BEFORE INCOME TAXES = L591 -L631 - L681 - L741 - L791 - LR11 - L831  - L851
881 *
891 INCOME TAX  = MINIMUM ( MAXIMUM (0, INCOME TAX RATE*L871) )
901 CASH TAX REFUND = IF L891 .EQ. 0  THEN INCOME TAX RATE * L871 ELSE 0
911 NET EARNINGS = L871 - L891 + L901
921 *
END OF MODEL

111 *     IMAGINIT MODEL # ONE
121 *     PRO FORMA INCOME STATEMENT
131 *
141 *
151 *
161 TOTAL REVENUE OF A1 = SHIPMENTS IN UNITS OF PRODUCT A1*PRICE OF A1
171 TOTAL REVENUE OF A2 = SHIPMENTS IN UNITS OF PRODUCT A2*PRICE OF A2
181 TOTAL REVENUE OF B1 = SHIPMENTS IN UNITS OF PRODUCT B1*PRICE OF B1
191 TOTAL SALES REVENUE = L161 + L171 + LI81
201 *
211 *COST OF GOODS SOLD
221 *
231 DIRECT LABOR COST A1 = PRODUCTION LEVEL A1*STANDARD LABOR HOURS PER UNIT A1*FIRM LABOR RATE
241 *
251 DIRECT LABOR COST A2 = PRODUCTION LEVEL A2*STANDARD LABOR HOURS PER UNIT A2*FIRM LABOR RATE
261 *
271 DIRECT LABOR COST B1 = PRODUCTION LEVEL B1*STANDARD LABOR HOURS PER UNIT B1*FIRM LABOR RATE
281 *
291 EXPECTED OVERTIME COSTS =EXPECTED OVERTIME COSTS
301 EXPECTED SHIFT CHANGE COSTS = EXPECTED SHIFT CHANGE COSTS
311 TOTAL DIRECT LABOR COSTS = SUM(L231 THRU L301)
321 *
331 *
341 *  DIRECT MATERIALS
351 *
361 DIRECT MATERIAL COSTS A1 =PRODUCTION LEVEL A1*MATERIAL INPUTS PER UNIT A1
371 *
381 DIRECT MATERIAL COSTS A2 = PRODUCTION LEVEL A2*MATERIAL INPUTS PER UNIT A2
391 *
401 DIRECT MATERIAL COSTS B1 = PRODUCTION LEVEL B1*MATERIAL INPUTS PER UNIT B1
411 *
421 TOTAL DIRECT MATERIAL COSTS = L361 + L381 + L401
431 *
441 STORAGE COSTS = ESTIMATED STORAGE COSTS
451 *
461 FACTORY DEPRECIATION = ESTIMATED DEPRECIATION
471 *
481 OTHER FACTORY OVERHEAD = ESTIMATED FACTORY OVERHEAD
491 *
501 COST TO MANUFACTURE = L311 + L421 + L441 +L461 + L481
511 *
521 CHANGE IN FINISH GOODS ON HAND FOR PRODUCT A1 = ESTIMATED I$ CHANGE IN INVENTORY A1
531 CHANGE IN FINISH GOODS ON HAND FOR PRODUCT A2 = ESTIMATED I$ CHANGE IN INVENTORY A2
541 CHANGE IN FINISH GOODS ON HAND FOR PRODUCT B1 = ESTIMATED I$ CHANGE IN INVENTORY B1
551 TOTAL CHANGE IN FINISH GOODS ON HAND I(I$I) = SUM(L521 THRU L541)
561 *
571 COST OF GOODS SOLD = L501 - L551
581 *
591 GROSS PROFIT ON SALES = TOTAL SALES REVENUE - L571
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APPENDIX III

