THE EXECUTIVE EDUCATION EXPERIENCE USING THE TORONTO MANAGEMENT GAME

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INTRODUCTION

This paper presents a report on an experimental business game. The game represents an application of a simulation of a prototype management decision system. The basic conceptual model of the game follows from recent ideas generated by Ackoff [1], Morton [2], and others. The game portion of the system acts as an operating system in which the manager or student engages in structuring behavior.

Business games have come to be classified or grouped, as, for example, by Bobb and Eisgruber [3], in terms of "simple" or "complex", and of whether they are intended for teaching, training, and/or research. This report is concerned with a complex game aimed at training MBA students and executives in business management. The game is also intended to have potential as a research device. Yet, as will be seen, the game sits awkwardly within this traditional classification scheme if at all.

A consensus has gradually arisen, well stated by Amstutz and Claycamp [4,p.47], that such a game should teach "skills in organization, problem solving, communications, and interpersonal relations" because these "are essential to successful administration in a complex dynamic, and uncertain business environment in which results must often be achieved by influence rather than direct control". There is certainly an issue as to whether these should be the central goals; this aspect will be discussed later. However, the above goals may be at least a subset of the goals in using a "complex" game. The usual game designed to achieve such goals pits groups of human players against each other in inserting short-run decisions into a complex simulated environment. This differs markedly from the real world. The decisions of managers in reality are filtered through a hierarchical organization with a line staff dichotomy. Often the most crucial problem for a manager is to get the organization he runs to insert something close to the desired decision into the real environment.

The argument could be made - and is just about to be made - that such complex games are seriously dysfunctional. This is because these games train students about decision-making in an organizational environment so different from reality. The implied assumption of many existing games is that the hierarchical nature of real organizations is irrelevant and that staff functions are immaterial and unimportant. If this is so, then the present set of existing complex games is perfectly adequate. But suppose this is not so. Resolution of the question is possible only if hierarchically complex games are available. The provision of such a game was the rationale for constructing the business game discussed in this paper.

Is such a goal achievable? This is the central question. To attempt to answer it requires a discussion of the design goals of the game, the design implementation, a brief summary of how the game has behaved in actual use, and a report of what is yet undone. The above statement represents a capsule outline of this report.

DESIGN GOALS

The central design goal for this game came from a prediction made recently by Ackoff [1]. The prediction was that the computer, mathematical models and data bases would act as an extension of a managers capability as a decision maker. By placing the manager in the proper configuration one could create a "management decision system". Very little is known about how a manager operates in such an environment or how we train such a manager to operate effectively. Morton [2] points out that significant changes in organizational structure take place when a management decision system is created. Much less is known about how to design such organizations effectively. The basic design goal for the game described in this paper was to provide a vehicle to answer such questions: that is, the game was supposed to be one which could be used to teach management of man-computer organizations, and which could be used to perform research on the problems of man-adaptive, decision-making, computer organizations. This means that an attempt to impose a hierarchical structure upon human players as the central feature of the game design was rejected.

The organization of the game firm should have at least two levels of hierarchy, with some of the decision making usually done by the lower echelons. The game should provide humans with staff functions and with a data base. The staff functions should be designed to enable players to gain experience in using formal analysis based on the data base, in a "what-if" mode. If there are to be lower echelons, top management must be capable of firing and hiring them. Thus the basic character of the game design is a simulation of an environment and a simulation of a task- oriented, decision making, management group, where the outcomes from both simulations depend upon the actions of the human management team. The rest of this paper will contain a discussion of how a game was designed which apparently met some of the above goals. The game has been used as a teaching and research tool in the executive development program of The University of Toronto.

DESIGN IMPLEMENTATION

The gaming system developed to implement the goals outlined earlier includes four components: the manager - student, the management game, the data base and the model bank. The relationships existing between these components are outlined in figure 1.

