FabSim

A (semiconductor) factory simulator

The fabrication of modern semiconductor chips is one of the most complex manufacturing efforts ever seen. A typical process sequence has more than 300 steps, runs in a fab which costs beyond 1 billion US$, where an individual manufacturing tool may cost well above 10 million US$. Due to the large investments required it is important to optimize the manufacturing plant. Many questions have to be answered: How many tools are required for a certain throughput, where are possible bottlenecks, how does the fab react to a product or process mix, what are typical cycle times for lots, how does equipment downtime influence the operation, how many operators are needed?

The detailed and quantitative answer to these questions cannot be given by analytical modeling. The model of a fab resembles a highly dynamic system. Its system variables change state at discrete time steps. Therefore discrete-event simulation as offered by FabSim is the appropriate tool to describe the fab operation.

FabSim is a complete and universal (semiconductor) fabrication facility model in a single executable file, ready to immediately start the simulation of a factory. The setup of the fab is entered via a machine tool list which contains process step and machine data of up to 128 toolsets. Processes are described by flow charts which apply the process steps offered by available machines. Alternative toolsets and processing time constraint as well as send ahead wafers are defined. Simulation is controlled by a lot list, which defines lots with start time, process name, priority and other data. As output FabSim offers several tables including lots processed, machine usage, and buffer occupancy.

The fab model includes various advanced features and options: batch operation, three priority levels (including hot lot capability with machine reservation), fixed or throughput dependent or statistically distributed downtime, fixed or lot size dependent process time, transport time (fixed per toolset or loaded from a from-to matrix), WIP controlled or time based lot starts, unlimited number of different flow charts, dispatching rules like operation due date, critical ratio or shortest processing time first. Optional machine setup includes setup avoidance policies. Lot or wafer yield may be taken into account.

FabSim is written in C++ and available for MS Windows or LINUX operation systems. The proprietary simulation engine guarantees very fast execution (a few ten seconds up to a few minutes per simulation run depending on machine count and time to be emulated).

FabSim is accompanied by MS EXCEL based data evaluation tools. Cycle time data may be plotted against time, as well as toolset usage, WIP vs. time, lot flow through the factory.
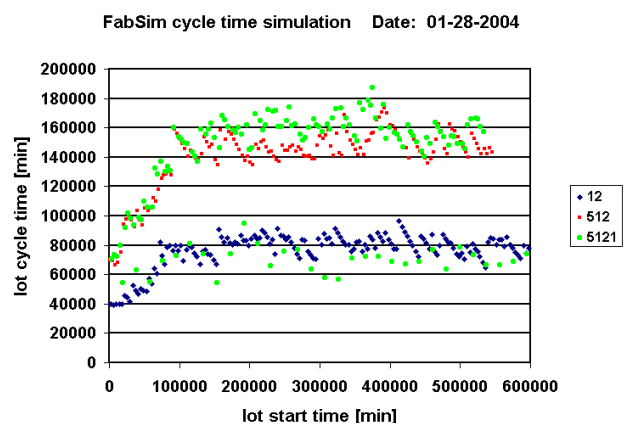
Different process flows and different lot priorities are evaluated in a single simulation run.

FabSim Interactive (currently available for MS Windows) is an enhanced version of the factory simulator. Offering all the options cited above, it additionally allows a truly interactive semiconductor factory setup.

The simulator is now organized as a dynamic link library. It may be controlled from any suitable supervisor program.

At any time FabSim Interactive may suspend its simulation flow, either unconditionally at a prescribed time or depending on the simulation status, e.g. when a specified lot has reached a certain process step.

Then the simulator waits for user (or supervisor) supplied input before it continues. Any of the following inputs may be given: Start a new lot, put or lot on hold or retrieve another lot from being held for further processing, access overall product, lot or fab status, locate any lot, get any toolset buffer size, change lot priority, change machine status (e.g. set machine down). Simulation may start with an empty fab or by firstly reading in a factory status stored in a previous run, provided manually or offered by the MES system. Thus fab setup and stabilization time (inside the simulator) may be skipped, or the simulator starts with an actual fab image to give a preview of the next few hours or days in the factory.

The supervisor program FabStart offers an intuitive graphical user interface to FabSim with several modes to interactively control the simulation flow.
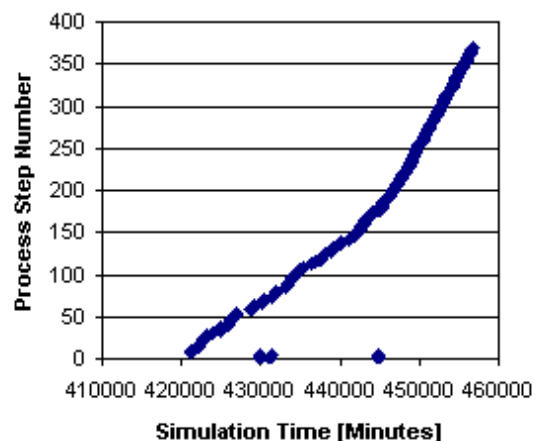
FabSim setup is as simple as providing machine and flow chart data and determining a lot start sequence.

Movement of lot no. 6000, process no. 25

The process step number versus simulation time of lot 6000 shows its progress in the fab. At time 445000 the lot priority has been increased interactively. The "speed" of the lot enhances considerably.

A more sophisticated setup may be done by tailoring the Supervisor program. Its source code is provided with the full version of FabSim. A customer API is provided for adding local or global dispatching rules (minimum inventory variability scheduling and others).

Availability and support

FabSim is available as a demo version for download at www.fabsim.com. The demo version is restricted to 5 toolsets, but otherwise has the full simulator capability. Please contact the author at info@fabsim.com for more information or for a quote on the full version of FabSim.

We also will provide support for setting up the simulator for your factory.

FabSim is the tool for planning and optimizing a semiconductor factory. It is easy to use, results are available immediately.

For further information please contact:

Prof. Dr. Holger Vogt
Fraunhofer-Institut IMS
Finkenstr. 61
47057 Duisburg, Germany
phone: 49 203 3783 100
email: info@fabsim.com,
web site: www.fabsim.com