IMPLEMENTATION: A REQUIREMENT FOR SUCCESSFUL SIMULATION

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Abstract

The goal of any simulation effort should be to correctly assess those factors that have an influence on system operation and design and to support decisions regarding the facilities and policies that will control the process. As such, a simulation effort must be considered unsuccessful and non cost-effective if no decisions are influenced by the analysis performed. For this reason, implementation (using the results of the analysis to support decisions) must be treated as the most critical step of the simulation modeling process. While model accuracy, its validity for the problem under study, and the timeliness of the information provided are all essential elements of a successful study, priority must be given to the implementation.

To enhance the probability of implementation a modeler should:

* Recognize that implementation is the overriding goal of the effort,
* Define a problem solving objective that is achievable within the decision making time frame, and
* Involve decision makers and concerned parties in the modeling and analysis effort.

This paper discusses the reasons behind this recommended approach to simulation modeling efforts.

INTRODUCTION

Simulation is the process of creating a representation, or model, of the operation of a system on a digital computer. The model is comprised of the physical components of the system and the logic associated with the operation of the system. Once the model is defined and created, experiments on this model can be conducted to make inferences regarding the operation of the system. With this capability, the impact of a decision involving facility upgrade or operating logic can be predicted before the decision is put into action.

Simulation provides the capability to evaluate a wide variety of systems and analyze a large number of diverse questions. With simulation, an artificial laboratory is created where sensitivity evaluations can be performed and "what if" type questions can be addressed. A variety of designs can be evaluated. Alternative equipment characteristics can be studied. Diverse and complex operating policy scenerios can be addressed. The effects of uncertain demands and environmental constraints like weather conditions and the effect of union policy can be evaluated. Thus, simulation is a very powerful technique which facilitates the analysis of almost any question relative to the operation of the system, its design, or external influencing factors on the system.

Unfortunately, even with its power and flexibility, simulation methodology is not used extensively in all industrial and

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governmental institutions. In some institutions, simulation modeling methodology is not used at all. In many others, simulation is used but is not employed effectively to answer questions. In these places, simulation often has a bad reputation in that it requires much time, occupies many resources, and still does not provide the benefits that are advertised . On the other hand, there are industries and companies who do successfully use simulation to support their decisions. There are many documented examples of how simulation has been used to provide cost savings or to effectively assist process designers in obtaining the best facility configuration. In addition, selected simulation users are now pursuing the link of simulation concepts with process control systems. This link will provide on-line evaluations and support quick decision making for scheduling, operating logic, and order response questions.

From this discussion, it can be seen that simulation has met with a wide degree of success in many institutions but has failed to be accepted by others. Why is simulation so successful in some areas and unsucessful in others? What are the components of a successful simulation modeling effort? Why do others fail? Based on his experience in the modeling and analysis of many diverse systems, the author believes that there are three key elements of a successful simulation effort that are often overlooked.

These key elements are:

* The recognition at the start of the study that the overriding goal is to implement the results.
* The defintion of a set of objectives that is achievable within the decision making time frame.
* The involvement of the decision maker and other concerned parties in the entire modeling and analysis process.

THE GOAL OF SIMULATION

Before a modeler can work towards achieving a successful modeling effort, he must define a measure of success. The goal of a simulation modeling and analysis effort should be to support decisions. If this premise is accepted, then it is easy to understand that other potential goals are not as critical, although they may be necessary in order to address the real goal. The goal of an effort is not to build a complete model of an entire system. The goal is not to build an accurate model of every element of the system. The goal of a simulation effort is not to build a model using the most sophisticated simulation modeling techniques. Rather, the goal of a simulation effort is to provide information to decision makers and to have them use this information to influence their decisions.

With this goal, a simple defintion of a successful simulation effort can be created. A simulation is successful if its results are implemented, that is, if it provides inputs to the decision making process that influence decisions. A simulation effort is unsuccessful if its results are not used in the decision making process. The simulation modeler must understand this goal at the outset and direct the performance of all project tasks towards achieving this goal.

AN ACHIEVABLE AND TIMELY OBJECTIVE

Two general characteristics of simulation for decision making must be recognized before the problem-solving objective is set. First, since simulation is such a powerful technique, it can be employed to provide answers to almost any questions, provided that sufficient time is given to the evaluation. This could imply that the simulation effort might be very lengthy to answer all the questions of interest. The second characteristic that must be recognized is that decision making is time constrained.

These two conditions often pose conflicts in simulation analysis. The decision makers require an answer in a certain length of time. A "perfect" resolution to all their concerns can be generated by simulation analysis within another certain period of time. If these do not match, which is most often the case, some compromise must be made. Unfortunately, the simulation modeler is very seldom in a position to force compromise on the decision making time frame. Thus, it is the responsibility of the simulation modeling effort to produce the best results that can be obtained within the decision making time frame.

Because of this, the modeler must select an objective that produces results that support the decision making process and can be supplied with the decision making time frame. If necessary, the scope, accuracy, or level of detail to be included in the modeling effort should be scaled down in order to meet this time frame. A

basic tenet to follow: it is better to produce lesser but supportive results in the time frame that the decision will be made than to provide a complete set of evaluations after the decision deadline has passed.

DECISION MAKER INVOLVEMENT

Since a simulation effort needs to produce results that will be used by decision makers, its results must be belived by decision makers. It is not enough to do a perfect analysis and come up with the best possible evaluation of a situation. The simulation modeler must go beyond the technical aspects and also provide a convinding and sellable argument to the decision making community that the results are correct. Without effective communication, the simulation modeling results will be set on the shelf and not used, and the simulation effort will be unsuccessful. Now, one might argue that simulation results should speak for themselves; that if the model is done correctly, it will be obvious what decisions should be made and the results will be used. Unfortunately, simulation modelers operate in a political environment. Unless results are correctly presented to decision makers, they simply will not affect the decision-making process.

Obviously, a simulation model must be done technically correct. The best tools available must be used to provide the information required for the application at hand. The modeler must insure that the inferences made using the results are correct for the system of consideration. If this is completed, however, it is still not enough. The modeler must also take this information, which he has proven to himself to be correct, and present it to the next level of decision making. The modeler must consider how this presentation can be accomplished.

In normal modeling procedures, implementation is regarded as the last step of the simulation modeling process. This implies that a successful simulation effort can be performed and then implemented, which is simply not the case. Implementation must be treated as the most critical step within the simulation modeling process. That is, while actual implementation cannot be performed until all the other steps of the process are completed, the implementation process must be started at project initiation and implementation procedures must have a major impact on how the remaining steps in the process are performed.

This implementation process is best accomplished through a high level of interaction with the decision maker and concerned parties during the entire simulation effort. These individuals must be a part of the objective-setting effort; they must be given an understanding of the model scope, processing, and limitations; and they must be able to interpret model outputs. In essence, implementation requires a sales effort that begins at project initiation.

It is recognized that simulation is a "computer technique" and that many decision makers and concerned parties are not necessarily favorably disposed to computer techniques. Thus, obtaining their involvement in the process often requires some effort. However, recent developments in computer simulation software relative to network procedures (1,2), graphics (3,4), and report generators (5,6) provide the modeler with tools that can greatly assist him in communicating model definition, operation, and results to decision makers.

CONCLUSION

A successful simulation effort is one whose results are used to support decision making. To increase the probability that simulation results are used, a modeler should, wherever possible, force the involvement of the decision maker in the entire simulation modeling process. He should also insure that usable results are obtained from the simulation effort within the decision maker's time frame.

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