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SIMULATION: "WHAT TO DO WITH THE MODEL AFTERWARD"

Daniel J. Muller
AutoSimulations
655 E. Medical Drive
Bountiful, Utah 84010, U.S.A.

ABSTRACT

Once the simulation analysis is completed, what becomes of the simulation model? Often all the efforts and costs incurred during the simulation project are forgotten once the results of the simulation are determined.

Simulation models can have a second life, in which they provide training, educating, and the means to assist the decision making process. Although simulation projects often involve the key individuals necessary for defining, analyzing, and evaluating the simulation models, they often overlook the individuals whom the simulation results will greatly impact. This paper discusses the need for education in the simulation process and some approaches for structuring models to be used for training and educational use.

1 INTRODUCTION

This paper presents various concepts for structuring and using simulation models as an educational and training tool. Using simulation for this purpose may play a greater role in a project's success than the simulation model development and resulting analyses. The effectiveness of any simulation project should always include the education of individuals who will be directly or indirectly affected by the simulation's outcome.

Education and training are the key to model acceptance. Using simulation for training purposes can often provide key insights and play a major role in the acceptance of the physical system changes prior to implementation. The first sections of this paper present the reasons for education in the simulation process. The final sections present different approaches on how to structure and apply a simulation model for future use after experimentation is completed.

2 THE NEED FOR EDUCATION

Every simulation model requires "selling" in the simulation project life cycle, such as selling the concept of simulation or selling the simulation results. Since simulation models often cross the lines between functional departments, many individuals are often affected by the project's outcome. The key to success lies in the information exchange between the interested "stakeholders" in the project. Figure 1 displays a sample of various project stakeholders.

There are many factors that can alter the success of a simulation project, such as:

1 - internal politics
2 - previous simulation successes and failures
3 - fear of change
4 - lack of communication

All of these influences can be reduced by educating the proper individuals. Communication during a simulation project is required throughout the simulation effort between the model builder and the stakeholders. This is notably important during the early stages of a project. Not only does the analyst require accurate logic and data from various sources, but the interested stakeholders require feedback on the potential project's impact on their operations.

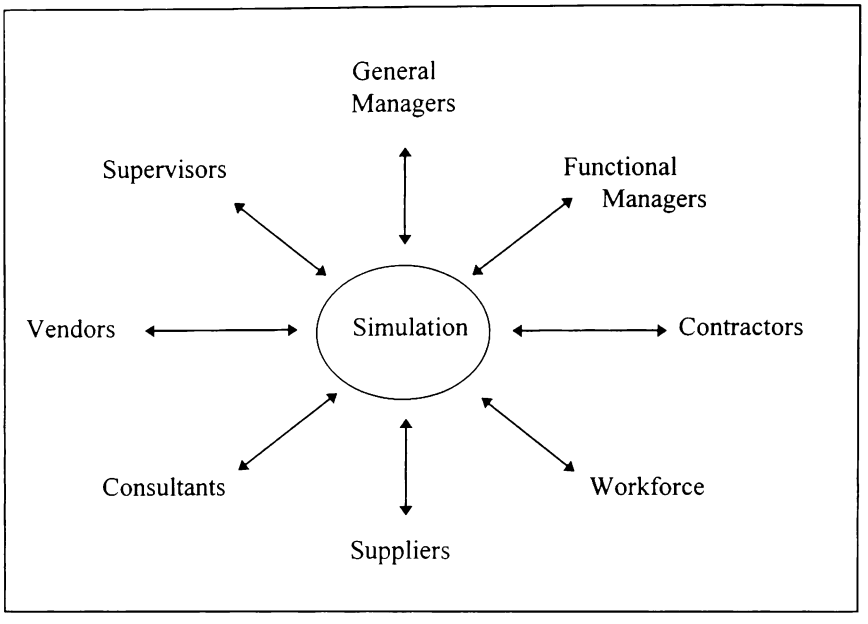

Figure 1: Various Simulation Project Stakeholders

The following section describes how simulation can be used to educate different parties based on individual responsibilities.

