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INTRODUCTION TO SLAMSYSTEM®

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ABSTRACT

SLAMSYSTEM is an integrated simulation system for advanced personal computers based on the Microsoft Windows interface (under MS DOS) or the OS/2 Presentation Manager. This tutorial will discuss SLAMSYSTEM's support for the range of tasks performed in a SLAM II simulation project. It will also describe two new modules released in 1990, an OS/2 animator and the Extended Modeling Option for Packaging Lines.

1. SLAMSYSTEM OVERVIEW

SLAMSYSTEM integrates software supporting the range of tasks performed in a simulation project. All features are accessible through pull-down menus and dialog boxes, and are selected from the SLAMSYSTEM Executive Window, shown in Figure 1.

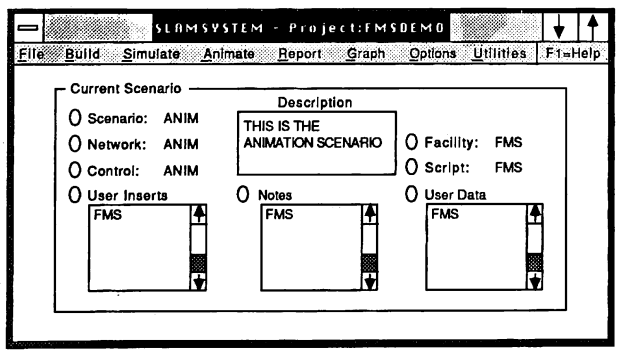

Figure 1. SLAMSYSTEM Executive Window

A SLAMSYSTEM project consists of one or more scenarios, each of which represents a particular system alternative. A scenario is comprised of components such as a network and control, user inserts and user data, animation facilities and scripts, notes for model documentation, and model output. The Current Scenario Box in the SLAMSYSTEM Executive Window shows the components associated with the scenario presently being analyzed.

SLAMSYSTEM's project maintainer removes the burden of remembering the procedure necessary to perform the tasks of simulation, animation, and output review. Each time the modeler requests one of these functions, the project maintainer examines the components of the current scenario to determine if any of them have been modified, indicates whether tasks such as model translation and executable creation should be performed to reflect the changes, and allows the user to specify whether these tasks should be done prior to performing the requested function.

Since SLAMSYSTEM is a Windows application, multiple tasks may be performed in parallel while simulations are executed in the background. The simulation modeler can switch between tasks by using a mouse to click in the appropriate window.

2. BUILDING MODELS WITH SLAMSYSTEM

SLAMSYSTEM may be used to build SLAM II models with the assistance of the graphical network builder (Figure 2) and the forms-oriented control builder. These builders use the mouse and a forms-based approach to aid the modeler in the entry of the system description. They remove the need to remember syntax and field definitions, and allow the modeler to concentrate on constructing models.

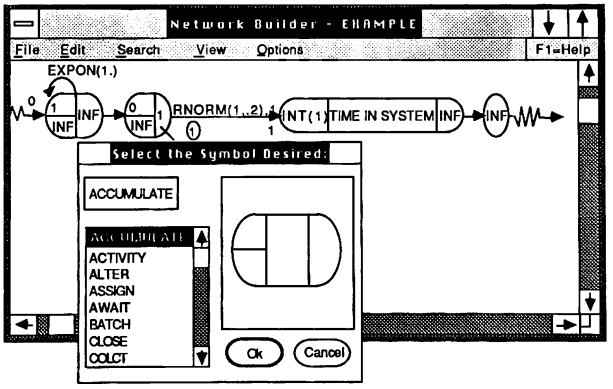

Figure 2. Graphical Network Builder and the Forms-oriented Control Builder

Network symbols are selected from a graphical palette and located with the mouse. The symbol's parameter values are specified by filling out a form of information applicable to the particular symbol. On-line error checking is performed upon completion of the form so that input errors can be corrected immediately. Networks can be viewed at three levels of detail. At the highest level, more than 150 symbols can be seen at once. The Windows "Clipboard" can be used for copying a set of symbols to other positions in the network or to other networks or applications. Symbols may be repositioned by selecting and re-locating them with a mouse. The Network Builder also facilitates model building by providing context-sensitive help, searching capabilities, and options for placing symbols at grid points, selecting symbol colors, and flowcharting models by defaulting symbol parameters.

