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"COMPUTER-AIDED PROJECT PERFORMANCE CONTROL SIMULATION: AN INTERACTIVE EXPERIENTIAL GAMING TECHNIQUE FOR MANAGERIAL DECISION MAKING"

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Business decisions today have far greater impact upon a firms survival or growth due to the complex interrelationships existing in modern enterprises. As a consequence an increased effort is being made to improve decision making tools. This paper presents an experiential learning approach for enhancing a student's knowledge of significant variables critical to making the best choice among alternatives in a production/operation management setting. The vehicle used to develop this learning technique is called CAPPCOSIM*, a computer gaming simulation which models the manage- cent of a product development project utilizing a cost plus incentive fee contract.

INTRODUCTION

The CAPPCOSIM programs were developed as an extention to, and enhancement of two separate gaming simulations namely CAPERTSIM and CAPCONS. These predecessor simulators provided the basic vehicle for CAPPCOSIM whose cost significant extensions were:

1) An interactive gaming environment
2) The use of noncommittal trial runs
3) The introduction of stochastic perturbation of the model
4) The inclusion of non- linear technical option tradeoffs in addition to cost and time tradeoffs.

The version of CAPPCOSIM currently in use was programmed in Fortran on the H-P 300011. It is designed to be played in private sessions at a CRT terminal. During a user session any number of trial run decisions can be simulated without adversely affecting the real" decision for the current decision period. However, once the player commits to a real" decision, the result is final and the player is " locked from any attempt to replay the decision.

Results of trial runs are normally displayed at the terminal, but optionally may be reproduced on the printer. Final results of each player's decision are automatically recorded on the printer. At the present time, the nature of the project and its associated PERT network are "hardwired" into the simulation. Basic starting cost figures, tradeoff relationships and stochastic characteristics are loaded into the model by the game coordinator prior to participation by the players.

THE PROJECT NETWORK

In this simulation, the project to be undertaken is the development of a prototype vehicle. The develop-cent process is represented by a PERT type network of 33 events and 50 activities. The structure of the network is assured to be fixed, with the exception of the possibility of selected activity cancellations, which may be effected by setting activity tine to zero. The player therefore has no capability to alter the structural features of the network to represent substitution of one technical process with another.

All activities have cost and tire characteristics associated with them and come of the activities have a technical achievement level associated with them. Although technical levels will be discussed later, it is important to note that when these exist, tradeoff relationships exist between all three activity characteristics. Additionally, these tradeoff relationships can be defined by the game coordinator in some cases. As a control feature, tine characteristics for each activity are forced to fall within reasonable control limits established internal to the program. Control Limits are also applied to technical levels when used as an activity characteristic.

Decision periods for the players correspond to predetermined milestone events in the network. Thus after each "final" player decision the nodal is advanced through the network to the next milestone. A status report is issued upon reaching the new milestone to indicate the activities completed during the simulated tine period and the characteristics of these activities. Seven milestone events are represented in the network and total tire simulated for the project is 18 months.

INTERACTIVE ENVIRONMENT

The player interfaces with the simulated project at project start and at the seven milestone events of the network. At each of these junctures the player has the requirement to decide how he should adjust activity durations, with consequential cost changes and technical levels. In all cases his overriding objective is to make changes which meet minimal contract requirements of the project and which will serve to maximize the incentive fees he seeks to earn. His knowledge of project behavior is incomplete due to stochastic phenomenon which may perturb the model and random factors which may affect the tradeoff relationships between activity characteristics.

The model is designed to permit the player to 'test' potential strategies under "ideal" conditions. That is to say, the results of the players trial decisions are given without consideration of stochastic effects or random factors which impact the relationships of activity characteristics. The player initiates his session and is prompted for the nature of the session, i.e. trial or real. Multiple trials may be made in a single session and a session can be terminated without a final decision being made. During the trial decision the user is prompted to supply necessary information on prepared changes in activity characteristics.

The intent of this process is to provide the player with educated estimates of the consequences of various decision strategies which might be used during the current decision period. It is hopefully assumed that the student comes to the session having carefully thought out the best selection of strategies for this decision period although it is recognized that a player could try decision options willy-nilly until he found what he felt was the best. Such behavior is not controllable since any number of trial sessions is permitted.

STOCHASTIC NATURE OF MODEL

It is an unpleasant fact of life that things rarely go according to plan. Deliveries are later than expected, inferior materials have to be substituted for the quality of materials originally projected and many other denzens of capricious fate. The more notable of these stochastic varieties of the model are announced to the player after his final decision is made via memos and notes depicting the manner in which such events would actually be heralded. For example, wildcat strikes by disgruntled workers seem to be a common occurrence. Such a misfortune might be announced to the player as a management memo as follows:

Head, Project Mgt. Office
11/15/78
Subject: Project SPAV

A wildcat strike in the transportation industry held up delivery of materials for frame construction by two weeks. Through use of overtime in frame assembly (activity 31-21) the tire less has been cut. Change in scheduled time is 6 days. Change in project cost is $1136.75. There is no change in technical performance.

The consequences of this unexpected occurrence must now be dealt with by our player at his next milestone session and any incentive losses incurred hopefully recovered.

INCENTIVE APPROACH

The simplest way to approach a project is to assume that we wish to minimize tine with little restraint on cost or conversely to minimize costs with little constraint on tine. Such an approach is, of course, unreasonable. In real world situations we are faced with cost limitations and time requirements and frequently quality requirements (standards).

This simulation assumes that the player is operating in a cost plus incentive node in which he earns bonus money by achieving specific cost time and quality levels at phases in the project life and at its completion. The player can improve the fee he obtains for a specific contract incentive factor by doing better than the minimal acceptable level. As an example, assume that the weight of the end product is subject to incentive. The requirement is to minimize the vehicle weight A target weight is established by the entity letting the contract and the associated fee identified. Say the target fee is $33,750.00 for a weight of 13,000 pounds. If the project manager can get the weight below this figure and still meet all other minimum requirements his fee will be larger. For each target incentive factor, a range of fees or a fee relationship is pre-established. Thus, in the current example, a weight of 11,500 pounds will generate a fee of $67,500 but weight reduction beyond this point will not improve the fee. In addition, if weight exceeds 14,500 pounds then no incentive fees are paid for the entire project since that represents a critical contractual threshold beyond which the contract is violated.

The player is kept informed of his current status as regarc3s fees earned and the critical nature of all incentive factors. This report is issued at the completion of each milestone event so that the player can reflect upon the best approach to take in the next decision period so as to insure compliance with threshold limits of incentive factors and optimize his fee receipts.

CONCLUSION

The gaming simulation described is designed to provide the student with a realistic exposure to the decision making process when using sophisticated planning tools. The interactive nature of this simulation allows the players to fully exercise their analytical capabilities through trial decisions that can be easily and conveniently evaluated. It is felt by the authors that the many features added to the project management process for heightened realism will enhance the quality of student participation and forcefully bring home the uncertain nature of the environment in which he will one day be required to operate.

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