Implementation of the design goals entirely from scratch would be a gigantic task, and one which was not attempted. Instead, the simulation of the environment was built upon the basic model and programs of the Harvard Management Game [5]. This environment simulates, roughly, the traffic (i.e. small, gift type) appliance industry. Examples of such

appliances would be electric knives, toasters, fry pans, etc. Each industry is composed of four to seven companies which may produce and sell from one to three products. At the beginning of each quarter of the simulation the firms must input decisions on product policy, advertising, pricing, market research, product research, promotion, inventory control, production scheduling, raw material and purchased parts ordering, manpower allocation and sources and applications of funds. A detailed description of the original simulated environment is given in McKenny, McFarlan and Sieler [5].

FIGURE I
MANAGEMENT GAMING SYSTEM
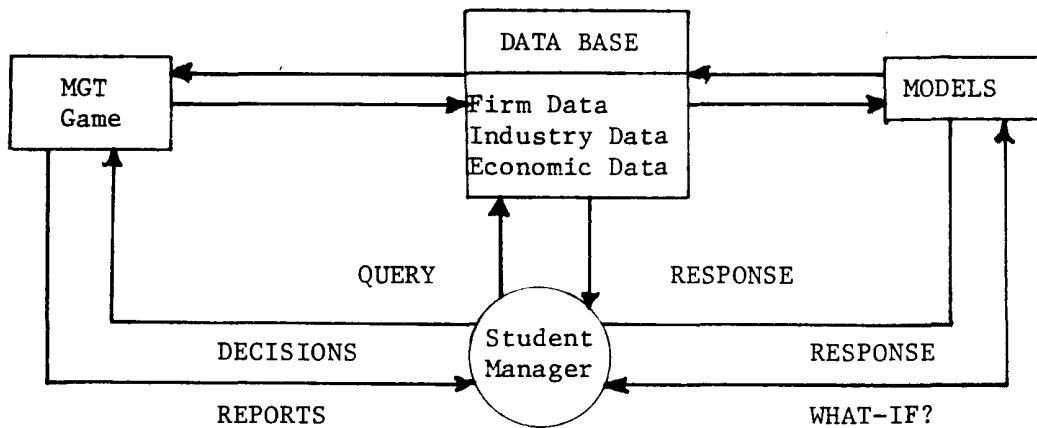
The first task was to take the program and make a number of revisions in order to get an error free run of the model. This took about three months of intensive activity. Finally, the entire program was rewritten to improve efficiency; run time was reduced by a factor of three. Then, work began on the construction of data bases and formal analysis modules.

The data base for the management game is composed of three files; a historical firm file, an industry file and an economic environment file. The firm file includes historical data on the internal operations of the firm and is updated after each decision is made in the game. Firms may also purchase data related to the marketing environment in the form of market research analyses.

Typically the participants in the gaming exercise receive a date file that includes one or two years data upon beginning the game. The industry file contains data pertaining to the operation of the competing firms. Minimally each data file contains accounting data which would typically be available for publicly held companies and marketing data obtainable through comparative shopping. Beyond this, a firm may purchase data each period on their competitors operations. This data would include measures of sales, quality, general marketing expenditures and related product information. The accuracy of the data is directly related to the dollar expenditure made for it.

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The final data file created for the firms includes data on the general economic conditions for each period and the behavior of the entire industry. At the current development level of the system this data is limited, however, future directions include plans for expansion of this file.

Methods of communicating with the data base outlined above are simple at this stage of development. This reflects a basic design philosophy that students should be taught that simple data base communication systems are desirable and useful. Initially MBA students were given the data in card format with instructions for the creation and deletion of on-line files. Thus they were given the opportunity to create their own data bases and then proceed to write their own software packages for manipulation and analysis of the data. Further developments of the system led to the creation of on-line data bases for each firm which could be accessed through interactive terminals. Participants in executive development programs were introduced to the system in this form. Rather than develop their own software packages the executives were given a package of interactive models which facilitated the analysis of the data.

