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ENRICHMENT OF A MULTI-FUNCTIONAL GAMETHROUGH DYNAMIC OVERLAYS AND INTENSIVE DECISION ANALYSIS

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This paper describes a multi-functional, interdisciplinary use of a computer-based game in a new MBA program. The game process involves sequential modification of both internal and external variables in order to demonstrate particular functional issues and problems in line with the fundamental subject matter development of the course content.

By way of introduction to this description, it is relevant to understand the basic academic framework within which the game is used. At SUNY-Albany, a traditional MBA program was recently subjected to drastic modification. This new program features an initial semester of 1 credit-hour "modules", designed to bring a rather heterogeneous body of candidates to some minimum level of common competence, in areas of accounting, economics, statistics and behavioral concepts. Students are waived out of these modules on the basis of acceptable prior background. A total of 20 such modules are offered, with the average student taking 14. Following this first semester experience, students begin the second semester by participation in a 6 credit-hour course (conducted full-time for about 7 1/2 weeks). This course, entitled "Management Analysis: Functional Problems", provides the basic milieu for the game under discussion.

The course is team-taught by four instructors, representing the functional areas of Finance, Marketing, Operations, Human Resources and Management. In addition to their functional areas, the latter two instructors also represent the quantitative and behavioral disciplines respectively. It is a portion of their activities which are reported here.

The balance of the second semester of this first year consists of a three-week full time involvement for the students in the Harvard Management Game, followed by a five-week course which stresses corporate strategy and intensive analysis of a major industry. The second year of the new program is predominantly oriented to specialization in a functional area, and features a rather unique experience for students working on field projects in a quasi-consulting relationship with faculty at area firms.

The basic game as developed by Paul Greenlaw and Michael Hottenstein is entitled PROSIM and published by Intext. The PROSIM environment is described by the authors as follows:

> "Each PROSIM firm manufactures and sells three different unidentified products. For each period of play, which represents one day, PROSIM managers make a number of decisions: expenditures for quality control and for plant maintenance, the placing of regular and/or expedited raw materials orders, the assignment of either of the three products to each of four machines on each of

> two production lines, the hiring and training of workers, the assignment of workers to machines, and the number of hours of work to be scheduled for each employee. [1]

The PROSIM manufacturing process can be represented by the diagram in Figure 1.

As originally designed, PROSIM is an efficient vehicle to motivate the presentation of EOQ, Dynamic Programming, and macro considerations related to quality control, plant maintenance and operator training. In all cases decisions are non-interactive between firms and only in the case of plant maintenance is the environment non-deterministic. A well-defined goal of cost minimization is established by the authors.

In the SUNY-A application all participants engage in a "training program" which consists of three decisions made with the original published PROSIM environment. This allows them to become familiar with the general operating procedures prior to starting their major simulation experience. At the end of this period, the clock is rolled back to day one and the following changes are made in the environment:

1. Parameters such as wage rate, reject rate and carrying costs are changed to effectively outdate "optimal" strategies from previous semesters.

2. The Human Resource dimension is substantially enriched by substituting application forms for the summary tables presented in PROSIM and providing recruiting options.

3. Learning curves are revised and the new curves must be estimated by the participants.

4. An additional probabilistic element in the form of absenteeism is included.

5. The participants are grouped into regions and a number of decisions (all those requiring program modification) now become regional decisions.

These and other modifications to the game are further described in terms of Human Resource and Management Science overlays, many of which are introduced in successive iterations of the game.

1. Recruiting/Selection Processes

As indicated above, with the "assignment" to a regional plant after his "headquarters" training, the student is provided with a different set of data regarding the work force available to him. A critical aspect of the change involves the use of completed application forms, in which

