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Abstract

This paper is concerned with the qualification management problem of parallel machines under high uncertainties in the semiconductor manufacturing industry. Product-machine qualification, or recipe-machine qualification, is a complicated, time-consuming process that is frequently encountered in semiconductor manufacturing. High uncertainty, a common aspect of the semiconductor manufacturing process, significantly enhances the complexity of this process. This paper mainly focuses on addressing such a complex scheduling problem by presenting a general two-stage stochastic programming formulation, which embeds uncertainty into the qualification management problem. The proposed model considers the capacity loss resulting from traditional random capacity factors, such as tool failures, and recipe-machine qualification, making it more applicable to real systems. To solve this problem, we propose a Lagrangian-relaxation-based surrogate subgradient approach. Numerical experiments indicate that this approach is capable of optimizing the problem in acceptable computation time. In addition, given that obtaining complete distribution information for random variables is unavailable in practice, a simplified approach is also developed to approximate the initial problem.