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ADVANCED USES FOR MICRO SAINT SIMULATION SOFTWARE

Catherine Drury Barnes
K. Ronald Laughery, Jr.

Micro Analysis and Design, Inc.
4900 Pearl East Circle
Boulder, Colorado 80301, USA

ABSTRACT

For the past fifteen years, Micro Saint Simulation Software has been helping people solve their complex simulation problems. Micro Saint's power, flexibility, and tools for optimization, make it the simulation tool of choice for hundreds of Fortune 500 companies.

This paper will focus on the new features of Micro Saint 3.0, show its flexibility between industries and discuss areas of future application for simulation software.

1 INTRODUCTION

Micro Saint's power, flexibility, and tools for optimization make it the simulation tool of choice for any organization. If you can draw your system as a flow chart then you can build a model of your process in Micro Saint. Micro Saint's intuitive graphical user interface and the power to model systems of any type or size make it the simulation choice for Fortune 500 companies.

Micro Saint 3.0, a discrete-event simulation tool, is an efficient and cost-effective tool for simulating the complexities of systems within manufacturing, health care, retail, government, human factors, process redesign and the service industry. The problems being analyzed range from process control and resource utilization to military maintenance procedures and human performance.

2 MICRO SAINT ANSWERS "WHAT IF'S"

Micro Saint helps you answer "what if" questions. What if I increase the number of people working on the job by 10? What should I speed to decrease my cycle time by 20%? How do I ensure that customers do not have to wait 20 minutes for service? What if I redefine the human's role in the system through automation or a better interface?

These are just a few of the questions Micro Saint can help you answer. Micro Saint helps you find the best solution to your problem. With a computer model of your process built with Micro Saint's intuitive model development system, the "what if" scenarios can begin. What if I change my resource mix? What if I rearrange the process? What if I change the way the humans work with the system? How will this affect my productivity, cycle time, throughput, and workload? Now, Micro Saint can give you the answers quickly and completely for systems of all sizes, shapes, and complexities.

Micro Saint's strength has always been ease of use, but we have made it even better. We continue to enhance and refine our graphical user interface for model development and testing. Plus, we have added new wizards and spreadsheets that automatically set up resources and constraints for you. This leaves you more time to find the answers to your problem.

Micro Saint automatically collects data that you need to make those tough decisions. Data on utilization, queues, resources, and tasks are all collected automatically so once you have run the model, you can start getting answers instantly. Plus, you can customize data collection to suit your special needs through simple menus.

To make the job of finding the optimal solution faster and easier, Micro Saint has a built in optimization system. You define what the goals of your system are, the limits on what you can do to achieve that goal, and how long you want your computer to spend looking for it, and Micro Saint will go hunting for the best alternative. Plus, the way Micro Saint searches represents the latest in the state-of-the-art in intelligent search algorithms, finding solutions quickly and efficiently.

Simple models of straightforward systems can be built quickly and easily. But, there is no limit on the size or complexity of the models that you can create. Any and all unique aspects of the system you are modeling can be represented through a series of modeling tools and a built in programming language.

Micro Saint offers the power, flexibility, and tools to find the best alternative in an easy to use simulation package.

3 NEW FEATURES IN MICRO SAINT 3.0

Micro Saint Version 3.0 has added many new features to make building a model and finding the best answer faster and easier. These new features include:

The Resource wizard can be used to quickly create a new resource variable and allocate resources to tasks in the process. Resource variables then track the current number of available resources and the total number of resources in a model.

More Automatic data collection features gather data on resources and tasks. Every time the value of a resource variable changes, data on the clock time, the amount of resource in use after the change, the total amount of resource available after the change, and the resource utilization after the change are collected.

Model Optimization enhances Micro Saint by automatically searching for and finding optimal or near-optimal solutions to simulation models. OptQuest determines the correct combination of variables that produce the best results possible employing state-of-the-art intelligent search algorithms.

Flowcharting Symbols are now customizable on the network diagram. You can choose from over 50 bitmaps to customize your diagram. You can even choose different settings for tasks that are executing and idle.

The syntax checker searches the model for errors in syntax and automatically displays the errors. This saves debugging time and effort in your model.

4 TECHNICAL SPECIFICATIONS

Users defines the flow of the process through a network of activities through the Activity Network. In this network, you define the activities the system must perform, and the basic sequence of activities. Conditions that must be met before an activity can be performed, and the effect of activity performance on other activities and aspects of the process.

