MANAGEMENT GAMES AND COMPUTERS

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Management Games

Management games, although a relatively new educational technique, are being widely utilized, and much discussed. They are primarily of concern to the educator and to the research scientist, but since many of these games are played with the aid of an electronic computer, they should be of interest to computer people in general. In addition to the use of a computer for existing games, new games are being developed and will require programming. Many papers have been published on the educational aspects of management games; this paper has been written primarily to arouse interest in them as a computer application.

The first management game to become widely known was one developed by the American Management Association in 1956. It continues to be used, along with four or five other games since developed by A.M.A., as part of their management education courses and seminars. Over one hundred different management games now in use are listed in a forthcoming book on the subject*, and more than 30,000 executives have participated in at least one of them.

It seems worthwhile to give a brief description of a typical game play for those who have never participated. The Remington Rand Univac Marketing Management Simulation will be used as an example.

The game session begins with a briefing. At this time the instructor describes to the participants the type of company they are about to manage, the economic environment, the general nature of the product, and the competitive forces they will face. He also discusses the scope of their authority, the functions to be filled, the decisions to be made, and the information they will receive.

The participants are divided into management teams, and after the briefing, the various teams meet to develop an organization, set objectives, and decide upon policies and procedures. In a typical game, involving perhaps forty to fifty executives, there might be six teams each with seven or eight members.

Games are played in "periods," with a period, depending on the particular game, being a simulated day, week, month, quarter or year. The Univac Marketing Game takes place in months. The participants are given operating statements for December and begin by making decisions for January. In addition to the operating statements they are also provided with a case history, sales forecast, and data on material and operating costs, production facilities, and shipping times.

The decisions for January are processed by the computer and operating reports are produced, and are returned to the participants. Decisions are now made for February, and so forth, perhaps for one simulated year. In a typical play the companies have a half-hour in which to make decisions, and reports are returned about ten minutes after the decisions have been submitted.

In the Univac Marketing Game, each company manufactures one product and markets it in three different regions, East, West, and South. All companies are competing in the same consumer market. The managers set price, spend money on advertising, hire or fire salesmen, set the salesmen's compensation rate, set production level, engage in special market research projects, etc. The total market is shared among the companies according to their pricing and advertising policies, according to the number of salesmen and their degree of training, and so forth. The operating reports show the sales obtained, the net profit achieved, inventory on hand, etc. The report also shows the number of salesmen on hand; companies can pirate experienced salesmen away from one another.

Each management attempts to achieve the largest possible accumulated net profit, and a "winner" might be proclaimed. This is usually discouraged, however, as good performance in a management game as in real business, depends on many factors such as return on investment, share of market, personnel policy, and numerous others that contribute to success. At the end of the game play, a discussion session takes place. This "critique" is held to focus attention on the

*Management Games, by Joel M. Kibbee, Clifford J. Craft, and Burt Nanus, soon to be published by the Reinhold Publishing Company.
lessons which were to be taught, and it gives the participants the opportunity to review their performance, discuss management principles with other members of the group, and receive feedback from the game administrator and other observers.

Existing management games vary widely in the types of models used. The original A.M.A. Game, and similar games developed by IBM, UCLA, Pillsbury and other organizations, are concerned with general management. The Carnegie Tech Management Game is based on the detergent industry. Other games exist for banking, petroleum, telephone exchanges, insurance companies and super markets. Some games concentrate on a particular management function, such as marketing, materials management or manufacturing. There is a game concerned with the management of a gas station, and three different existing games are based on an auto dealer model. The military have, of course, been playing war games for many centuries, and they are now utilizing computers for this purpose.

Most games are played by one or more management teams, where a team might be made up of anywhere from one to twenty executives. Since most games contain some obvious measure of performance there is always a "rivalry" between teams. There may or may not be a direct "interaction." In a marketing game various teams may be in competition for a common market, and the action of one team, say price of its product, will affect all other teams. In an inventory control game, on the other hand, each team is attempting to achieve the best performance beginning from the same conditions. A game with interaction is like tennis, a game without interaction is like golf. Both such games engender rivalry.

The word "competitive" has often been used in the classification of games, usually as synonymous with interaction. There is, however, an economic meaning for "competition," namely, competing for a share of a common market. A marketing game would include competition, but such competition can be either of an interactive form, with the competitors being other participating teams, or a non-interactive form, in which the economic competition is built into the model itself.

