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INCLUSION OF COST COMPARISONS IN SIMULATION MODELING FOR IMPROVED DECISION-MAKING

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ABSTRACT

This paper discusses possible implementation methods for economic factor estimation and an alternative comparison capability in simulation language design and use. Three possible approaches to the inclusion of cost estimation routines are outlined. Motivation for each of these approaches is developed.

INTRODUCTION

In all businesses from the production to the service industries, management must evaluate multiple and often complex alternatives, and using some criterion decide which is "best". Simulation modeling is a computerized tool that can assist in the evaluation and ultimate selection of alternatives by allowing the modeler to ask "what if" questions concerning his particular situation. Assuming the system is modeled correctly, simulation allows the modeler to step through various decision alternatives to see what would happen in the system given a particular decision without actually implementing the decision.

Some examples of selection criteria offered by most simulation languages are:

(1) Largest number of entities to pass through the system in a given time period. (The entities could be repair jobs, customers, material, or vehicles through a toll bridge, etc.).

(2) Shortest time for a specified number of entities to pass through the system.

(3) Elimination of bottlenecks in the system.

(4) Percentage of time resources are fully utilized. Resources are anything which offer a service as required by entities passing through the system, and which have limited quantity and time.

While this list is not exhaustive it does illustrate the flexibility and usefullness of simulation as a decision assistance tool.

A central issue not directly addressed or provided for in simulation languages is the need for a criterion based on the economic impact of alternatives. If the decision tool that management uses incorportes an economic analysis in dollars,as well as the above mentioned criteria, there could be more confidence developed in that decision tool. In response to this need, the development of an economic support package for simulation modeling is worthy of investigation. Three options are discussed and briefly evaluated. A target language is necessary to use as the development mechanism. Currently in this work the microprocessor version of SIMAN is that language.

LITERATURE SURVEY

In the past twenty years simulation has become a widely accepted decision assistance tool. New languages are appearing regularly, and old languages are being continually upgraded. There are languages that are run on mainframes, such as SLAM and GPSS as well as languages like SIMAN that can now be used on microcomputers. Most simulation languages have quite sophisticated graphics packages to ease the inputting of data and make the output easier to interpret. However, one area that is noticeably absent in many simulation languages is an inherent allowance for the economic analysis of developed alternatives.

The literature discusses appropriate uses of economic analysis in simulation and as a necessary part of the decision making process. Haider and Blank [1] introduce the idea of "operational costs" estimation as a potentially integral part of the simulation. This may allow different policies and system scheduling decisions to be economically evaluated prior to their piloting and implementation. No actual formulation is presented in this paper. The simulation language GEMS II [2] allows for cost calculations. Total cost of activities, setup costs, and costs per unit time are included for queue related transactions. Non-queue related costs are handled in terms of "cost groups". The US Army Tank-Automobile Command Research Development Center [3] has developed an investment analysis package that assists the user in comparing FMS alternatives using NPV and ROI methods. The suggestion is that these packages be utilized in conjunction with simulation results.

Cost estimation and evaluation is an area where further work is vitally needed. Fleischer [4] surveys various cost catagories to consider when analyzing alternative robotics systems. Costs such as plant and equipment, operation and maintenance and product cost are developed. A checklist for cost considerations is provided. The need for improved costs tracking systems is clearly stated by Michaels, et al [5, 6].

Consideration of these economic-based decision assistance methodologies when simulation models are constructed would allow for improved costs conscious decisions earlier in the design stage of the life cycle process. But, the inherent capability to include cost-based decisions in the simulation language presents the requirement of a natural inclusion of economics in the design and analysis tasks that are commonly performed when a simulation model is developed.

INCLUSION OF ECONOMICS IN SIMULATION MODELING

Some of the obvious parameters of cost and revenue that are included in an economic analysis are:

initial investment	economic life
annual operating costs	salvage value
required rate of return	tax considerations
fixed and variable costs	revenue estimates

Some of these estimates, and indeed other factors, are estimatable via simulation models which are developed to analyze the feasibility of system design, scheduling policies, discovery of bottlenecks, etc. The use of established simulation languages to assist in the economic comparison requires the development of software to incorporate into the language or the model a capability to translate system parameters into economic terms. Further, it may transform them into the format commonly used in an economic comparison as conducted by management and analysis personnel in the financial justification divisions of the firm.

Inclusion of some economic comparison capability in a simulation language may proceed in several ways. Three of these are summarized here.

Postprocessor - Development and implementation of a package using the final results of the simulation run that would be able to translate given terms into economic estimates for use in economic models. This package would be initiated after a run of the simulator and would require input from the user for cost coefficients, economic model factors, etc.

Preprocessor - Development and implementation of a system composed of subroutines that the user is able to interface to the simulation model via commands thus inserting the economic estimating capability where necessary. These subroutines would function with the simulation. A link to the output processor of the simulator would have to be developed to provide the desired output format usable in the economic models.

Language-inherent Processor - The actual enhancement of the simulation language to incorporate economic parameter estimation and possibly alternative comparison directly into the model building and system simulation capability of the language. This approach, through the most natural from the economic evaluation viewpoint, is the more difficult from the simulation language aspect. Indeed the economic consideration of this approach itself should be carefully evaluated prior to its undertaking.

CONCLUSION

The inclusion of economic factor estimation and alternative comparison capabilities in a simulation modeling effort can have very positive effects upon the decision support potential of the model. Management can more easily see the economic ramifications of suggested alternatives if the simulation is able to directly interface to the financial evaluation scheme of the firm. The method by which this economic modeling capability is incorporated into the simulation efforts of the analysis must be carefully considered in order to insure that the maximum benefits of the simulation and the economic analysis are realizable.

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