STUDENT TERMINAL SESSION
USING INITIAL DATA AND PARAMETER VALUES

		INITIAL VALUE
161.00	TOTAL REVENUE OF A1	$ 7,000,000.00
171.00	TOTAL REVENUE OF A2	$ .00
181.00	TOTAL REVENUE OF B1	$ .00
191.00	TOTAL SALES REVENUE	$ 7,000,000.00
COST OF GOODS SOLD		
231.00	DIRECT LABOR COST A1	$ 1,800,000.00
251.00	DIRECT LABOR COST A2	$ .00
271.00	DIRECT LABOR COST B1	$ .00
291.00	EXPECTED OVERTIME COSTS	$ .00
301.00	EXPECTED SHIFT CHANGE COSTS	$ .00
311.00	TOTAL DIRECT LABOR COSTS	$ 1,800,000.00
DIRECT MATERIALS		
361.00	DIRECT MATERIAL COSTS A1	$ 3,000,000.00
381.00	DIRECT MATERIAL COSTS A2	$ .00
401.00	DIRECT MATERIAL COSTS B1	$ .00
421.00	TOTAL DIRECT MATERIAL COSTS	$ 3,000,000.00
441.00	STORAGE COSTS	$ .00
461.00	FACTORY DEPRECIATION	$ 200,000.00
481.00	OTHER FACTORY OVERHEAD	$ 430,000.00
501.00	COST TO MANUFACTURE	$ 5,430,000.00
521.00	CHANGE IN FINISH GOODS ON HAND FOR PRODUCT A1	$ .00
531.00	CHANGE IN FINISH GOODS ON HAND FOR PRODUCT A2	$ .00
541.00	CHANGE IN FINISH GOODS ON HAND FOR PRODUCT B1	$ .00
551.00	TOTAL CHANGE IN FINISH GOODS ON HAND ($)	$ .00
571.00	COST OF GOODS SOLD	$ 5,430,000.00
591.00	GROSS PROFIT ON SALES	$ 1,570,000.00
601.00	SALESMEN COST A1	$ 40,000.00
611.00	SALESMEN COST A2	$ .00
621.00	SALESMEN COST B1	$ .00
631.00	TOTAL SALESMEN COST	$ 40,000.00
651.00	ADVERTISING COST A1	$ 210,000.00
661.00	ADVERTISING COST A2	$ .00
671.00	ADVERTISING COST B1	$ .00
681.00	TOTAL ADVERTISING COST	$ 210,000.00
711.00	RESEARCH AND DEVELOPMENT COST A1	$ .00
721.00	RESEARCH AND DEVELOPMENT COST A2	$ .00
731.00	RESEARCH AND DEVELOPMENT COST B1	$ .00
741.00	TOTAL RD COST	$ .00
751.00	EMPLOYEE FRINGE BENEFITS A1	$ 300,000.00
761.00	EMPLOYEE FRINGE BENEFITS A2	$ .00
771.00	EMPLOYEE FRINGE BENEFITS B1	$ .00
791.00	TOTAL EMPLOYEE FRINGE BENEFITS	$ 300,000.00
811.00	OPERATIONS RESEARCH	$ .00
831.00	ADMINISTRATIVE OVERHEAD	$ 334,000.00
851.00	INTEREST	$ 32,000.00
871.00	PROFIT BEFORE INCOME TAXES	$ 654,000.00
891.00	INCOME TAX	$ 300,840.00
901.00	CASH TAX REFUND	$ .00
911.00	NET EARNINGS	$ 353,160.00

```
? WHAT IF
WHAT IF CASE 2
ENTER STATEMENTS
? PRICE OF A1=4000
? SOLVE
```

```
ENTER SOLVE OPTIONS
? NET EARNINGS,TOTAL REVENUE OF A1


***** WHAT IF CASE 2 *****
1 WHAT IF STATEMENT PROCESSED

                              1

NET EARNINGS              893160
TOTAL REVENUE OF A1      8000000

ENTER SOLVE OPTIONS
? SENSITIVITY
ENTER VARIABLE TO BE STEPPED
? PRICE OF A1
ENTER START,STOP,STEP PERCENTAGES
? 12.5,15.0,2.5
ENTER VARIABLES TO BE PRINTED
? NET EARNINGS


***** WHAT IF CASE 2 *****
1 WHAT IF STATEMENT PROCESSED

SENSITIVITY ANALYSIS FOR  12.5 PER CENT CHANGE IN PRICE OF A1

    NEW VALUES

                              1

NET EARNINGS             1433160

    CHANGE FROM BASE

                              1

NET EARNINGS              540000

    PERCENT CHANGE FROM BASE

                              1

NET EARNINGS               60.46


SENSITIVITY ANALYSIS FOR    15 PER CENT CHANGE IN PRICE OF A1

    NEW VALUES

                              1

NET EARNINGS             1541160

    CHANGE FROM BASE

                              1

NET EARNINGS              648000

    PERCENT CHANGE FROM BASE

                              1

NET EARNINGS               72.55

? GOAL SEEKING
GOAL SEEKING CASE 1
ENTER NAME OF VARIABLE(S) TO BE ADJUSTED TO ACHIEVE PERFORMANCE
? PRICE OF A1
ENTER 1 COMPUTATIONAL STATEMENT(S) FOR PERFORMANCE
? NET EARNINGS = 1.25*NET EARNINGS


***** GOAL SEEKING CASE 1 *****

                              1

PRICE OF A1                3173

ENTER SOLVE OPTIONS
? QUIT
SAVE UPDATED M&R FILE IMAGINIT (YES OR NO)
? YES
FILE UPDATED RETURNING YOU TO OPERATING SYSTEM
%LOGOFF
```

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