Games also differ as to the level of management for which they are intended. They differ widely as to the complexity of the model. Some are meant to be played quickly, others require considerable analysis. In general, then, a management game is a dynamic case history in which the participants, faced with a simulated business situation, make decisions, and are fed back reports based upon these decisions.

**Manual and Computer Games**

Management games, like the business situation they simulate, require that information be processed and calculations made. The extent of the computations depend on the particular game, and may require anything from a pencil to a large computer. This has given rise to an obvious classification into manual games and computer games. Computers are used for management games for the same reasons they are used in any business application, primarily to perform computations speedily, accurately, and automatically. Computer games can also be more flexible, as will be discussed more fully below.

Some rather odd advantages have been attributed to manual games. It has been stated, for example, that manual games can be made very simple and easy to play. Obviously a computer game can be made just as simple, though there is a temptation to use the full capacity of the computer with a resultant complexity that is not needed to satisfy the educational objectives. Similarly, one published statement claims that an advantage of manual games is less time pressure on the participants. Just because the computations are made rapidly does not mean that the participants must make their decisions quickly. Manual games do have advantages. They usually cost less initially, do not require special facilities, and can be scheduled as desired. Good design is required to keep down the number of clerks and administrators needed. There are so many advantages to computer games, however, that, at least for this author, they seem well worth the development and operating costs.

Since games vary widely in complexity, it is not possible to state how much computer time or programming is generally involved. However, several moderately complex games which the author helped develop, and which were designed for a one or two day management exercise, involve something of the order of 3,000 to 5,000 instructions, and took from three to nine man-months to program. The total development cost of a game includes more than programming, however. More or less time can be spent on the creation of the model, consulting fees can be required, as well as the cost of materials and test plays. Most often the programmer is involved in the development of the model as well as the computer coding. These moderately complex games are usually designed for a one day management exercise and might involve five to eight hours of computer time, although the computer might actually be used only part of the time and be free for other processing between game periods. As an example, a play of the Univac Marketing Management Simulation, lasting for perhaps eight to ten simulated months, and accommodating about fifty executives, might cost $300 to $500 for computing time. The cost is about the same if the game is played discontinuously using a Univac Service Center. However, a group playing a game might also have non-computer expenses for special facilities, materials or staff.

It is not necessary to have a computer on the premises to conduct a management game. Recently, five different cities in the Midwest simultaneously played the Univac Marketing Game through the use of leased telephone lines. Of
more interest, however, is what we call the "dis-
continuous" mode of play. Decisions are made
perhaps once a week and mailed to a service center
and the reports are mailed back. This enables the
game to be played without infringing upon regular
production time since the game can be run at any
odd 15 minutes at the convenience of the center.
Many educational, industrial and professional
organizations are at this moment engaged in dis-
continuous plays of management games.

Management Games And Computer Personnel

Because of the widespread use of management
games, and their ever increasing growth, it is
likely that most computer installations will at
one time or another find themselves involved in
running a game session. Several computer man-
ufacturers have developed management games and
happily supply the programs to their users. Most
game computers developed by other business or ed-
ucational organizations are also available.

Directors of Training or of Management Develop-
ment are now generally interested in this new tool and
will probably be getting in touch with the manager
of the computer installation if they have not al-
ready done so.

The computer installation may also be called
upon to help develop and program a new management
game. Irrespective of their interest in education,
computer personnel will find that management games
can provide an excellent orientation to data proc-
essing for top management. It is sometimes dif-
ficult to get a company president to watch a pay-
roll demonstration, or a matrix being inverted,
but, as personal experience has shown, he can be-
come very much interested in the computer as a re-
sult of his involvement in a management game.

The data processing manager might consider
the use of management games for training per-
sonnel within his own department. A game called
SMART for systems and procedures managers was de-
developed a few years ago, and the System Develop-
ment Corporation developed a game called STEP for
use in training programming supervisors.

