An efficient algorithm for the multi-mode resource constarined project scheduling problem whith resource flexibility *

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Abstract

The scheduling problem under study may be viewed as an extension of the standard Multi-mode Resource-Constrained Project Scheduling Problem (MRCPSP) including Multi-Skilled Labor and will be called as MRCPSP-MS. This problem requires an integration of resource limitation, labor skills, and multiple possible execution modes for each task, and the objective is to minimize the overall project duration. This paper present a new tabu search (TS) algorithm using a powerful neighborhood function based on a flow graph representation in order to implement various search strategies. The search of the solution space is carried out via two types of moves. Furthermore, the TS algorithm is embedded in a decomposition based heuristic (DBH) which serve to reduce the solution space. The effectiveness of the new Tabu Search is demonstrated through extensive experimentation on different standard benchmark problem instances and proves that our results are competitive.

Key words: Project scheduling, Heuristics, Tabu Search, Human resources.

1   Introduction

The Resource Constrained Project Scheduling Project (RCPSP) is a well-known NP-hard problem [6], widely studied in Operations Research literature and broad applicability in project management and production scheduling during the previous last decades. This is not surprising given the high practical relevance of this scheduling problem. Nevertheless, extensions are needed to be better able to cope with situations arising in practice. In literature, various RCPSP extensions have been proposed such as allocating multiple types of the resources (renewable, nonrenewable, partially renewable) simultaneously as well as considering multiple activity-execution modes, pre-emption of activity execution, generalized precedence relations (start-start, start-finish, finish-start and finish-finish) and various performance measures, such as makespan minimization, costs minimization, Net Present Value (NPV) maximization and quality maximization.. Makespan minimization is one of the most frequently studied criteria in the scheduling literature and probably the most applied objective in the project scheduling domain. In mass production environments, makespan minimization is often a useful approach, since it allows more widgets to be produced and other jobs can help smooth out the resulting resource loading artifacts the process induces. In other industries like shipyards, where it is not uncommon to have one, or at most

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