Entities (e.g. people, patients, documents, and parts) flow through the system in many complex ways. In Micro Saint, the user can define the set of decision rules for their specific process. Through Micro Saint's own C like language, the user defines the system's behavior without ever leaving Micro Saint. Micro Saint logic can be redefined as the model is running, to refine the model or to experiment with process improvements.

Queues are one of the most important building blocks of discrete event simulation. Automatic queue data collection collects data on the maximum length of the queue, the minimum length of the queue and the wait times. By using Micro Saint's built in tools, the user can perform detailed statistical analyses on the queues.

Resources are a snap with the new resource wizard. The Resource wizard can be used to quickly create a new resource variable and allocate a resource to tasks in the model. This leaves the user with more time to work on the logic of their model.

Micro Saint offers you not one but two ways to animate your model. First the network diagram comes to life when you run your model. Now with the choice of bitmaps as well as task ovals you can make this view much more realistic. The second type of animation, ActionView, allows the user to create realistic picture quality animations. With ActionView, backgrounds can be scanned in, brought in from a CAD drawing, or paint packages. The user chooses from over 250 icons or designs their own custom icons that move about on the background to represent the process. ActionView animation is an excellent way to present simulation model to a group in a quick and effective manner.

Models are constrained only by computer memory. With systems currently available, our users have modeled processes with tens of thousands of activities simulating millions of entities flowing through a process. Micro Saint is only limited by the power of your computer, not your imagination.

Micro Saint models are built in a C-like programming environment that gives it all the power of a programming language. Anywhere in Micro Saint that you can enter a numeric value, you can enter an algorithm consisting of a sequence of algebraic and logical expressions that calculate that value. Operators include:

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Logical operators include if…then…else, while…do.

5 OPTIMIZATION

OptQuest enhances Micro Saint by automatically searching for and finding optimal or near-optimal solutions to simulation models. OptQuest determines the correct combination of variables that produces the best results possible for practical application.

OptQuest for Micro Saint is a new advance that extends the capabilities of simulation. OptQuest replaces the inaccuracy of trial-and-error with a potent search engine that pinpoints the best decisions available from simulation.

Standard simulation packages give the user no help in identifying good decision alternatives to evaluate by simulation. More importantly, they offer no guidance or insight into the nature of alternatives that can yield the best outcomes.

To illustrate, the intelligent simulation user wants answers to questions such as: What is the best investment portfolio? What is the most effective factory layout?

What is the safest equipment replacement policy? What is the most cost effective inventory policy? What is the best workforce allocation? What is the most productive operating schedule?

The answers to such questions require intelligent identification and analysis of multiple scenarios, to determine the consequences for costs, profits and risks. The critical "missing component" in standard simulation packages is to disclose which decision scenarios should be investigated -- and still more completely, to provide an automated process designed to find the best set of decisions.

OptQuest for Micro Saint effectively provides these missing functions. In addition, OptQuest enables the decision maker to specify a variety of important relationships to control the determination of optimal decisions, such as: ranges of key parameters, budget limitations, machine capacities, minimum and maximum lot sizes, limits on hours worked. These constraining relationships allow the decision-maker to focus the search on the relevant considerations. OptQuest then determines the strategic value-mixes of the decision parameters and decision scenarios that are investigated under its guidance -- and, at the "bottom line," identifies scenarios that yield the highest quality outcomes for profits, costs and risks, according to the criteria selected by the decision maker.

6 MANUFACTURING

Micro Saint is used in the manufacturing industry to look at throughput, cycle time, the optimal schedules and in new factory layout. Large and small corporations have found Micro Saint is easy to use and very flexible. This flexibility makes Micro Saint the tool to use in different departments such as the work cell analysis and the reengineering of the accounting department.

The new Optimization feature in Micro Saint appeals to manufacturing facilities. For example, if a company is doing a simulation of their inventory system, the reorder point, the order quantity and the time between inventory reviews are the variables that define the system. OptQuest can help define the optimal inventory policy with respect to minimizing a function of total expected cost.

For example, a Fortune 100 company had a cellular manufacturing layout that they felt could be made more efficient. They were about to make substantial capital improvements in manufacturing system equipment and wanted to make sure the new equipment was integrated with the old equipment in the best possible way. The company used Micro Saint to model their manufacturing system and reach their goals of finding a cellular layout that would meet their production goals. This study required a sophisticated model because the production goals were spread across 40 different product types , and capacity for inventory was limited, indicating a need for a JIT design. The study was limited to three weeks in length.

