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The following are summary of the four technical presentations on the 5th ASEAN WITNESS User Group (WUG) conference held on 25 January, 1996, in Singapore.

## APPLYING SIMULATION IN AN INTEGRATED ASSEMBLY LINE

*by T.S. Soo of Motorola (M) Sdn Bhd*

Because of the stiff competition in semiconductor industry, many companies re-engineer their process to gain competitive edge. Motorola (M) Sdn Bhd is in the process of converting the job shop environment assembly lines to integrated assembly lines to reduce cost, improve productivity and quality.

### Why Simulate ?

The biggest barrier to the adoption of business process re-engineering (BPR) is the risk inherent in redesign of processes. It is essential to build a model to analyse the proposed system before implementation. The proposed integrated lines are too complicated for analytically mathematical approach to model and analyse. WITNESS™ can reduce the risk by allowing animated computer model of redesigned processes to be constructed in a very short time, so the design flaws and omissions can be identified and eliminated prior to implementation.

WITNESS™ can provide comprehensive performance measurement for the modelled integrated lines. The system can then be assessed and the performance be evaluated. The different scenarios can be analysed by changing the parameters so that the optimal parameters can be derived. By what-if analysis, the best operating policies can also be identified.

### Parameters Investigated

A very important issue in the design of a new production line is to optimise the configuration of the line. Simulation can help to identify the optimal combination of the elements in the line such as machine quantity, buffer size and etc. In the project, the following parameters have been investigated and determined.

- Workstation design: Determine the number of wire bonders
- Material handling system transport: Investigate conveyor characteristics, i.e. speed; Decide the number of storage buffer
- Operating strategy: Study the effects and reactions to disruptions such as component failures; Identify the optimal traffic control logic

### Experiments

By running the basic model, a design flaw was identified and corrected. It was also noticed that starvation occurs on the last wire bonder. To solve these problems and investigate the parameters mentioned above, the following scenarios have been simulated:

- Rerun the model with different bonding time to investigate the significance of the starvation problem
- Reassign the priority of buffers in receiving material
- Add more buffer to the line
- Apply different traffic control logic

### Conclusion

Simulation has been proven to be an ideal tool in the BPR to reduce the technical and financial risk. It is also very useful in the optimisation of manufacturing system configuration and operational strategies.

# WAREHOUSE CAPACITY SIMULATION

*by Francis Ho of Hewlett-Packard ICBD-SGP*

Due to the recent aggressive cost reduction program, the raw material inventory cost was one of major target in the program of 1995. HP ICBD-SGP is considering to use a smaller in-house's warehouse to cater for all raw material inventory. If implemented, it could benefit the company in tens of thousands of dollars in cost saving through lower inventory and replacement of external warehouse with internal one.

**Objectives**

- To study the impact of transferring the external warehouse to in-house's warehouse in terms of space/capacity requirement.
- To determine the most optimum rack space or additional capacity required to house all inventory of raw material without affecting production line schedule.

**Key Steps Undertaken**

The following steps have been taken to collect the data required in the simulation project:

- Understand physical flow of raw material in both the receiving and issuing activities
- Understand the part number structure and re-name the parts
- Study the part number relationship (any grouping possibilities)
- Understand the current methods in capturing parts received and issued information on the computer system
- Determine the data format/structure which can be used by WITNESS$^{TM}$ in the input file
- Determine the mechanical dimension of racks/shelves and also the boxes or containers for computation of capacity requirements
- Obtain the receiving and issuing schedule for the raw material inventory in the past four months
- Decide to use a dedicated or open/ random storage principle

During the model building and running, some difficulties were encountered and solved. They are summarized as follows:

1. There were too many parts in the model one time. It slowed down the system running and occupied a lot of memory. Using variables to represent the number of parts in the racks made the system run much faster and take fewer memories.
2. There were too many types of parts which made the tracking very difficult in terms of inventory level. By grouping all similar raw material, it was easier to track the capacity utilization and inventory level.
3. Each type of part has different storage/space capacity requirements. Using the mean storage space for the individual group solved this problem.

The number of rack/space required for individual groups can be calculated based on the simulation results:

Number of racks (max) = Maximum level of inventory/capacity per rack
Number of racks (min) = Minimum level of inventory/capacity per rack

**Implementation**

The management went ahead and purchased the new racks required after consultation with the simulation results.

The buyer/scheduler made adjustments according to the purchasing policies, so that there would not be any excess inventory and kept the inventory to a minimum level without affecting production schedule to save the inventory cost.

## CAPACITY PLANNING USING WITNESS™ - Finite and Non-finite Capacity Planning

*by K.C. Goh of Siemens Penang*

Siemens Penang is one of largest manufacturers of opto-electronics devices in this region. In the manufacturing process under study, there are over 200 machines in the factory and 920 different kinds of devices manufactured. Due to the large number of machines and devices, it is difficult to manually plan for capacity in any great detail; especially true for test area. So WITNESS™ is chosen as a tool to develop a capacity planning system.