The Educational Advantages Of Management Games

Very little research has been done on the
validity of management games as an educational
tool, but a similar statement can probably be
made about most educational techniques now in use.
The most striking thing about a management game is
the involvement on the part of the participants.
One is continually impressed with the way in
which executives will work "after hours" in plan-
ing the operations for their simulated companies,
and it is generally necessary to bring in sand-
wiches and coffee rather than to attempt to in-
terrupt the play for a luncheon or dinner. Mo-
tivation is an important aspect of learning, and
management games are sometimes used at the start
of a course or seminar merely to stimulate
"students" towards a greater receptivity for
lectures or other types of training that will
follow.

Management games are superior to other ed-
ucational techniques for demonstrating the impor-
tance of planned, critically timed decisions; the
necessity of flexible organized effort; and the
significance of reaching a dynamic balance be-
tween interacting managerial functions. They can
also demonstrate the need for decision-assisting
tools, such as forecasts, control charts and
budgets. They can demonstrate to management the
power of a scientific approach to decision making.

Management games are educational tools, and
to be effective should be used along with other
techniques as part of an overall course or seminar.
The briefing and the critique are as important as
the actual play. Furthermore, most management
games involve many "incidents" which are not actually
part of the computer model. The participants
might be asked to formulate a personnel policy, or
to submit special reports. Job rotation, promo-
tions, appraisals, and so forth can all be made
part of the exercise. Much of the activity that
takes place -- in organizing, planning, commu-
nicating and controlling -- is in addition to the
numerical decisions which are submitted to the
computer. Management games continue to be de-
monstrated for a variety of reasons, but a demon-
stration is not a course, and a participant
should not form his opinion as to their educa-
tional merit from a few hours engaged in a dem-
onstration play.

Building A Management Game

Management games are constructed for educa-
tional purposes, and their construction is prem-
ised on a set of educational objectives. Working
from the objectives, a model which simulates a
business situation is constructed. One of the
most important constraints on the model is a need
for simplicity.

A game must be simple to play. This does
not mean that it needs to be easy to make good
decisions, but the participants should not have
to devote considerable time and energy to learning
the rules. It requires skill and experience to
abstract from the real world those elements of
major importance so that a playable game will re-
sult. It is here that a programmer must work
closely with the team that is building a game,
and vice versa, the team should get the programmer
into the act as early as possible. Skillful pro-
gramming can do much to simplify the mechanics of
play for the participants. A good program facil-
itates the manner in which the players submit their
decisions, and attempts to set up procedures which
will keep clerical errors to a minimum, and even
possibly have the computer edit the decisions for
obvious errors.

In the Univac Manufacturing Game, for ex-
ample, there are quite a few shipping decisions.
Suppose a company decides to ship 100 Clanks to
the Western Region, and 100 Clanks to the Eastern

From the collection of the Computer History Museum (www.computerhistory.org)
Region, but only has 160 Clanks on hand. The computer automatically interprets the decision as a desire to ship equally to both regions and 80 are sent, with no interruption in the game session. Similarly in games which have a limited cash on hand, the computer can issue emergency loans at some interest rate to accommodate an error on the part of the participants in spending too much money.

In some games, it is only necessary for the participants to circle code numbers on a decision form, rather than write out quantities with possible errors in the number of trailing zeros. The object of games is seldom to teach the participants to be less careless in their clerical tasks, and a good computer program can do much to eliminate clerical chores entirely so that the teams can concentrate on their decision problems.

While in university courses, and often in military games, the time spent on the game session might be lengthy, in most business applications only a day or so of a course or seminar can be devoted to the game exercise and simplicity for the participant is extremely important. This is one of the main constraints on the model, and even more on the computer program.

Experience has shown that the mathematical model used in management games can be extremely simple. One may begin with a curve, perhaps relating a demand to advertising expenditure, which is defined by a table of fifteen points. Later it is found that if only five points are used, the play from the standpoint of the participants is identical, and the author has actually used games in which all relationships are linear -- though there are many interacting ones -- without any apparent difference in the training experience. In the usually short time a company has to make its decisions, the mere fact that demand might depend on six or seven variables is seldom to teach the importance of planning and control rather than the specific relationship between inventory carrying costs and stockout costs. For such games verisimilitude and not realism is the most important attribute.