3 CONVEYING SIMULATION BENEFITS

When the boundaries of a simulation project are clearly defined, it should be the responsibility of the project manager to coordinate the efforts of the necessary individuals. The objectives and requirements of the simulation should be presented and documented. Key points addressing each person's role and the impact the project could have on their respective operations should be highlighted.

In educating these key individuals, certain concepts should be stressed relative to the simulation effort. Some of the points listed below can serve as a guideline in the education process:

1. Preview System Changes.
   Through the use of graphical simulation, everyone can observe the impact of the expected system's operations, thus reducing the uncertainty associated with a new concept.

2. Acceptance of Change.
   Simulation bridges the gap between the unknown and the real world. Individuals can foresee the effects of change on their respective systems, thus allowing them to accept and understand change.

3. Insurance Policy.
   Simulation provides an insurance policy against making a costly mistake when large capital expenditures are involved.

4. Project Feasibility.
   Simulation can be used to evaluate the feasibility of a concept to ensure the equipment performance and design criteria are accurate.

5. Project Confidence.
   Simulation provides a level of confidence necessary to take the project results towards implementation.

The results of the simulation project may result in the implementation of new and automated equipment, operating philosophies, operator task assignments, or material handling procedures. Subsequent to the implementation of these system changes, the education of employees is required to assure a successful operation. Using the simulation model to assist in the training and education of key individuals on the effects of system changes can greatly assist at this phase of the project.

4 DESIGNING INTERACTIVE MODELS

Prior to developing any simulation model, it is important to plan for model-user interactiveness. Many individuals associated with the simulation effort are not simulation modelers, nor do they necessarily understand the simulation process. Their vested interests lie in how the project results will impact their respective areas. By planning ahead, a model can be developed to support the education, training, and transfer of information to these of key individuals. By planning user involvement, an analyst can increase the likelihood of model acceptance.

In developing a model for individuals who may not fully understand the simulation process, the need to create easy interactive capabilities should be a high priority. Creating an interactive model for the sole use of demonstration and execution by non-simulation experts is well worth the effort. Providing this "hands-on" involvement will lead to increased model confidence and acceptance. The following are some examples of building user interactiveness:

1. Menuing System.
   The simulation model could include a menuing system that permits the user to specify certain performance data. This provides the user with the ability to run what-if scenarios for specific events to understand the cause-and-effect relationships between model components.

2. Data Files.
   Information used in the simulation model can be developed in data files which are read into the simulation model. These ASCII data files should be well documented so that the contents of the files are easily understood. This provides an easy way for a non-simulation expert to run experiments and what-if scenarios.

3. Model Interactive Dialogues
   A non-simulation expert can be easily trained to use a modeling interface or dialogue box that prompts the user to make a decision in the operation of the simulation. The user can then understand the cause and effect relationships of the system operations and unforeseen variability.

4. Equipment/Resource Failures.
   The model could include an interactive equipment or resource window for causing a resource breakdown. A user could see the effects of breakdowns on the system's performance and the resulting system's responses.

The above items can greatly improve the ease of use of a simulation model. Basic interactive planning does not require a large effort during the model development phase.

5 THE ROLE OF ANIMATION

The following paragraphs summarize the role of animated simulation models relative to various stockholders, for when education plays a key role in the project's success.

1. Management Acceptance.
   Since most simulation models are developed to prove a new approach, concept, or facility design change, the major concern is whether the system will meet its design requirements. Since major capital expenditures are often involved, simulations provide management the needed level of assurance for validating or invalidating the designs. Graphical models provide the visual means of presenting the system's findings to various levels of management in an efficient and expedient manner.

