Dynamic due date assignment method

A simulation study in a job shop with sequence-dependent setups

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Abstract

Purpose – The purpose of this paper is to determine the interaction between dynamic due date assignment methods and scheduling decision rules in a typical dynamic job shop production system in which setup times are sequence dependent. Two due date assignment methods and six scheduling rules are considered for detailed investigation. The scheduling rules include two new rules which are modifications of the existing rules. The performance of the job shop system is evaluated using various measures related to flow time and tardiness.

Design/methodology/approach – A discrete-event simulation model is developed to describe the operation of the job shop. The simulation results are subjected to statistical analysis based on the method of analysis of variance. Regression-based analytical models have been developed using the simulation results. Since the due date assignment methods and the scheduling rules are qualitative in nature, they are modeled using dummy variables. The validation of the regression models involves comparing the predictions of the performance measures of the system with the results obtained through simulation.

Findings – The proposed scheduling rules provide better performance for the mean tardiness measure under both the due date assignment methods. The regression models yield a good prediction of the performance of the job shop.

Research limitations/implications – Other methods of due date assignment can also be considered. There is a need for further research to investigate the performance of due date assignment methods and scheduling rules for the experimental conditions that involve system disruptions, namely, breakdowns of machines.

Practical implications – The explicit consideration of sequence-dependent setup time (SDST) certainly enhances the performance of the system. With appropriate combination of due date assignment methods and scheduling rules, better performance of the system can be obtained under different shop floor conditions characterized by setup time and arrival rate of jobs. With reductions in mean flow time and mean tardiness, customers are benefitted in terms of timely delivery promises, thus leading to improved service level of the firm. Reductions in manufacturing lead time can generate numerous other benefits, including lower inventory levels, improved quality, lower costs, and lesser forecasting error.

Originality/value – Two modified scheduling rules for scheduling a dynamic job shop with SDST are proposed. The analysis of the dynamic due date assignment methods in a dynamic job shop with SDST is a significant contribution of the present study. The development of regression-based analytical models for a dynamic job shop operating in an SDST environment is a novelty of the present study.

Keywords Simulation, Job shop, Scheduling rules, Dynamic job shop scheduling, Sequence dependent setup, Due date assignment

Paper type Research paper

Nomenclature

λ	Arrival rate of jobs	D_i	Due date of job i
μ_p	Mean processing time per operation	A_i	Arrival time of job i
μ_s	Mean setup time of an operation	n_i	Number of operations of job i
μ_g	Mean number of operations per job	ρ	Steady state utilization of the system

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