Verisimilitude is the appearance of reality. It is as important in management games as in the theater. As long as the relationship between price and demand, for example, seems similar to what goes on in the real world, and sufficiently engrosses the participant in the exercise, it is not important that the actual curve used, assuming even that it was known, is identical with that obtained from a detailed study of real data. Usually one is attempting to train a manager in, for example, marketing principles, and not the way in which a particular product with which he is concerned will behave in the real market.

The word "Management Game" has generally been used with a training implication, and the term "Simulation" used when the object is to solve a problem, or actually guide management decision making. Under this terminology a simulation model must have validity, in the sense of an ability to predict the future, if it is to be of value; the management game model, used for training, must more often stand the test of verisimilitude. In fact, it is possible that an over concern with realism can produce a game that is too complex, too difficult to play, and can actually destroy verisimilitude, and the involvement of the participant which is so important.

The programmer working together with a team that is constructing a management game can do much in the cause of simplicity and verisimilitude. It is this very ability which makes computer games, in general superior to manual games. The reports returned to the participants can resemble the actual reports which they obtain in everyday life. Furthermore, there is essentially no limit to the amount of special information that can be provided to simplify the role of the participant. Thus, a report can give total costs, unit costs, and percentages. It can provide a variety of research type information and statistics. Little of this is usually possible in a manual game. The American Management Association's Top Management Decision Making Simulation permits management to engage in market research studies, at a suitable cost, which will provide them with the answer to questions concerning the number of orders for a product that might have been received had a different price been set. From the computer standpoint, it is only necessary to loop through the same set of computations using the research price rather than the actual price.

A good computer program can also simplify the task of the game administrator. In the American Management Association's General Management Simulation, it is possible during the play to develop additional products through a program.
of research and development. When a product has been developed the staff sends a pre-printed letter to the company informing them of this. However, the computer program has been arranged so that a special report to the administrator is prepared each period, and the computer itself, on this report, informs the administrator when to send out a particular letter. This same report, incidentally, informs the administrator about various aspects of the company's performance so that he is better able to control the session, and to provide feedback at the critique.

There are many ways in which the relationship between quantities can be introduced into the model. The most common approach is to use a mathematical function; this itself may take the form of a graph, a table, or an algebraic expression. Another approach is the use of judges. There might be one or more "expert" judges who make a subjective evaluation of the effect of particular policies. Such a judge should not be confused with a clerk, sometimes called a judge, umpire or referee, who, in a manual game, merely performs the arithmetic computations according to pre-arranged formulas. This is the function of the "computer," whether it be a man or a machine. The "expert" judge is a person with specific knowledge and experience, who arrives at a subjective evaluation of the decisions, hopefully without bias towards the particular participants.

The judges themselves may be a group of participants, and can be considered to be one of the playing teams. One might have five competing companies in a general management game, together with two teams of competing bankers who may invest money in the various companies. A model may use various combinations of equations, judges, etc., and in the example just cited only the capitalization aspect is relegated to judges. In some games only certain non-quantifiable factors may be left to observers who can directly influence company performance in the role of judges.

In one game based on a real product, the judges consisted of several members of top management, and their own deliberations and arguments as to the evaluation to be placed on the various marketing policies being exhibited by the teams playing the game proved to be, in their own opinion, an extremely valuable educational experience. At the other extreme, one might use judges who did not even know that a game was being played. For example, marketing policies together with advertising copy could be presented to an external group of simulated "customers," for their own preference in the products being offered.

A very objective and unbiased manner for incorporating the necessary relationships in a model is by the use of bidding techniques. For example, each company might submit a closed bid as to how many units they could supply at a particular price, and the demand would be awarded on the basis of lowest price. Similarly, raw material could be offered to the highest bidder, and the cost would then not be based on a specific value built into the model. Bidding techniques have been highly successful in many games. A particularly good example is the "Management Business Game" produced by the Avalon Hill Company, an excellent "parlor" game that can have serious uses.

