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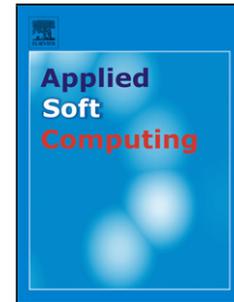
Title: A Hybrid Project Scheduling and Material Ordering
Problem: Modeling and Solution Algorithms

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<AT>A Hybrid Project Scheduling and Material Ordering Problem:
Modeling and Solution Algorithms

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<ABS-HEAD>Highlights ► A novel integration of project scheduling and material ordering is addressed. ► The integrated model is considered under multi-objective conditions. ► Three multi-objective evolutionary algorithms are extended. ► The parameters of algorithms are calibrated using response surface methodology. ► The algorithms are compared based on a set of examples and performance metrics.

<ABS-HEAD>Abstract

<ABS-P>A novel combination of a multimode project scheduling problem with material ordering, in which material procurements are exposed to the total quantity discount policy is investigated in this paper. The study aims at finding an optimal Pareto frontier for a triple objective model derived for the problem. While the first objective minimizes the makespan of the project, the second objective maximizes the robustness of the project schedule and finally the third objective minimizes the total costs pertaining to renewable and nonrenewable resources involved in a project. Four well-known multi-objective evolutionary algorithms including non-dominated sorting genetic algorithm II (NSGAI), strength Pareto evolutionary algorithm II (SPEAII), multi objective particle swarm optimization (MOPSO), and multi objective evolutionary algorithm based on decomposition (MOEAD) solve the developed triple-objective problem. The parameters of algorithms are tuned by the response surface methodology. The algorithms are carried out on a set of benchmarks and are compared based on five performance metrics evaluating their efficiencies in terms of closeness to the optimal frontier, diversity, and variance of results. Finally, a statistical assessment is conducted to analyze the results obtained by the algorithms.

<ABS-P><ST>Results</ST> show that the NSGAI considerably outperforms others in 4 out of 5 metrics and the MOPSO performs better in terms of the remaining metric.

<KWD>**Keywords:** Material ordering; Multimode project scheduling; Multi-objective evolutionary algorithms; Pareto frontier; Total quantity discount.

<H1>1. Introduction

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