A SCHEDULING PROCEDURE FOR A GENERAL CLASS OF RESOURCE-CONSTRAINED PROJECTS

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ABSTRACT

Scheduling of a project is to determine a start time of each activity considered in a problem such that all the involved precedence constraints and resource requirements are satisfied under any given performance measure. Such resource-constrained project scheduling problems are known to be NP-complete.

Project scheduling problems are often encountered in many manufacturing and service organizations. However, they are very complex to analyze in real situation, so that they have simply been treated without considering many practical resource restrictions including employee availabilities and employee skills.

To reflect practical situations to some extent, a specific form of the project scheduling problem has been tried by restricting to resource-duration tradeoff for which each activity could be accomplished with one of several resource combinations. Accordingly, the duration to complete each activity is dependent on the way of combining resources, called (operating) modes. In other words, each mode specifies a resource requirement and the associated duration to perform an activity, all known a priori. Moreover, it provides a cost-related constraint. These may make the problem possible to have wide practical applications.

This paper introduces a solution algorithm derived based on a branch and bound procedure to solve a generally-classified resource-constrained project scheduling problem where various operating modes are allowed to perform each activity in the project and all activities are nonpreemptive. With the objective of minimizing the makespan of the project, two lower bound computation procedures are derived for the algorithm. The first one is a precedence-based bound, and the second one is a resource- combination -based bound with resource constraints incorporated into the critical sequence. In the branch-and-bound algorihm, a depth-first search strategy is employed for the associated tree search. An efficient heuristic algorithm for large-size problems is also exploited by using partly the branch-and-bound algorithm. Both the algorithms are tested with various numerical problems for their effectivenesses and efficiencies.