The final component of the management decision system is the model bank. A primary objective for the development of the system was to provide students and managers with the opportunity to evaluate the use of simple planning models in a quasirealistic environment. Simple planning models are most readily exemplified by deterministic simulations with relatively few variables and equations. The concept of a management decision system as characterized by the authors emphasizes that the role played by the manager is not as a passive user of some complex computer system or model but as an integral part of the system. Thus he must be able to manipulate models that are easy to use and understand to create a system that may be unique to his particular management style or personality. The primary weakness of most complex systems developed to date does not lie in a lack of technical competence on the part of a modeler but in .a lack of flexibility and means of adaptability to different management styles. In short, complex models are too rigid for managers to use effectively in their dynamic environment. The models developed for this system are primarily automated pro forma generators for financial, marketing and production analyses. That is, the user poses "what if" types of questions and the models generate pro forma results based on these conditions. The following simple models have been developed to date:
short term profit planning; intermediate term profit planning; production planning; cash flow planning; marketing expenditure planning; simple market forecasting. Initially these models were accessed through a batch mode in which students provided a great deal of data each time a model was used. Recently, all models were converted to APL and are accessed through a terminal based interactive system in which the models access the on-line data bases and input required from the user is minimal. When provided with models in this form the user is able to create a modus operandi for the system which may be unique to his own management style.

Of course once a user becomes familiar with the use of simple models in a decision making environment he may wish to proceed to more complex formal forms of analysis. To this end, two additional packages have been developed which do permit this extension. First, a multiple regression based forecasting package is available for the development of

forecasting models for particular product, total firm or total industry demand. Second, a long range planning model is available which has optimization modules for production scheduling, marketing expenditures, media allocation, etc.

TEACHING OBJECTIVES

Most management games are designed with two particular purposes in mind: (a) to give students experience in group problem solving in a realistic environment and (b) to integrate material from various functional areas in a business curriculum. To achieve these goals the game is typically used in the second year of an MBA program as a separate component of the program or as part of a business policy course. While the above objectives are more or less achieved by the decision system outlined earlier, the basic purposes for which the system was developed are much broader. As a result, the placement of the game in the MBA curriculum is quite unique. The game is included as a component in a first year course required of all MBA students entitled "Management Information Systems". The following objectives pertain to MBA students: 1) to achieve an understanding of the capabilities of a computer 2) to understand the problems of data manipulation in a dynamic environment 3) to evaluate the informational value of alternative models 4) to develop the concept of a decision system 5) to evaluate the role of management information and control systems 6) to integrate functional topics in the curriculum 7) to develop an appreciation for group problem solving.

To achieve these goals, the MBA students "play" the game throughout the spring semester of their first year in the program. In addition to playing the game, they must develop a management decision and control system on paper which outlines a hypothetical reporting and decision system for their firm.

Executives in management development programs also "play" the game in conjunction with a course entitled "Computer Assisted Decision Making" (CADM). This course is an integral part of two eight week executive programs offered by the University of Toronto. The basic teaching objectives are obviously somewhat different for executives with extensive management experience. In most cases these individuals are acutely aware of problems in data manipulation, group problem solving and the interaction of functional areas in a firm. The basic objectives are as follows:
1) to develop an understanding of computer systems 2) introduction to the concepts of modeling and their informational value 3) to develop the ideas of a management decision system 4) to outline the concepts of management information and control systems. In particular instances the game has helped to integrate material for individuals with previous exposure to only one or two functional areas in a firm.

REVIEW OF TEACHING EXPERIENCES

The basic gaming system has been used in various levels of management education at the University of Toronto. Clearly, the goals vary in different programs and as a result the level of successful achievement

of the goals may also vary. MBA students have been exposed to the game for two years in various stages of development. Initially the students were given the data base in card form and the models were written in FORTRAN for use in a batch processing mode. The students were also given complete freedom to develop and implement models of their own design. The results of this experience were extremely varied. Some student groups deposited the cards to update the data base each period in the nearest waste basket and at most used a simple production planning model to assist in the scheduling task. At the other extreme, one group created a complete data base made up of data files provided by the instructor and files created independently by the group. In addition they wrote a number of software packages to assist in the analysis of the data. As might be expected, neither of these groups achieved, the best performance in the game. Invariably the group that achieved the highest level of performance supplemented the relatively simple models provided them with a few models designed for aggregate analysis. This set of models were then used in a formal manner to reach a decision in the game. The formal use of the models was described as a relatively stable plan or sequence of model use and feedback loops which could be termed a management decision system.