A model's control statements are entered by selecting from a palette of available statements. The parameters of each statement are defined by entering the desired values in the fields of a form specific

to that type of statement. As with network symbols, most fields have default values.

Alternatively, networks and controls may be entered in SLAM II statement format with SLAMSYSTEM's textual editor. The Network Builder is capable of loading a network built textually by automatically placing symbols to create a graphical network.

3. OUTPUT ANALYSIS AND PRESENTATION

SLAMSYSTEM provides the capability for comparing simulation outputs from various scenarios both graphically and textually. A report "browser" allows alternative textual outputs to be compared side by side. Graphically, output may be viewed in the form of bar charts, histograms, pie charts, and plots. Bar charts can be used to display the value of a statistic across as many as 10 scenarios. It is possible to view multiple windows of graphical output at a single time, as shown in Figure 3. Graphical and textual information from SLAMSYSTEM graphs and reports can be exported to other Windows packages for additional analysis and for documentation.

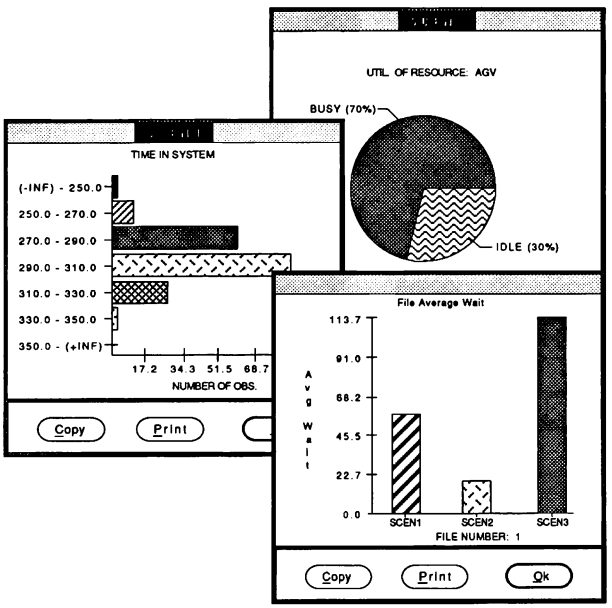

Figure 3. Multiple windows

4. ANIMATING MODELS

Animations are created with the Facility and Script Builders. The Facility Builder is used to design background screens, symbols and graphs, to define points on the screen where animation actions will occur, and to create application files which specify the background screens and graphs to be used during an animation. The Script Builder is used to specify which animation actions should occur when a particular simulation event happens. Animations can be performed either concurrently with the simulation or in a "post-process" mode. Plots, barcharts, histograms, and trend graphs may be shown along with symbol movements, color changes, numeric value displays, text placements, and stack updates. Two screens can be updated simultaneously, and up to 255 screens may be swapped into memory during an animation.

The Facility Builder allows the modeler to design background screens and symbols by drawing lines, outlines, boxes, circles, ellipses, arcs, and points using 16 standard colors, 16 hatch patterns, and 16 colored patterns. Sections of the background screens and symbols can be copied, moved, mirrored, rotated, and color swapped. Symbols may be transported back and forth between symbol tables and background screens. Facility screens can be imported from other software packages such as AutoCad.

The Script Builder allows animation rules to be entered with a forms system which is very similar to the one used in the Control and Network Builders. The parameters of each script statement are specified by filling out a form for the particular statement. The form displays all the options for each parameter, and on-line help is available.

5. OS/2 ANIMATOR

The SLAMSYSTEM OS/2 animator now utilizes special features of the OS/2 operating system. These special features include preemptive multitasking and a windowed user interface. Preemptive multitasking allows multiple animations of a single simulation model to be displayed concurrently. The windowed interface is utilized in the graphical animation builder to increase the animation developer's productivity. In addition, advanced animation constructs dramatically reduce the amount of time required to animate complex situations.

With the new SLAMSYSTEM OS/2 animator, one may develop and display multiple animations of a single simulation. For example, the modeler can create one animation of a system at an aggregate level and another at a department level, side by side in separate windows. The two views may then be displayed by selecting those animations through the SLAMSYSTEM executive and running the simulation.

Animation constructs under the OS/2 animator are called actions. Many of these actions directly correspond to elements in a SLAM II network model. These direct mappings are provided for activities, resources, queues, global variables (either as counters, plots, or bar graphs), AGV segments and cranes. For example, the ACTIVITY action shows movement of a symbol. It requires that the modeler define a symbol, a graphical path location where movement of the symbol will be shown, and the number of an activity in the SLAM II model to which to tie the movement.

