

Abstract

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Multi-Objective Optimization Using Simulation for Scheduling Re-Entrant Flow Shop in Semiconductor Wafer Fabrication Facilities

Modelling and simulation is repeatedly being used as an effective tool that helps in understanding the underlying behaviour of a system and the interactions of its different variables hence, the performance of that system can be improved. In this work, simulation is used in the scheduling of re-entrant flow shop manufacturing systems with an application in semiconductor wafer fabrication. The process of wafer fabrication is arguably the most technologically complex and capital intensive stage in semiconductor manufacturing. This large-scale discrete-event process is highly re-entrant, and involves hundreds of machines, restrictions, and processing steps. Therefore, production control of wafer fabrication facilities (fab), specifically scheduling, is one of the most challenging problems that this industry faces. Dispatching rules have been extensively applied to the scheduling problems in semiconductor manufacturing. Also, lot release policies are commonly used in this manufacturing setting to further improve the performance of such systems and reduce its inherent variability. A simulation model has been developed for the Intel Five-Machine Six Step Mini-Fab using the ExtendTM simulation environment. The Mini-Fab has been used as it captures the challenges involved in scheduling the highly re-entrant semiconductor manufacturing lines. A number of scenarios have been developed and used based on a two factorial experiment design, and are used to evaluate the effect of different dispatching rules and lot release policies on the used performance measures. Results of simulation showed that the performance of the Mini-Fab can be drastically improved using a combination of dispatching rules and lot release policy. In addition, a multi-objective optimization using simulation model has been built to find the best scenario that can improve the performance of the Mini-Fab based on both cycle time and production rate. The work shows that by using simulation to model operations and optimization to find the best possible scenarios out of a pre-determined set of scenarios, great benefits can be achieved.