Capacity Planning for Project Management by Adaptive Robust Optimization

Nicholas G. Hall
Fisher College of Business
The Ohio State University
hall.33@osu.edu

Many project companies use outsourced service providers which require the reservation of capacity in advance, typically before project performance is known. Based on those decisions, the project company considers the worst case distribution of task durations, given partial knowledge of distribution characterized by a set of general information. In view of the reserved capacity and the worst case distribution of task durations, the project company makes decisions about fast tracking and outsourced crashing. The objective is to minimize the project's worst case conditional value-at-risk (CVaR) of its total capacity reservation, fast tracking, crashing, and makespan penalty costs.

We allow for correlation in task performance, and for piecewise linear costs of crashing and makespan penalties. Our work is apparently the first to apply adaptive robust optimization to capacity planning in projects.

Computationally efficient optimal solution of the discrete, nonlinear model is possible for practical size projects, using column and constraint generation. We compare the performance of the model against the best available benchmarks, and show that it provides lower risk and greater robustness to distributional information. Our work provides project managers with a planning tool for effective risk minimization in projects, and insights about how to make capacity reservation decisions.