EFFECT OF ADOPTING DIFFERENT DISPATCHING RULES ON THE MEAN FLOW TIME IN A TWO MACHINE BATCH-SHOP PROBLEM

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To my beloved Family; the power of my life. To my dear Husband and my lovely Daughter; the light of my life…. To all those supported me to complete this study I dedicate this work with great respect and love.

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ABSTRACT

The two-machine flow shop problem was shown to be NP-hard when the objective is to minimize total (mean) completion time instead of makespan even for the case where setup times are neglected. This means that it is highly unlikely to find a polynomial algorithm to solve the problem. Therefore, researchers concentrated on developing branch-and-bound or heuristic algorithms. Ali Allahverdi, 1998 obtained the optimal solutions for minimizing mean flow time in a two-machine flow shop with Sequence-independent set up times by using three heuristic algorithms. In this project we addressed the same problem of Ali Allahverdi, based in his model a simulation model was built and validated using Witness software. Experiments were conducted for different number of jobs and different dispatching rules for jobs sequence. The setup-time also varied along the experiments. The effectiveness of the rules used was also measured by two other performance measures beside the mean flow time; they are WIP and machine utilization.

The results were analysed and discussed and it concluded that all the performance measures were affected by number of jobs and change of set-up time for all rules used. It found that SPT rule generally performs best in terms of minimizing flow time, minimizing average number of jobs in the system and maximize machine utilization.

ABSTRAK

Masalah syop aliran 2-mesin ditunjukkan sebagai NP-keras apabila objektif untuk meminimumkan jumlah masa penyiapan sebaliknya walaupun untuk kes dimana masa pasang adalah diabailean. Ini bermakna babawa bukan seperii untuk mencari polynominal algorithm bagi menyelesaikan masalah. Sebubungan denganitu, para penyelidik menumpukan untuk membangunkan algorithm cabang-dan-ikat atau herurisii. Ali Allahverdi, 1998 mendapati penyelesaian terbaik untuk meminimukan jumlah aliran masa dalam kedai aliran 2-mesin dengan turutan berasingan masa pemasangan (setup) dengan menggunakan 3 algorithm heuristic. Ujikaji telah dijalankan untuk bilangan kerja dan penghantaran yang berbeza bagi peraturan untuk turutan kerja. Masa pemasangan juga dipelbagaikan sepanjang ujikaji. Keberkesanan peraturan yang diguna juga diukur dengan 2 pengukuran keupayaan yang lain disamping jumlah aliran masa; ianya adalah WIP dan mesin jenjanaan. Keputusan-keputusan telah dianalisa dan dibincangkan dan ianya disimpulkan bahawa semua pengukuran keupayaa disebabkan; oleh bilangan pekerjaan dan perubahan masa gerak (setup) untuk semua peraturan yang digunakan. Diketauhi bahawa peraturan SPT biasanya melaksanakan yang terbaik dalam meminimumkan aliran masa, purata jumlah pekevjaan dalam sistem dan memaksimumkan penjanaan mesin.

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INTRODUCTION

1.1 Problem statement

The two-machine flow shop problem was shown to be NP-hard when the objective is to minimize total (mean) completion time instead of makespan even for the case where set up times are neglected. This means that it is highly unlikely to find a polynomial algorithm to solve the problem. Therefore, researchers concentrated on developing branch-and-bound or heuristic algorithms to find the optimal solution, using different assumptions.

With separate setup time, two problem types exist. In the first problem, setup time depends only on the job to be processed, hence called sequence independent. Whereas, in the second, setup time depends on both the job to be processed and the

previous job, hence called sequence dependent. If there exists some idle time on the second machine, which is usually the case, then the setup time for a job on the second machine can be performed prior to the completion time of the job on the first machine [1].

Ali Allahverdi [2] obtained the optimal solutions for two special flow shops, with sequence-independent setup times and mean flow time performance criterion. He presented three heuristic algorithms, and evaluated the efficiencies of the branch-and-bound and heuristic algorithms. In this project we are going to use the mathematical model he proved in his study to validate a simulation model for finding the mean flow time adopting different dispatching rules.

1.2 Objective

The objectives of this project are:

- To determine the effect of dispatching rules on mean flow time in a batch shop.
- To determine which dispatching rules will give the lowest mean flow time under certain conditions.
- To construct and validate a simulation model which will be the base for the study.

1.3 Scope of the study

I. Four dispatching rules will be used for job priorities they are;
    1) First Come First Served - FCFS
    2) Shortest Processing Time - SPT
    3) Earliest Due Date - EDD

II. The performance measures to be used beside men flow time are;
    1) WIP
    2) Machine utilization

III. The simulation tool used in this project is Witness simulation package.

1.4 Definition of Terms

In conducting this project, the terms in table (1) are used to simplify the meaning of the specific characteristics and techniques used.

Table 1.1: Definition of terms

Dispatching rules	
FCFS	First come first serve
SPT	Shortest processing time
EDD	Earliest due date
Performance measures	
MFT	Mean flow time
WIP	Work-in -process
Problem formulation	
$PT_{i,j}$	Processing time for job i in machine j
$ST_{i,j}$	Set-up time for job i in machine j
$CT_{i,j}$	Total Completion Time
TFT	Total flow time