# Scheduling Unrelated Parallel Machines in Semiconductor Manufacturing by Problem Reduction and Local Search Heuristics

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We investigate a difficult scheduling problem in a semiconductor manufacturing process that seeks to minimize the number of tardy jobs and makespan with sequence-dependent setup time, release time, due dates and tool constraints. We propose a mixed integer programming (MIP) formulation which treats tardy jobs as soft constraints so that our objective seeks the minimum weighted sum of makespan and heavily penalized tardy jobs. Although our polynomial-sized MIP formulation can correctly model this scheduling problem, it is so difficult that even a feasible solution can not be solved efficiently for small-scale problems. We then propose a technique to estimate the upper bound for the number of jobs processed by a machine, and use it to largely reduce the size of the MIP formulation.

In order to effectively handle real-world large-scale scheduling problems, we propose an efficient dispatching rule that assigns a job with the earliest due date to a machine with least recipe changeover (EDDLC) and try to reoptimize the solution by some local search heuristics which involve interchange, translocation and transposition between assigned jobs. Our computational experiments indicate that EDDLC and our proposed reoptimization techniques are very efficient and effective. In particular, our method usually give solutions very close to the exact optimum for smaller scheduling problems, and can also produce good solutions for scheduling up to 200 jobs on 40 machines within 10 minutes.

***Keywords*****:** dispatching rule, local search, scheduling, mixed integer programming

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