Advanced animation actions are provided for modeling more complex system constructs. One of these actions can be used to accurately represent the movement of parts along a conveyor. The modeler identifies a graphical path where movement will appear, a symbol or symbols to move, and the simulation event or events which trigger the action. The symbols may be made to appear instantly on the path or they may be moved from the beginning of the path to a buffer area in a specified time. When a symbol is removed from the buffer, the remaining set of entities moves forward just as packages on a conveyor behave when the lead package is removed.

The symbols manipulated by the animator are of two types: graphical items one wants to display or move, and the background on which they will appear. These symbols are stored in standard OS/2 bitmap format. This allows them to be exchanged between programs using the OS/2 clipboard. For example, the modeler may have a facility layout drawn in AutoCad with OS/2. This layout can be copied to the clipboard and pasted into the SLAMSYSTEM animator as the background for the animation. In addition, a utility is provided with the SLAMSYSTEM animator which converts any portion of the OS/2 Presentation Manager (PM) screen to a bitmap. This allows the modeler to import images from OS/2 PM programs which do not support the clipboard.

6. PACKAGING LINES

The SLAMSYSTEM™ Packaging Lines Extended Modeling Option models and evaluates high speed, high volume container filling and manufacturing systems. This option addresses dynamic interactions of a line's components and measures overall system efficiency and stability. Within SLAMSYSTEM, the Packaging Lines Extended Modeling Option is a simulation system that supports model building, the use of simulation for model analyses, and the presentation of simulation results.

A model of high speed, high volume container filling and manufacturing systems must describe the line's material flow, its control system and operating procedures, and the influencing equipment reliabilities. The Packaging Lines Extended Modeling Option provides four primary constructs (building blocks) for defining a line's material flow:

1. Process – machines and inspection points;
2. Conveyor – conveyor sections and accumulator tables;
3. Diverge – splits conveyor flow; and,
4. Merge – joins converging flows.

Figure 4 shows an animation of a simple system using these four constructs.

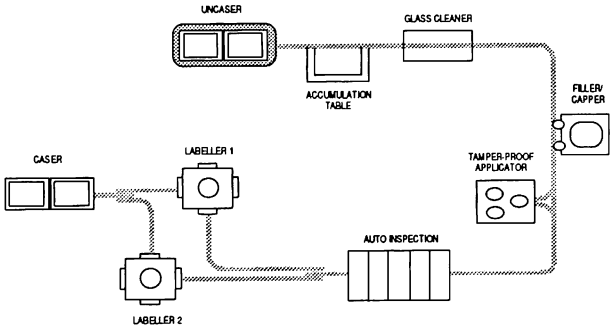

Figure 4. Bottling line layout

Two additional constructs are provided for defining the line's control systems:

1. Control – locates control sensors on conveyors or accumulator tables; and,
2. Action – describes the response initiated when a control is "covered" or "uncovered."

Model components as well as overall simulation parameters are defined through fill-in-the-blank forms, with complete on-line help.

The Packaging Lines Extended Modeling Option produces a variety of output for model analyses. Reports and graphs display quantitative simulation performance measures from one or more scenarios. Time series plots and event traces verify the model; performance summaries evaluate and compare performance of the conveyor, process, and control dynamics; diagnostic reports assist with trouble shooting modeling errors. Graphical plots augment the summary reports and verify individual component dynamics and their interaction with other components. Trace reports are optional and provide a textual history of selected "process" states over time.

Animations are developed by drawing or importing a background screen and using forms to create commands that relate simulation events to animation actions. Reference points that link simulation events to the animation are placed on the background to show status of the process, rates of accumulation, and the ends or branch points of a conveyor.

7. CONCLUSION

SLAM II is a proven, powerful modeling methodology. It has been used for hundreds of simulation projects and as the basis for simulation courses in many colleges and universities. Published applications describe models dealing with problems in manufacturing, transportation, material handling, staffing, experimental design, communications systems, and many more.

Continuing development of SLAM II and simulation support software has culminated in TESS and SLAMSYSTEM, integrated simulation systems for workstations and personal computers. SLAM II, TESS and SLAMSYSTEM are distributed by Pritsker Corporation, which offers regularly scheduled training classes as well as applications support.