

Journal of Operations Management 15 (1997) 71-82

Heuristic, optimal, static, and dynamic schedules when processing times are uncertain

Stephen R. Lawrence ^a, Edward C. Sewell ^b

^a College of Business and Administration, University of Colorado, Boulder, CO 80309-0419, USA
^b Department of Mathematics and Statistics, Southern Illinois University, Edwardsville, IL 62026-1653, USA

Accepted 28 November 1995

Abstract

In this paper we compare the static and dynamic application of heuristic and optimal solution methods to job-shop scheduling problems when processing times are uncertain. Recently developed optimizing algorithms and several heuristics are used to evaluate 53 standard job-shop scheduling problems with a makespan objective when job processing times are known with varying degrees of uncertainty. Results indicate that fixed optimal sequences derived from deterministic assumptions quickly deteriorate with the introduction of processing time uncertainty when compared with dynamically updated heuristic schedules. As processing time uncertainty grows, we demonstrate that simple dispatch heuristics provide performance comparable or superior to that of algorithmically more sophisticated scheduling policies.

Keywords: Scheduling; Job shop; Measurement and methodology

1. Introduction

In this paper we investigate the static and dynamic application of optimal, near-optimal, and heuristic solution methods for production scheduling problems when the underlying assumptions of the scheduling model are relaxed. Specifically, we examine the apparent trade-off between heuristic and optimal solution methods when processing times are uncertain, and provide a better understanding of the relative utility of optimum-seeking algorithms versus heuristic methods, and of fixed schedules versus dynamic schedules when solving practical production scheduling problems that are inherently difficult to model.

The objective of this paper is to begin to resolve the fundamental tension which can exist in the choice of either an optimal or heuristic solution methodol-

0272-6963/97/\$17.00 © 1997 Elsevier Science B.V. All rights reserved. PII \$0272-6963(96)00090-3

ogy. On one hand, algorithmic solution techniques offer the promise of probably optimal or near-optimal solutions, but are restricted to certain classes of relatively simple problems and to problems of limited size. On the other hand, heuristic dispatch methods are easy to use in a wide variety of complex production settings, and provide fast solutions for even the largest problems. In particular, the computational simplicity of dispatch heuristics allows them to be dynamically applied as a schedule develops, while the computational expense of optimal solution techniques often requires that an entire schedule be determined and fixed prior to the start of production. But heuristic methods may provide schedules which are far from optimal with possibly costly or disruptive results. When choosing a method for solving production scheduling problems, operations managers are apparently confronted with the dilemma of