2. Equipment Venders.
   Graphical simulation models can be used to educate the equipment vendors on how their systems will perform and interact under various conditions. Besides validating or correcting the equipment quantities, simulation models can help a vendor analyze the performance characteristics such as reliability, throughput and maintenance requirements necessary for a successful implementation. Through the use of graphics, vendors can visually see the effects of equipment performance and quantity on the surrounding systems.

3. Operator Feedback and Acceptance.
   Simulation models can be used to educate employees on their roles in support of system changes. Animated models can help employees accept design and system changes that will alter their operations and/or responsibilities.
   Involving operators in the simulation process may supply key input and feedback on improving the system or identifying potential problems with the new concepts. This approach can only increase the acceptance of any new designs upon implementation at the shop floor level. A system that is not well received by the people responsible for its operation is destined for failure.

6 EDUCATIONAL AND TRAINING USES

The statistical output and project results can often hide the true potential of using simulation for educating and training. An animated model can be used in a variety of ways to convey different objectives. The following paragraphs briefly describe how an animated simulation model may be used for training and education.

1. Cause and Effect Relationships.
   An animated simulation model is an excellent way to educated people on the cause and effect relationship between system components. Since functional areas often divide individuals' responsibilities, a simulation model can be used to educate individuals across numerous physical boundaries to assist in facility improvements. This provides a quick way to communicate the effects of change within each area relative to the other.

2. System Response Requirements.
   Simulation models can be utilized to educate and train individuals on response measures associated with various scheduled and unscheduled system events. A model can be used to test various preventive maintenance plans to help minimize system and equipment downtime. Also, simulation can be used to evaluate the best response during equipment failures events. An animated model can be used to educate operators and management on the effects of schedule changes and failures through "hands-on" model interactiveness.

3. Videotape.
   Videotapes of animated simulation models can be used to educate and train individuals. Videotapes permit the analyst to highlight key performance features of a system, and they accommodate a large viewing audience. Since many large capital expenditures involve management at various corporate locations, a videotape can assist in bridge the distance and communicate the results. Also, a videotape can assist in defining and describing the material flows and functions associated with each area of a new design. This videotape can then be used to educate new employees prior to the physical system startup.

7 PITFALLS

Often the above approaches seem good in practice but are limited by time and schedules. Building a model with interactive capabilities does not usually add a large amount of model development time to a simulation effort. What usually takes the most effort is coordinating the schedules and allowing enough time in the project cycle to include all the key people. Various schedules, locations, and everyday responsibilities may reduce the amount of educating and training that can be applied to the project.

Another potential problem is the involvement of too many individuals in the simulation effort. As more individuals become aware of the simulation effort, often they will want to customize the effort to meet their internal objectives. This will always tend to increase the scope, schedule, and cost of simulation effort.

8 SUMMARY

Education and training play a major role in every simulation project. Whether enough time exists to involve all interested and affected individuals and departments is project-dependent. The greater the communication and involvement in the simulation model across all levels of management and operations, the greater the success in the project's acceptance can be expected. Developing a user-friendly interactive model for experimentation, what-if analysis and demonstration

purposes will allow an analyst to perform quick what-if demonstrations. User-friendly models also allow non-simulation experts to participate in the project. Scheduling and coordinating the right individuals relative to maintaining the focus and objectives of the simulation effort is a difficult task. Simulation efforts tend to increase in size and scope as more individuals are involved. A good simulation project plan should always allow for the necessary time to educate key project members. The amount of time required is dependent upon which obstacles exist that could limit the project's success.

AUTHOR BIOGRAPHIES

DANIEL J. MULLER is a Senior Simulation Analyst with AutoSimulations. He received a Bachelor degree in Industrial Engineering from Georgia Tech in 1985, and he received his M.S. degree in Industrial Engineering from the University of Pittsburgh in 1991. He performs full time simulation consulting services for AutoSimulations' Mid-Atlantic region. He was the WSC' 94 exhibits chair. He is a member of IIE.