[1] PROSIM, pg. 5

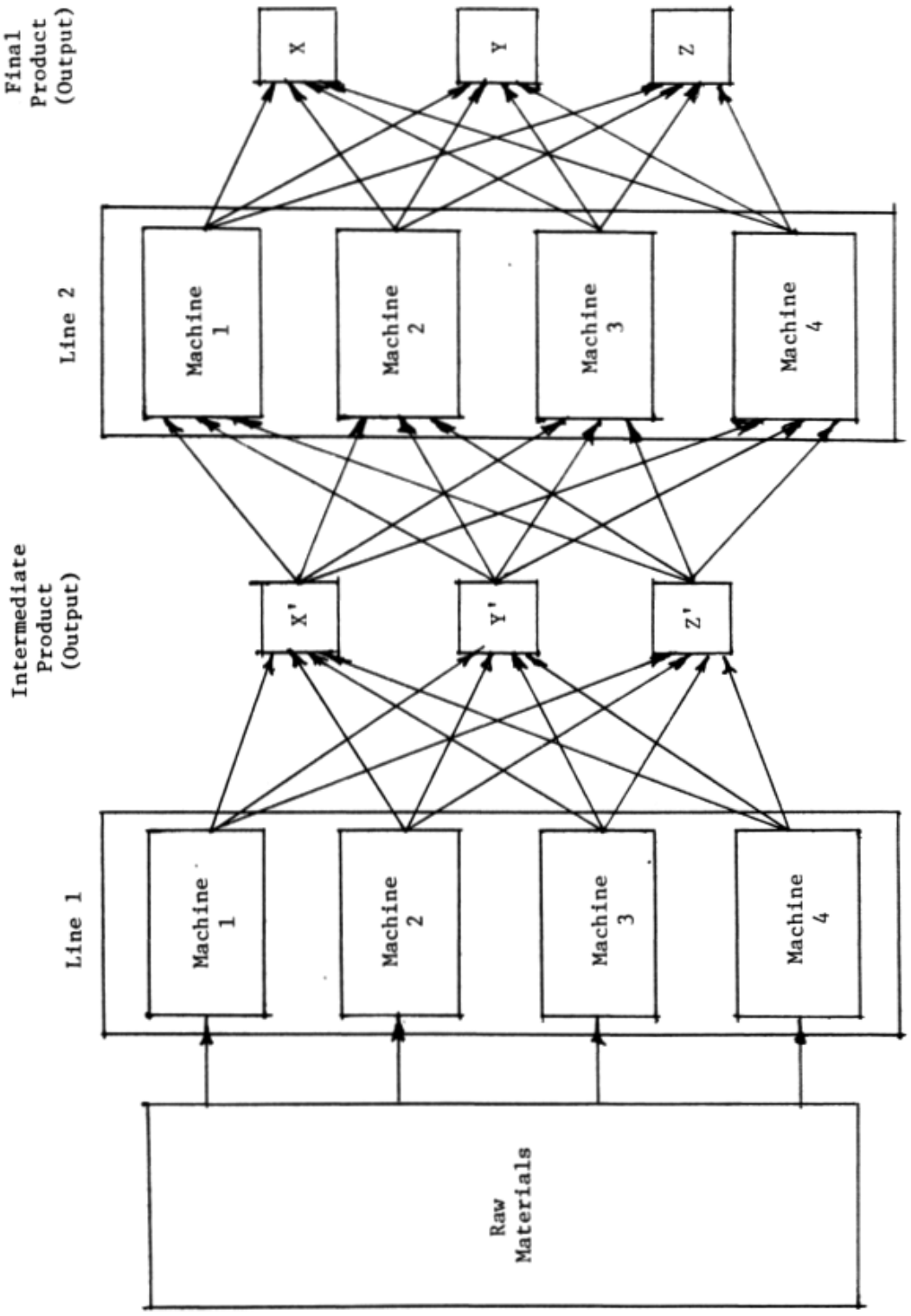

Figure 1 THE PROSIM MANUFACTURING PROCESS

selection test score data is provided along with typical biographical and work history information. Whereas in the published version of the game, the productive potential of individual workers is provided by the authors in the form of a 5-point rating scale, the student must use this new data to develop his own predictive measures. Parenthetically, it is significant from a human resource point of view that members of the work force can now be described in terms of names, rather than merely numbers,

Coincidental with this initial change, the size of the available work force is reduced from the published 28 workers to 12. Copies of the Employment Applications of these 12 workers are provided to the students. Although production potential characteristics of the original 8 workers are kept the same due to technical aspects of the computer program, all others are changed. In addition, by the expenditure of additional funds for "recruitment" at a marginally increasing rate, applications are made available in groups of 4 workers. The recruiting expenditure decision is made on a regional basis, and these additions to the work force are made available to all members of the region.

This recruiting expenditure option is re-opened at a later point in the game when students are required to consider Equal Employment Opportunity factors. A "Rogues Gallery" of photos, with names, is maintained under the guise of the local Union's sponsorship. Incidentally, this EEO aspect is introduced by means of an In-Basket exercise used in connection with the Human Resource analysis of training and development concepts.

2. Impact of Training on Performance

The published version of the game assumes two types of learning which augment worker proficiency over time. Formal training, with associated costs, tends to produce rapid early but diminishing returns to the manager. Learning from pure on-the-job experience produces much slower, but constant increases. It is suggested to the students that the latter assumption had been made from the vested interest position of the headquarters training staff, and that at the regional plant level, the "school of hard knocks" turns out to be somewhat less inefficient. At this point, they are provided with "empirical" data on the proficiency levels of workers without formal training. This gives them opportunities to apply statistical and forecasting concepts (taught in the first semester modules) to the task of fitting curves and equations to the data. Significantly, at this point in the course, both the Finance and Marketing instructors are concentrating on forecasting aspects of their own functional specializations.

3. Competitive Wage Rate Analysis

At the point when the Human Resource subject matter is focused on compensation, the student is told that a new plant opening nearby will need workers with skills similar to those required in his own work-force. In order to cope with the effects of this potential loss of productive workers, the student is asked to consider the possibility of increasing his firm's wage rate. A model is developed using Bayesian analysis of (a) the workers likelihood of receiving an offer from a competitor and (b) his likelihood of accepting the offer, if given. The game is modified by removing workers who are "selected" by the competitor, via random techniques and an appropriate distribution.

