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KEYNOTE ADDRESS

Simulation: Pushing a Dead Mouse Through a Maze?

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ABSTRACT

Simulation has been defined in various ways, depending upon the particular biases of the definer. As an example, simulation has been defined, albeit facetiously, as "pushing a dead mouse through a maze". The definition is examined in the paper. Special emphasis is given to the recent changes that have occurred in user acceptance and consideration is given to trends in the field. The need for increased accessibility to simulation is the primary focus of the paper.

1. INTRODUCTION

More than a decade ago, I heard someone define simulation to be "pushing a dead mouse through a maze." Unfortunately, I do not recall who defined it in this particular way. However, I do remember that at the time I considered the definition to be no more than humorous. And, I used it often to draw smiles and laughter in various presentations. Now, I have a greater appreciation for the wisdom behind the definition, and will endeavor to explore with you the definition and suggest areas for further development of the field.

At the outset, a disclaimer is in order. In particular, it should be made clear that I am not an expert either in the development or in the use of simulation. Yet, I have been, and will continue to be, an advocate of the use of simulation in designing and operating integrated manufacturing systems.

My area of specialization is the design of integrated material handling systems. It is in this context that I have observed, first hand, the impact simulation has had on the design of integrated systems. Today, any supplier or consultant who claims to have the capability of designing integrated material handling systems must either possess or have access to simulation capability.

As you might expect, my presentation will be based on my experience base. Yet, there is little about material handling to restrict my observations to that context. A challenge to you is to make the requisite extensions to your own application area.

To facilitate the presentation, we will use the following approach to deal with the allegorical definition of simulation. First, we will examine the reason for pushing a dead mouse through a maze. Second, we will treat the restriction of a single mouse. Third, we will challenge the fact that the mouse is dead. Fourth, we will examine the choice of a mouse as our subject. Fifth, we will deal with the need to go through the maze. Sixth, we will test the limitation of a single maze. Seventh, we will speculate on the impact of a maze on the development of the field.

2. PUSHING A DEAD MOUSE THROUGH A MAZE

Because of the recent emphasis given to the use of just-in-time production systems, many of us have had to re-think our positions on a number of "givens" in push-oriented inventory management systems. The benefits of a "pull" system had to be understood and sold at all levels of management. Also, the impact of "pull" versus "push" strategies on all aspects of the production system had to be analyzed. Simulation has proved useful in gaining increased understanding of the new "pull" culture in production.

Returning to our allegory, simulation can be used to determine the benefits of pushing versus pulling the dead mouse through the maze. In fact, were it possible to train the mouse, simulation could be used as a decision aid for the mouse and eliminate the need to either push or pull; it could simply complete the task on its own.

3. PUSHING A DEAD MOUSE THROUGH A MAZE

In terms of a human's capability to control the movement of a dead mouse through a maze, limiting the situation to a single mouse is a reasonable restriction. However, by applying current computer technology, we can control the movement of numerous mice through the maze.

Too often, we oversimplify the situation being modeled, due to our limited ability to comprehend complex interactions of the system and ascertain cause-effect relationships. As a result, we fail to take advantage of the power of the computer used to perform the simulations. If we could transfer to the computer the responsibility of comprehending and ascertaining complex interactions and relationships, then we could simulate more complex systems without losing the important complexities of the real world system.

4. PUSHING A DEAD MOUSE THROUGH A MAZE

It is significant that the object of interest in our allegory is a dead mouse, an inanimate object. More than anything done to advance the field, the use of animated output

of simulation results has brought the "tool" out of the "tool box" and positioned it in front of management. As evidenced by the recent coverage in Business Week, animation has captured the imagination of managers and engineers. Animation allows us to release a live mouse in the maze and view its behavior.

Perhaps not too surprisingly, the person most opposed to the use of animation is the person who is viewed as the simulation expert in the organization. There are those who want to "open the door to the masses" and those who want to "close the door to those who do not meet the membership qualifications of the simulation fraternity."

Perhaps because I am not a member of the simulation fraternity, I support opening the door to a larger group of users. The growth in the use of simulation and the concomitant enhancements in its power will be akin to the microcomputer's impact on computer usage.

Simulation, today, is basically captive to the small group of individuals who are knowledgeable programmers and are extremely familiar with computers. Thus, simulation is their own "dead mouse."

(I concur with the comment on page 84 of the August 17, 1987 issue of Business Week that "Watching cartoons on a screen is no substitute for good statistical work." But, I also know that the number of people capable of performing good statistical work exceeds the number of people using simulation. Also, few users are sufficiently knowledgeable of statistics to recognize when good work is being performed. Finally, no matter how good the statistician, animation can reveal hidden sources of problems in the simulation model that statistical analyses cannot find. "A moving picture can be worth 1000 statistical tests" in the design of integrated systems.)

