

## ABSTRACT

Solving the Stochastic Capacity Planning Problems in Semiconductor Manufacturing.

(May 1995)

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The objective of this research is to determine the resource capacity of each work center, i.e., the number of machines and operators, so as to minimize the total resource capacity cost while satisfying the product's or products' total expected waiting time constraint(s). A queueing network model is used to compute the expected waiting time given the current capacity at a particular work center. Three special cases of the capacity planning problems related to semiconductor manufacturing are considered: (1) the single product case, (2) the multiproduct case, and (3) the new product case. The first and second cases are useful in designing a new fab. The third is applicable when modifying a current fab to accommodate a new product. In this research, we propose three traditional approaches to solve the single product case. Because these traditional approaches do not provide an optimal solution in a reasonable time and these three capacity planning problems are NP-hard, we develop a waiting time heuristic in order to find an optimal solution for the single product case in a reasonable time. We use the integer programming approach's result to verify the other algorithms' output. Based on our evaluation through test examples, the waiting time heuristic behaves well. Subsequently, we develop a multiproduct waiting time heuristic with a structure similar to the waiting time heuristic to solve the multiproduct case. The theoretical proofs of the approximation formulae used in

both waiting time heuristics are provided. In our experience, we were able to obtain the optimal solution for 49 out of 50 test problems using these waiting time heuristics. Finally, we develop a method based on the multiproduct waiting time heuristic for solving the problem of incorporating a new product in a standing facility. This approach is demonstrated by running a test example. Due to the high resource unit cost, determining an efficient and cost effective means for solving the stochastic capacity planning problem in semiconductor manufacturing is essential.