In the process of building the model, the customer gained an understanding of the system that showed them many areas for potential improvement. The project did not attempt to discover the "optimal design" for the cell rather it only identified one of an entire family of solutions that would work. More models were built in order to simulation the other production line cells. These models allowed the customer to consider tradeoffs based on operator utilization balanced against the cost of the equipment, operator training, and installation requirements and process time. The bottom line was the manufacturer was able to increase production by 71% and increase profit per unit by 142%. This resulted in an increase in the annual profits of the company by over 400% on that single production line. The company reduced costs and improved quality with a small investment in simulation.

7 HEALTH CARE

In the health care industry, Micro Saint has been used to look at emergency room flow, ambulatory services, OBGYN units, pharmaceutical processes and patient file flow. Customers often choose health care facilities on the basis of the quality of service they receive. Every hospital or health care organization must answer questions about cost and quality. One way hospitals are able to look at cost versus quality is by using simulation. In one instance, an Ambulatory Surgery Department, the department that cares for patients both pre-operatively and post-operatively, had run out of space. The question was to build a new facility or redesign the existing space without changing the surgery schedule. Micro Saint was used to simulate the flow of patients from ambulatory surgery to surgery to recovery and back to ambulatory surgery. A management engineer simulated the effects on many different alternatives for routing patients through the system and maximized the utilization of the facilities.

The hospital staff was so pleased with the recommendations for the ambulatory surgery facilities that the management engineer was asked to help evaluate the surgery schedule on a daily basis. The changes recommended as a result of the simulation models allowed the hospital to increase the number of patients that can be scheduled for ambulatory surgery, therefore increasing profits while improving the quality of service being offered to patients.

This is just one example of how Micro Saint can help improve the patient care while reducing costs at a hospital.

8 HUMAN FACTORS AND ERGONOMICS

The use of simulation to analyze human factors and ergonomics is a relatively new application of simulation.

However, we at Micro Analysis and Design have found simulation to be extremely useful in evaluating decisions such as "how many crewmembers do we need to fly an airplane?" and "what will the availability of trucks be for a given number of maintainers of given skill types?" Additionally, we have developed simulation techniques to answer these questions as a function of equipment design factors.

For example, during the early design phases of the Army Comanche helicopter, one of the key objectives was that the aircraft be piloted and operated entirely by one human. Central to that objective was the question, "Can one person do it all?" We were called upon to examine this issue with respect to four alternative helicopter cockpit designs. Specifically, the purpose of this project was to determine whether a one-person cockpit design would cause the operator's workload to reach unacceptable levels during the mission.

Micro Saint computer models were developed for each of the cockpit alternatives considered. Variables and modeling constructs were included in these models to track operator workload demands in the visual, auditory, cognitive, and psychomotor aspects of the operator's tasks. Using these models, simulation experiments were conducted under several experimental conditions corresponding to different cockpit designs. For each design, operator workload was predicted and the tasks driving workload were identified. The advantages of each of the alternatives were identified. The report we prepared discussed the relative advantages and disadvantages of each design as well as the projected technological requirements that would be required to support a one-person cockpit. Ultimately, we recommended that a one-person cockpit was not feasible within the technical and other design constraints.

9 SUMMARY

In this paper, we have focused on the Micro Saint methodology and the underlying principles of modeling with Micro Saint in a variety of different industries. We have not attempted to cover all of the software features for building models, controlling a simulation, and generating and analyzing data. If you would like to know more, please contact Micro Analysis and Design.

What we have shown is that Micro Saint is a powerful tool for evaluating the dynamic aspects of systems within a wide variety of application areas. Micro Saint's primary strength is that it has an intuitive, graphical interface that allows users to quickly develop models that accurately represent their system. Users are then able to evaluate "what if" scenarios with a variety of inputs to find the optimal solution. Simulation technology has been used by industrial engineers in a manufacturing context since the 1960's but only recently has it been applied to business applications. Regardless of the application area, the results are the same: better decisions can be made, money can be saved, productivity can be increased, and customers can receive a higher level of service.

AUTHOR BIOGRAPHIES

CATHERINE DRURY BARNES is the Marketing Director of Micro Analysis and Design, Inc. She has a Bachelor's of Science in Marketing from Miami University of Ohio. Currently, she is finishing her MBA at the University of Colorado at Boulder.

K. RONALD LAUGHERY JR., received his Ph.D. in Industrial Engineering from the State University of New York at Buffalo. He established Micro Analysis and Design in 1981, managing contracts for the development of computer modeling and simulation languages, the design and evaluation of training simulators, the development of supporting technologies for constructive and distributed simulations, and the development of tools for the Army MANPRINT program.