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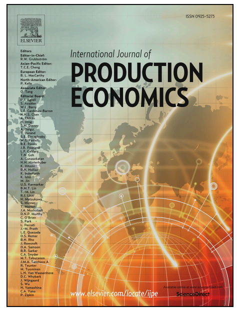

Evaluation of solution approaches for a stochastic lot-sizing and sequencing problem

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Abstract

A stochastic multi-product lot-sizing and sequencing problem is studied. Two kinds of uncertainties are integrated into the model: defective items due to the process imperfections and random lead times because of randomly arising machine breakdowns and uncertain repair times. There are also sequence-dependent set-up times between two items of different types. The objective is to find a sequence of lots and lot sizes maximizing the probability of demand satisfaction for all products. A decomposition approach has been proposed in the literature to reduce this problem to a sequence of known optimization problems with different algorithms available for each of them. However, a proper evaluation of the practical performance of the whole method has never been presented. The goal of this paper is to analyze and compare the behavior of different solution frameworks (with and without decomposition) and techniques for the considered problem.

Keywords: Stochastic production lines, Lot-Sizing, Sequencing, Decomposition, Dynamic programming, Genetic Algorithms

1. Introduction

We study a lot-sizing and sequencing problem under uncertainty. The goal is to find optimal sequence of lots and lot sizes maximizing the probability to satisfy the whole demand, i.e. the demand for all product lots. In the literature the problem of demand satisfaction is often considered from cost point of view with the objective to minimize total backlog and holding cost. But in practice it is very difficult to accurately calculate the backlog cost because of indirect consequences of stock-outs such as potential losses of clients. When the average cost evaluation is not possible, or average cost criterion cannot be used for decisions, the service level criterion is often applied.

The impetus for this research initially came from the design of a fully automated production facility in the electronics industry that processes different conductor patterns and assembles them into printed circuits. However, the conclusions drawn by our study could be of interest for other similar situations where the same random phenomena arise and the same objective function of service level maximization is used.

The facility considered is composed of (see figure 1): 1) a manufacturing line that processes items of several types; 2) an automatic storage device that stocks processed items; 3) an assembly line assembling final products with previously stored items. As shown in figure 1, the manufacturing line consists of m sequentially placed machines and is a paced