5. PUSHING A DEAD MOUSE THROUGH A MAZE

The choice of a mouse as the object of our attention is of interest for two reasons: it is not a particularly intelligent animal and the use of the "mouse" as an input device for the computer.

The absence of a naturally intelligent object motivates the use of artificially intelligent support mechanisms. Undoubtedly, expert systems are needed and will soon be available to support the design and use of simulation models.

The "mouse", keyboards, light pens, and punch cards are popular data input methods. However, more direct methods of transferring information to the computer are needed in the creation of the simulation model. An ability to create a simulation model directly from a CAD representation of a material handling system is one example of the need for direct input. Other examples exist in which input data is provided in schematic form. Also, the need exists to create control systems specifications directly from a simulation model. In a sense, new entrances and exits are needed for the maze.

6. PUSHING A DEAD MOUSE THROUGH A MAZE

The definition of simulation employed a narrowly defined objective: get through the maze! It failed to recognize the opportunity to go around, over, or under the maze!

In a similar manner, simulation is too often applied from a narrow perspective. Since simulation is not "friendly" enough to be used by most design engineers, and because the simulation modeler is not well-versed in the physical processes being modeled, it is often the case that the simulation modeler fails to challenge the elements of the set of initial assumptions. If the problem is given to be "get through the maze" then that is the way the problem is formulated!

Yet another interpretation gained from the word, through, is its operational aspect. Until recently, simulation was used as a design aid, instead of an operating tool. It is now used to support operating systems, and it does so on-line. Today, our mouse can be supported by a combination of simulation and expert systems as it negotiates the maze; whereas, in the past simulation would only have been used as an aid before embarking on its journey.

In the future, depending on the desires of our "mouse manager", simulation models will have both prescriptive and descriptive features. Not only will the mouse be able to obtain intelligent support to assist it in making decisions, but it also will follow the shortest path through the maze while riding in a simulation driven, computer controlled vehicle.

7. PUSHING A DEAD MOUSE THROUGH A MAZE

A common criticism of many simulation models is their failure to embrace the total system. In the same way our definition deals with a single maze, when there are several mazes to be negotiated, simulation models tend to deal with a large complex system by dividing it into a number of smaller segments or departments. Also, they tend to focus on, say, material flow and fail to address the myriad of other flows that occur, such as personnel, information, equipment, energy, and other resources. Instead of being faced with a single maze or a series of mazes, we are often faced with dealing with layers of mazes, without fully understanding how they interface and interact.

Instead of using simulation principally for analysis, its use in synthesis must be increased. Simulation is one of the few synthesis tools available; yet, it is used in the traditional manner of analysis: "break up a whole into its parts to find out their nature." It is seldom the case that we ever bother to "put Humpty Dumpty together again!"

8. PUSHING A DEAD MOUSE THROUGH A MAZE

The selection of a maze as the context for the definition of simulation is ironic, since many view simulation as a maze. They consider it to be extremely complex to use

and understand and believe it is accessible to only the educated specialist. Yet, there is little about simulation that is so complex as to be unaccessible to either engineers or to managers, if we choose to make it so!

The concept of simulation is simple and relatively easy to communicate. Few who use financial calculators to compute rates of return and payment sizes truly understand the mathematics and assumptions involved in their use. Yet, they have proven to be beneficial to those who must perform these calculations. Similarly, simulation can be more effectively transferred to those individuals who have need of it.

Having advocated improved accessibility of engineers and managers to simulation and its use, it is important to note, that I do not advocate shortcutting the essential uses of statistical analyses. Rather, I believe that they, too, can be "built into the model" in much the same way safety features are incorporated in other equipment to protect the user.

For example, why let the user specify the run size? Instead, solicit as input the confidence level desired. Expert systems can be incorporated in the models to perform the necessary variance reductions and achieve the level of confidence desired without excessive simulation runs.

9. SUMMARY

In summary, the need for simulation is great and includes support for designing, training, and operating complex, integrated systems. In the context of the "mouse and the maze", simulation needs to become more accessible to the mouse, rather than being restricted to use by the research scientist.

In the same way a "pull" philosophy forced an examination of fundamental concepts and practices of inventory management, the "givens" associated with the design and use of simulation models need to be examined. Among the critical aspects of the technology requiring the attention of the simulation community is its accessibility to engineers and managers. Impediments to accessibility need to be identified and steps taken to eliminate them. The result will be increased use and acceptance of simulation, plus more effective and efficient operating systems.

In closing, it is claimed that if we design a better mouse trap, the world will beat a path to our door. If that is the case, then if simulation is made accessible to the mouse, it will surely use it to deal with the maze.

AUTHOR'S BIOGRAPHY

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