Use of the system in executive development programs also led to varied results. Participants in these programs (and later NBA groups) were provided with on-line data bases and interactive versions of the models. One group of executives, who may be categorized as middle management, adapted slowly to the use of the models. As might be expected, they preferred to do all analysis by hand initially, and once the decision environment and processes were understood, they adopted the models. Generally, this group did not progress beyond the use of the six simple planning models. They did however, request other simple models, and toward the end of the program they generally had developed a formal system for making decisions. While their use of models was not as sophisticated as the MBA students, their performance in the game was vastly superior.

The most recent experience with the gaming system involved a group of senior executives in a senior management development program. There was great focus in this program on the relation between a firm and its environment; i.e., the program was externally oriented. In contrast to the middle level managers this group proceeded directly to the use of the interactive models. However, their level of sophistication in the use of the models to develop a decision system was not nearly as high as the former executive group. Additionally, they requested the game experience stop prior to its scheduled stop on the basis that "they had learned all they needed from this one experience but it does appear that 1) the game works better when it can be tied to other material being taught, which was not true for the latter half of this senior management development program, and 2) that since the senior executives did not fully understand the decision problems in the game, they could not use the models in a completely effective manner.

Since the gaming system has been used in varied stages of development it is difficult to accurately assess the achievement of objectives. There is significant evidence to suggest however, that the groups did develop an appreciation of the value of decision systems composed of models, data, and people and that they were highly motivated to learn

more about the entire field of computer assisted decision making. This in itself indicates the game has a kind of teaching value not found in many other "complex" games.

REDESIGN GOALS

Future development of the game rests on three general goals: 1) enhance the games' educational value 2) enhance the games' research value 3) reduce costs of administering the game. To achieve these, two different types of subgoals are proposed. The first group relates to improving the educational and research value of the game. Clearly the major modeling step that remains is to construct, as part of the game, a simulated organization for the game players to manage. The general nature of this simulation would follow the outline discussed in Haines [6]. Thus, there would be at least two levels of hierarchy, with some decision making usually done by these lower (simulated) echelons. If there are to be lower echelons, top management must be capable of firing and hiring them. The basic character of the game design is then a simulation of an environment and a simulation of a task-oriented, decision making, management group, where the outcomes from both simulations depend upon the actions of the human management team.

Each firm will come equipped with a set of middle managers, in the form of computer programs, who are capable of producing quarterly operating decisions. Below the middle managers will be clerks. Clerks perform clerical functions, and can not be fired by top management. The clerical functions in the firm will be internal collection of data, arrangement of data for the middle managers, protection against industrial espionage, carrying on of decisions, and transmission of decisions into the game environment. The carrying on of decisions means that once a decision is made the clerks will see to it that the same decision will continue to be made in all future quarters unless the top or middle management alters it. Thus the clerks will remove the requirements that a large number of numerical decisions must be put into the simulated environment by the human players each quarter. Only those decisions which are different from the past must be put in each quarter.

Very often the top management of a firm will reserve for itself actual operating decisions in critical areas of decision making. The game will be designed so as to make this the case. Product policy, product research, some aspects of inventory control, production scheduling, and sources and applications of funds will all definitely remain top management tasks. Also, the middle managers will be designed to be integrated with the aspects of the existing staff programs which relate to market forecasting and marketing expenditure planning.

The intent is to provide initially middle managers for all other quarterly operating decisions. The middle managers will receive guidance in the form of control parameters which have the effect of setting a policy within which the middle manager operates. The players will receive a detailed list of the control parameters, program listings for their own managers, flow diagrams, variable dictionaries, and verbal descriptions of how the middle managers operate.

Any of the middle managers may be fired by the top (human) management. If the players fire a middle manager, they must either replace him with a manager of their own construction or take over the quarterly decision task in this area themselves. The players, it's hoped, will also be able to institute any other managers they design themselves.

CONCLUDING COMMENTS

This report has described the present status of the University of Toronto game. The nature of the game has been described, experience to date in use of the game has been presented, and an outline of work in progress to complete the game development given.

We guess that in the future managers will be required to use computers in a variety of ways to successfully manage. The purpose of this game is to teach students how to be effective managers in such a world. We expect, in about fifteen or twenty years, to be able to assess just how adequate a vehicle the game was in achieving these goals.

ACKNOWLEDGEMENT

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