4. Disciplinary Actions

The introduction of the concept of absenteeism to the game is done by the creation of a poor of reserve workers. There is a minimum charge to the student for each worker he assigns to the reserve pool, and empirical data on absenteeism of workers is provided to help develop a probabilistic model which optimizes the size of the reserve pool in terms of both reserve worker wages and the costs of lost production through absences. Actual absences are, for the most part, determined by random processes. However, at the point when the Human Resource course material is concerned with discipline, the game is modified so that one otherwise highly productive and dependable employee is involved in an "excessive" short run absence. This becomes the basis for role-playing discussions to isolate the causes of the absence. Second year MBA students are recruited for these role-playing situations.

In an early application of the game, a set of possible disciplinary actions was developed in advance, and for each possible action, a theoretically determined impact on productivity of individuals and/or groups was established. Depending on which action was selected in the role-playing exercise, the appropriate parameter or history element of the computer program was modified. In theory, there is no reason why this procedure cannot be incorporated regularly. However, role playing tends to produce rather serendipitous outcomes which often do not "fit" the previously established categories too well.

Management Science Overlays

1. Quality Control: Location and operating characteristics of inspection station

A subset of the participants in each region are designated as a management science team with the task of developing a simulation model of the production line, focusing on cost/quality considerations. After performing the analysis, each team reports to its region in respect to the location and operating characteristic of inspection stations and the corresponding recommendation of expenditures to reduce defect generation.

If a majority of the managers in a region opt for a new inspection configuration, the corresponding changes are made in the computer program for that region. Implementation time lags are realistically incorporated.

2. Inventory Simulation: The impact of variable lead times

A second subset of participants in each region are formed into a team to develop a simulation of the production process which focuses upon inventory levels. The current vendor provides deterministic lead times while an alternative vendor has a lower price but lead times which vary probabilistically. The group develops a recommendation which specifies not only the vendor, but also the suggested order quantity and safety stock. Again, if a majority of the region support a change of vendor, the appropriate modification is made in the program.

3. Linear Program Model of the Firm: Sensitivity analysis

A third management science subgroup is asked to develop a linear programming model of the firm which will allow the exploration of a number of alternatives, including: (a) accepting a contract which would increase demand up to 50%; (b) increasing productivity through intensive training; (c) expanding the number of machines; and (d) improving the processes so as to substantially reduce defect generation. All technological coefficients must be determined by this team and the recommendation submitted to the region for action.

4. Management Information System: Value of current information

This overlay is used only occasionally since it tends to complicate other dynamic modifications. When it is used, a one period information lag is incorporated from the beginning of the simulation (i.e., the most recent information available for period 5's decision is period 3's output). After a few periods, a single improved information system is made available to the region submitted the highest sealed bid. Once again, each region's bid must have majority support of the appropriate managers. Thereafter, members of the region submitting the winning bid receive their output without a period lag, albeit, the time available for review of the most recent period is limited to less than one hour.

Intensive Decision Analysis

The learning experience has been substantially enhanced by requiring each participant to prepare an intensive decision analysis document. This document which will often exceed a hundred pages in length is submitted at the end of the game and is the major grading vehicle (80% of grade based on this analysis compared to 20% based upon achievement of cost minimization.)

Each participant explains his objectives (in addition to cost minimization) and discusses systematically and chronologically how he attempted to achieve these objectives. The participant is expected to explain why certain problem areas received higher priority with respect to in-depth analysis and if results in these areas were compatible with expectations. The document includes a letter of transmittal to the "next" manager where the participant discusses the state of the firm and makes recommendations for future actions. This letter encourages the student to view his firm as a going concern and has successfully minimized the usual end-game syndrome.

It is the contention of the authors that the intensive decision analysis document has increased by an order of magnitude the learning which occurs from the gaming experience.

Summary and Expected Future Directions

The use of a computer game as an integrating instrument for separate functional and academic disciplines has afforded unique opportunities to facilitate learning in the form of reinforcement and extension of concepts. Clearly, it is critical to the effective use of this technique that the game administrators be willing to modify certain parameters

and equations within the computer program. Such modifications are not undertaken without some risk, of course. In addition, rather high orders of cooperation are needed between the involved faculty.

Further directions anticipated at SUNYA include the possibility of extending this idea to the functional areas of finance and marketing. It is expected that the final form of the game could compare with and replace the Harvard Management Game used in the course succeeding the functional problems course. Such a direction would seem to offer an almost unlimited frontier for integrative and reinforcing types of instructional situations.

REFERENCES

1 Greenlaw, Paul S. and Michael P. Hottenstein, Prosim (Scranton, Pennsylvania: International Textbook Company,, 1969).