Parameters

The mathematical meaning of parameter applies mainly to the constants used in the algebraic relationships between quantities, but for games it is convenient to extend this concept to all constants. For instance, the cost of carrying inventory in a game might be a function of the opening value of the inventory A and the closing value of inventory B, namely, \(0.05 (A + B)\). The .05 is also a parameter, but it has been given a specific value for this illustration. If we set \(r = 1\) and \(s = 0\), we have a cost dependent only on opening values. We might prefer to set \(r = \frac{1}{2}\) and \(s = \frac{1}{2}\), which is slightly more realistic. Thus, we are changing the nature of the model by our choice for \(r\) and \(s\). Similarly, the cost of raw material is a parameter which may be changed for different game plays. The inclusion or omission of certain factors can be controlled by parameters acting as switches. Whether or not certain information is to be included in the report can be controlled by a parameter which can take on the values of 0 or 1. In well-designed computer games, extensive tables of such parameters are used, and in this way seemingly different games can arise from the same model by the choice of a particular parameter set.

One normally attempts to compute in advance the parameter values that will be used in a particular game, but this is usually followed by actual parameter studies once the program has been checked out, and, of greater importance, by numerous test plays. There is always a range of feasible parameter values, and the particular set to be used in a particular game session will depend on the game administrator. A game should be packaged with many such sets (and they may be labeled "highly stable somewhat price insensitive industrial product" or "highly competitive very price sensitive consumer product" and so forth.) Thus a single game program can be used for different games, and ideally one can imagine one large model with sufficient parameters to allow it to be adopted to a variety of industries and situations.

Extreme Values And Limits

Like any good program the game program must be prepared to handle any decisions, no matter how ridiculous or extreme. Many a program has "hung up" during a game session because the game designers were convinced that only a particular range of decisions might rationally be
made. Not only must the program handle extreme
decisions, but a rational result must be obtained.
For example, a product might be priced somewhere
around $10.00, but the program should be ready to
accept prices from $0 to $999999999 or whatever
the upper limit is that is imposed by the input
design. At some suitably high price the demand
will go to zero, but it must remain there, and
a curve must not be used that departs from zero
again above $999 just because one does not expect
such a decision to be made. It must also be de­
cided what the demand will be if a price of $0 is
set, even though the company that makes it will
be losing money on every item sold.

The American Management Association’s
General Management Simulation is immune to partic­
ipants who might take extreme decisions. It is
possible for a company to fire all of its workers,
close down plants, etc. The program not only
will handle this, but will change its overhead
cost distribution procedure accordingly! As in
any computer program, the programmer must be pre­
pared to have any quantity, unless limited by in­
put format (though that is just another method
under his control) take on any value from minus
infinity to plus infinity.

The Future Of Management Games

Management Games are only a few years old,
but one can already look back with fondness on
their infancy, and look ahead with confidence to
their maturity. Like most babies, the first few
games were very much alike; they usually modeled
the marketing or manufacturing of a durable good
and were slanted at higher management. Today
new games, like new teen-age singers, are
arriving on the scene with increasing rapidity.

Management games have been used primarily as
an educational tool. Their use in training is in­
creasing and will increase, and will also spread
well beyond the area qualified by the word
"management." In addition, they will undoubtedly
have considerable application in research, problem solving, personnel testing, and as a
direct aid to management decision making.

There are still no management games for
mining companies, the fishing industry, or the
mink farm. The entertainment field -- TV,
publishing, motion picture studios -- need
management as well as "talent." Government --
city, state or national -- provides a large area
of application of management games for training.
Labor unions, universities and professional
associations also have managers. It is fairly
easy to write down hundreds of training situa­
tions which could well use this new educational
tool. And perhaps somebody ought to build a
game to teach people how to build a game.

Games completely different from those now in
use can be expected. A super-game could be con­
structed which included manufacturing companies,
financial institutions, service organizations,
suppliers of raw material, and even a couple of
management consulting firms. Management games
are having extensive use in management education,
but there is probably an even greater need for
new tools in supervisory training.

Psychologists and sociologists have long
used humans, as well as animals, to study human
behavior. Much work has been done with small
task performing groups. The computer opens the
possibility of new uses of simulation in the
life sciences, and one can expect an increase
in the number of laboratories now doing such re­
search. Management games can also be expected to
play an important role in economic research.

While the simple manual management game has
a purpose, and is extremely useful in many
training situations, one can safely predict an
increasing use of computers in the management
game area. This paper was presented because of
increasing importance of management games to
computer people. It is hoped that the interested
reader will read elsewhere for those more
important aspects of management games related to
their construction, their educational utilization,
etc. And it is also hoped that he will find the
opportunity of playing one -- it is not only fun,
it is educational.