### Objectives

- To develop a tool that will accurately assess the capacity availability of the Optocoupler line for all processes by identifying bottlenecks.
- To develop a systematic and effective manner of capturing, storing, dissemi-nating and tying together critical manufacturing information.

### The Model

After an intensive study and consulting with correspondent I.E., it was agreed that the system should be made up of the following modules:

- Input - read in as text files produced by Lotus or Excel. This makes it easy for end-users.
- Rough-cut capacity check module.
- Dynamic module.
- Report generator module.
- Output - in the form of on screen graphics, graphs, tables and text files.

### Benefits

The benefits of the system can be summarized as follows:

- Greater accuracy in capacity planning.
- Better understanding between planning and production functions; both see the same "picture".
- Common database and tool that is accessable to all functions in the organization.
- Effective cross-function communication.

### Difficulties Encountered

The difficulties encountered in the project are summarized as follows:

- Collecting large amounts of data and process information.
- Getting people to work together in a pressured environment.
- Getting people to use the new tool.

At Siemens, the support of management and the use of SIT has helped to overcome many difficulties.

### Current Status

Database has been completed recently after major relayout of Test area. Database is now being put on the network for easy access; in the form of Excel and text files.

- Training for key personnel from planning and production is in progress.
- Tool will go "live" starting March 1996.

## SIMULATION APPLICATIONS IN AUTOMATION

*by Dr. Hu Guang Hua of CIMTEK*

### WHY Simulation

- Automation systems normally require a high capital investment
- Automated systems are complicated
  - » complex control logic
  - » random behaviour
  - » dynamic interactions
- Simulation helps to determine
  - » feasibility of the system
  - » numeric data, e.g. equipment quantity, buffer size, number of pallets/fixtures, speed of conveyor/AGV, cycle time
  - » logic data - e.g. priority of handling request, conflict resolution logic, impact of yield and preventive maintenance, optimal material flow, product families

**WHEN is Simulation Used**

- As early as possible in the manufacturing system life cycle, e.g. the design stage
- A must in both the installation and production growth stages

**HOW to Conduct a Simulation Project**

- Set objectives
- Collect data and make assumptions
- Build simulation model and validate
- Experiment different scenarios
- Analyse and implement results

**CASE 1: AGV System**

An IC manufacturer designed an AGV system to transfer and collect components to and from a group of 5 test machines.

- Objectives of Simulation Project
  » to assess the system feasibility
  » to identify the bottleneck
  » to optimise the layout and orientation
  » to optimise AGV's operational sequence
  » to identify areas for improvement
- Data and Assumptions
  » layout and orientation
  » AGV data: speed, loading/ unloading time, proposed operational logic
  » process data: process flow, UPH (Units Per Hour), yield, setup time
  » product data: demand, lot size, tray size
- Conclusions
  » initial design could not achieve the target
  » the AGV response time was too long
  » quantify improvement by what-if analysis
  - improved machine utilization by 6% & meet target by changing control logic
  - recommended improvement of machine loading mechanism for future purchase

**CASE 2: Conveyor System**

A new conveyor-based flexible assembly system would be installed in a consumer product manufacturing plant.

- Objectives of Simulation Project
  » to identify the bottleneck
  » to optimise the number of pallets
  » to optimise the product mix ratio
  » to quantify the cycle time and line rate
  » to study an automated tester in detail
- Data and Assumptions
  » detailed layout
  » conveyor data: speed, type, transfer time
  » product data: type and demand
  » process data: operations by station, time
  » operational sequence and conditions
- Conclusions
  » the production demand can be met
  » identified potential bottleneck machines
  » determined number of pallets
  » reduced automated testers by 1
  » increase conveyor speed cannot increase capacity but reduce number of pallets

**CASE 3: Overhead Conveyor System**

A car manufacturer set up an overhead conveyor system to transport the car seats to the main assembly line.

- Objectives of Simulation Project
  » to verify the synchronised material flow
  » to find the longest cycle time per pitch and maximum car assembly speed
  » to provide detailed control logic for seats loading and unloading
  » to identify the control logic when car and seats do not match
- Data and Assumptions
  » layout of the overhead conveyor system and the car assembly line
  » speed and pitch of conveyor and line
  » car and seats supplying pattern
  » synchronising control logic
- Conclusions
  » identified a design flaw
  » re-designed seats supply system can be synchronised with the car assembly line
  » identified max. speed of car assembly line
  » identified longest cycle time per pitch
  » identified/verified all control logic

**Conclusions**

WITNESS™ simulation is used :-

- at system design and growth stages
- assess feasibility of automation systems
- determine both numeric and logic data
- quantify benefits of improvement ideas
- identify hidden problems