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FACTORY SIMULATION WITH ANIMATION
THE NO PROGRAMMING APPROACH

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SIMFACTORY with animation is a PC-based simulation tool. It simplifies factory planning for industrial and manufacturing engineers by eliminating the costs and delays of computer programming.

When making decisions, engineers often wish they could somehow view the results of their decisions before they make them, thereby avoiding costly mistakes. SIMFACTORY provides the user with this capability by allowing convenient "what if" analysis of scenarios in advance of committing funds.

WHAT IS SIMFACTORY?

Some of the manufacturing issues addressed by SIMFACTORY are:

1. Determination of necessary equipment and personnel
2. Location and size of buffers
3. Impact of new product introduction
4. Impact of random breakdown
5. Throughput and bottleneck analysis
6. Impact of changing process yields
7. Results of scheduling strategies
8. Transporter and routing strategies

SIMFACTORY has been developed in the widely used SIMSCRIPT II.5 simulation language. Since SIMSCRIPT II.5 is the underlying language, many of the benefits are passed on to SIMFACTORY. However, at no time does the SIMFACTORY user write computer code.

SIMFACTORY provides a robust set of constructs for modelling discrete parts manufacturing facilities. The user decides through interactive menus which of the available features best meet his needs. This enables the modeler to create a dynamic simulation of the factory which can then be used for analyzing factory performance measures.

An animated picture of the factory during the simulation provides valuable insights and builds confidence in the results. Because the results are better understood, the recommendations are more likely to be accepted.

THE STRUCTURE

SIMFACTORY consists of three separate programs (see Figure 1):

1. User Interface
2. Icon Editor
3. Simulation Model

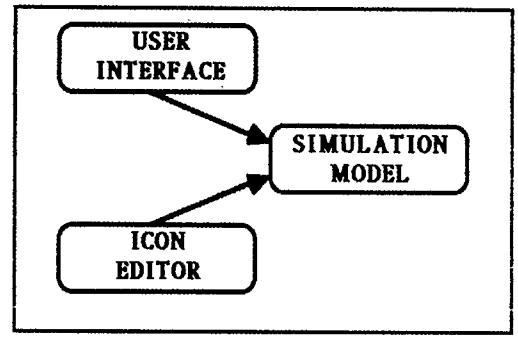

Figure 1. The structure of SIMFACTORY

The user interface offers two powerful capabilities: it facilitates data entry and serves as a data manager.

The icon editor enables users to create and edit graphical icons which represent the components of the factory layout and animation.

The simulation model executes the dynamic simulation and generates comprehensive statistical results as well as the animated picture of the factory at work.

HOW SIMFACTORY RUNS

In the most general sense, you simply:

1. Develop a conceptual model of the system you want to simulate,
2. Enter the data which describes the model, including physical layout,
3. Tell SIMFACTORY what type of reports you want,
4. Run the model,
5. Study the results,
6. Change some aspect(s) of the factory and rerun the simulation to see "what if."

MODELLING ELEMENTS

Processing Stations

Processing stations are where parts are processed. A processing station can represent a machine or a manual operation. Each processing station is defined in terms of the operations it can perform.

Each operation performed by a processing station has its own efficiency and setup time and may involve the use of resources such as jigs or fixtures. In addition, processing stations can be subjected to maintenance.

Queues

Queues are holding areas where parts or containers are stored. Raw materials enter the system in queues. Parts are not allowed to enter a queue that is full. Priorities for sorting parts in queues are available.

Process Plans

Parts routing, process times, and bill of materials are described in the Process Plans. Assembly and disassembly relationships of parts are also specified. Modelling of rejects can be incorporated.

Production Schedule

The quantity and production release date of work orders are specified in the production schedule. Priorities for orders with the earliest due dates can be assigned. The length of the simulation run and time units of simulation are selected.

Transporters

Transporters move parts between pick-up and delivery (P&D) points. They can be conveyors (accumulating or non-accumulating) or batch transporters. Transporters have a speed and can be subjected to maintenance.

Interruptions

Priority and passive interrupts are described in terms of mean time between interruptions (MTBI) and mean time to resume (MTTR). Interruptions can be specified in claendar time or operating time. Interruptions are useful for modelling maintenance as well as shifts and breaks.

Factory Layout

The relationship between processing stations, queues, and transporters is defined in the factory layout. This includes the location of processing stations, queues, and P&D points.

Paths between P&D points are defined and transporters are assigned a set of P&D points they serve. All this information is entered graphically on the layout screen. The factory layout becomes the animation screen during the simulation.

Probability Distributions

Many parameters can be defined by using the probability distributions that are built-in.

Dynamic Memory Management

Unlike most PC-based simulation software SIMFACTORY has no arbitrary model size limits that prevent realistic factory modeling. Dynamic memory management allows simulation of complex manufacturing problems without limits on the number of stations, parts, or job types.

PERIODIC AND SUMMARY REPORTS

SIMFACTORY provides both periodic and final statistical system performance measures. These reports include information on processing station utilization (see Figure 2 for example), queue levels, transporter utilization, raw material consumption, throughput, and resource utilization. This information can be used by spreadsheet or statistical analysis software.

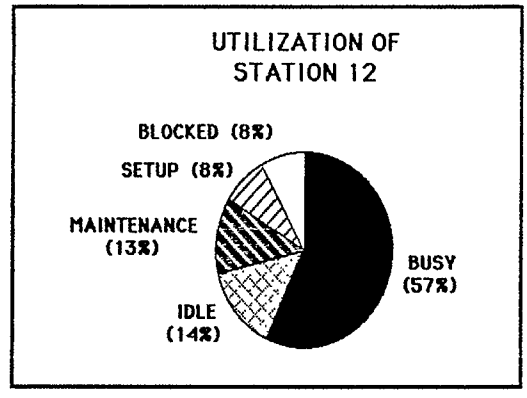

Figure 2. Graphical simulation results

VERIFICATION VALIDATION & ANALYSIS AIDS

In addition to periodic and summary reports, there are three types of reports that help users determine whether a factory description is correct and whether it is an adequate representation of the factory under study.

Data Echoes

SIMFACTORY provides optional echoes of the input data entered through the user interface. The data echoes are useful for verifying the inputs. They are also useful for relating summary reports to inputs when presenting the simulation results.

Traces

Traces are a step-by step report of what

is happening in a factory simulation. This is very useful when the factory behavior is different than expected.

Snapshots

Snapshots allow interruption of the simulation and observe the status of a factory. Detailed information is available on the status of processing stations, resources, queues, transporters, pending work orders and future events. Snapshots also allow modification of trace switch settings and control of animation.

CONCLUSIONS

While micro-computer-based simulation, graphical animation, and interactive modeling accelerate the wide use of simulation in factory planning, requirements for special programming skills and unrealistic model limitations have held back the use of this poserful technique.

SIMFACTORY with animation eliminates these objections. Model construction and data input are entirely through the menu-driven user interface -- there is no programming. Graphical and animated results improve communication between modeler and users. Finally, the dynamic memory feature permits the analysis of realistic manufacturing situations.

AUTHOR'S BIOGRAPHY

Ken Tumay is a product manager at CACI. He received his B.S. and M.S. degrees in Industrial Engineering at Arizona State University. He was involved in factory simulation projects at The Confacs Group while working as a simulation analyst.

CACI has been in the simulation business for 27 years. Its widely used SIMSCRIPT II.5 compiler is the technological basis for SIMFACTORY.