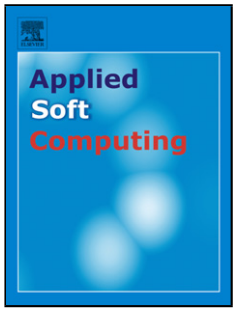

Title: A Hybrid Project Scheduling and Material Ordering Problem: Modeling and Solution Algorithms

Authors: N. Zoraghi, A. Shahsavar, S.T.A. Niaki

PII: S1568-4946(17)30293-4
DOI: http://dx.doi.org/doi:10.1016/j.asoc.2017.05.030
Reference: ASOC 4234

To appear in: *Applied Soft Computing*

Received date: 8-7-2016
Revised date: 11-3-2017
Accepted date: 15-5-2017

Please cite this article as: N.Zoraghi, A.Shahsavar, S.T.A.Niaki, A Hybrid Project Scheduling and Material Ordering Problem: Modeling and Solution Algorithms, Applied Soft Computing Journalhttp://dx.doi.org/10.1016/j.asoc.2017.05.030

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

<AU>N. Zoraghi* ##Email##nima.zoraghi@gmail.com##/Email##, A. Shahsavar ##Email##m.shahsavar@ymail.com##/Email##, S.T.A. Niaki ##Email##Niaki@sharif.edu ##/Email## ##Email##Hniaki@gmail.com##/Email##
<AU>
<AFF>Corresponding & first author
<AFF>Mr. Nima. Zoraghi: Department of Industrial Engineering, Faculty of Industrial and Mechanical Engineering, Islamic Azad University, Qazvin Branch, Qazvin, Iran., Tel: (+98) 912 338 6402, Fax: (+9821) 88261905

Second author:
Mr. Aria. Shahsavar: Department of Industrial Engineering, Faculty of Industrial and Mechanical Engineering, Islamic Azad University, Qazvin Branch, Qazvin, Iran., Tel: (+98) 936 035 3825, Fax: -------

Third author:
Mr. Seyed Taghi. Akhavan. Niaki (Phd): Department of Industrial Engineering, Sharif University of Technology, Tehran, Iran., Tel: (+9821) 66165740, Fax: (+9821) 66022702

<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 (NSGAII), 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 NSGAII 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