Simulation-based Method to Design Conveyors in Semiconductor Wafer Fabs

Related Industry:
International SEMATECH Manufacturing Initiative (ISMI)

Executive Summary:
Next generation factories aim to decrease cost by 30% and lower wafer cycle time by 50%. Small Lot Manufacturing (SLM) seeks to reduce lot sizes from 25 wafers to 12 wafers per carrier, thereby increasing system congestion. Automated material handling systems (AMHS) using conveyors have been recently proposed as a technology alternative for providing high-speed, high-throughput deliveries for next generation wafer fabrication facilities. In addition, this technology seems to provide an increasing capacity for moving and storing wafers in a continuous flow transport environment.

The goal of this research was to design and test conveyor-based AMHS configurations, which included turntables and buffer zones near the processing equipment. Simulation models were developed in AutoMod to determine the best conveyor layout, with emphasis in comparing centralized versus distributed storage systems.

The wafer fab developed was based on a 38-bay configuration (each bay had a capacity of 24 tools). To study the utilization of conveyors, a single bay was modeled and analyzed. Two main models were used to measure efficiency of the buffer system, distributed vs. central storage. The distributed model had individual buffers to service each tool. The centralized model had two main buffer loops in the center of the bay to service the tools.

A full design of experiment was conducted. The AMHS factors under study comprise turn-table speed (5sec. vs. 7 sec.), conveyor speed (.305 ft/sec. vs. 1 ft/sec.), and buffer storage (distributed vs. central). The responses under study include conveyor utilization, tool utilization, cycle time, work in process, number of loads in buffer system, and number of loads in the tool queue.

For small lot manufacturing, we found that faster conveyor speeds netted lower cycle times and lower work in process. However, there was not a significant difference in cycle times or work in process when comparing distributed and centralized storage. Due to the fact that distributed storage required additional track length and number of turn tables, using distributed storage would require a larger investment. Our final recommendation was to implement a conveyor system with a faster speed and a centralized storage system.
Buffer Storage
- Central
- Distributed

Design Team:
Alger Bradley, Leanna Miller, Ashley Tish

Time Period:
Spring 2011

Funding Level:
None