Enhancement of Machine Utilization considering Multiple Lot Scheduling with FCFS Dispatching Rule

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Abstract : Productivity of a particular company or manufacturing industry depends on various factors like labor, machinery, raw materials, degree of computerization, automation, so on and so forth. Companies can increase their productivity in a variety of ways. The main technique and simple logic behind the increase in productivity of any manufacturing industry is the utilization of resources effectively, the resources need not to be only tangible ones it may be even plans and schedules. This paper deals with the multiple lots scheduling and its effects on machine utilization to minimize the total completion time of the lots allocated to shop floor.

Key words : Multiple lots scheduling, FCFS, Productivity, Machine utilization

Introduction

Productivity of a particular company or manufacturing industry depends on various factors like labor, machinery, raw materials, degree of computerization, automation, so on and so forth. This paper addresses the flow shop scheduling problem considering multiple- lots scheduling with limited machine availability which are un-identical and designed for specific operations. Riad *et al.(*2006) describe, In such a problem *n* jobs have to be scheduled on *m* machines under the makespan criterion and under the assumption that the machines are not available during the whole planning horizon. Two-stage multiple-machine assembly scheduling problem is solved by Sung *et al.* (2008) for minimizing the sum of completion times. This problem was solved in two stages by considering two independent machines in stage one and two identical and independent parallel machines. Minimizing the sum of completion times at the second stage was considered as the scheduling measure. A lower bound based on the SPT rule was used to develop a branch-and-bound algorithm**.** Literature survey reveals about the work on identical parallel-machine scheduling under availability constraints to minimize the sum of completion times while considering a planned maintenance period on each machine Racem *et al.* (2009). A pseudo-polynomial dynamic programming algorithm was introduced to solve the problem optimally on the problem of two-machine flow shop scheduling problem with an availability constraint Chung-Yee Lee(1997), Whereas Cheng and Lee (2009) used Johnson's rule to minimize the make span problem.

This paper addresses the flow shop scheduling problem with limited number of machines available on shop floor, which are un-identical and designed for specific operations. The logic of multiple lots scheduling is used to enhance the machine utilization on shop floor which results to minimize the total production time. The FCFS rule is used as base dispatching rule with the constraint that the processing of the second stage cannot begin until the processing of the first stage is finished. Minimizing the total completion times at the end is considered as the scheduling measure.

In this work, the data of jobs including setup time and processing time is grouped into lots depending upon the number of machines required to complete the jobs in each lot. The lots are processed according to a well known dispatching technique FCFS (First come First serve basis). Concept of Multiple Lot Scheduling is used to optimize the make span time and comparison is done between single lot scheduling and multiple lot scheduling while keeping FCFS dispatching rule common for both conditions. The grouping of the lots has been done according to the availability of the machines which are idle, while another lot is being processed.

Manufacturing Model of Shop Floor

The Shop floor which is considered in this work is the ancillary which manufacture and supplies the products and components of various natures according to the demand. The industry consists of seven un-identical machines, all the seven machines of the industry are arranged in a single line. The job orders

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Fig. 2: Process Time FCFS

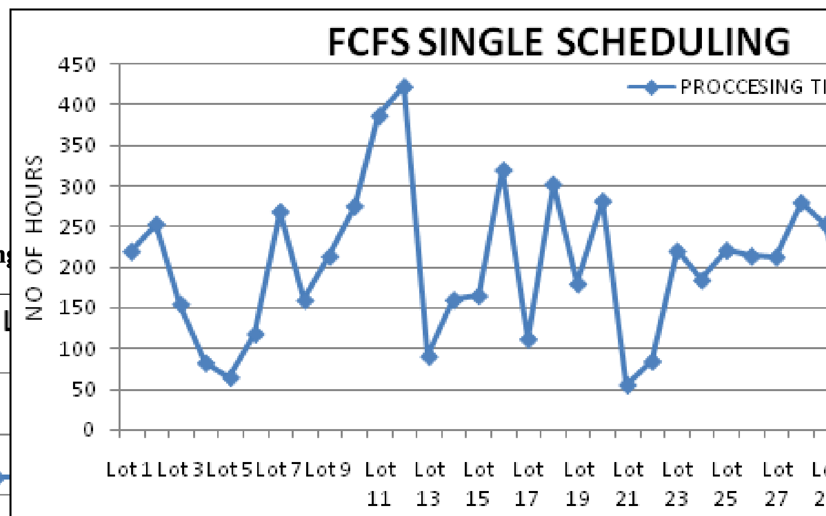

Fig. 3: Shop loading sin

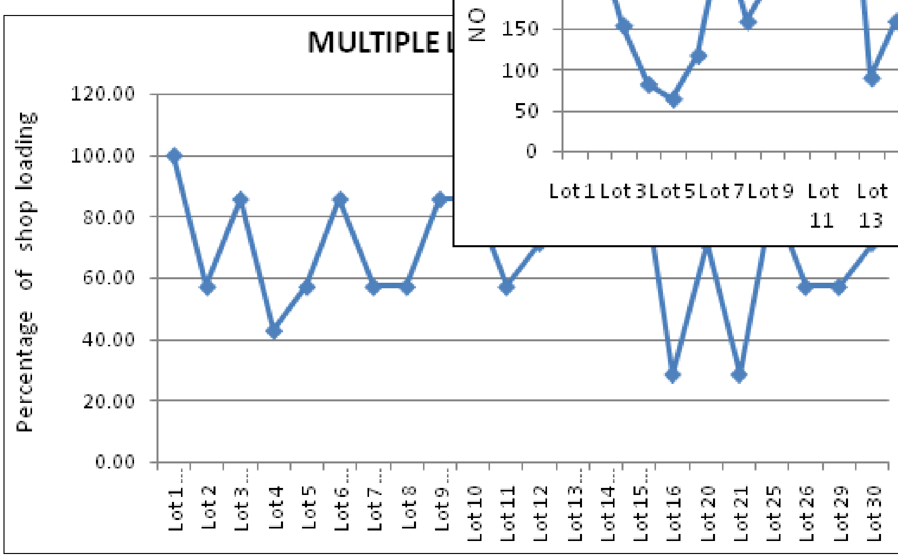

Fig. 4: Shop Loading Multiple lots Scheduling FCFS

Table 1: Process time and shop loading with single scheduling

Lot No.	Processing Time	No. of M/c Used	Total No. of Machines	Shop Loading (%)
Lot 1	219.66	4	7	57.14
Lot 2	253.1	4	7	57.14
Lot 3	154.395	3	7	42.86
Lot 4	82.253	3	7	42.86
Lot 5	64.368	4	7	57.14
Lot 6	117.947	3	7	42.86
Lot 7	268.42	4	7	57.14
Lot 8	159.409	4	7	57.14
Lot 9	213.437	3	7	42.86
Lot 10	275.305	6	7	85.71
Lot 11	386.65	4	7	57.14
Lot 12	422.4	5	7	71.43
Lot 13	90.34	4	7	57.14
Lot 14	159.875	2	7	28.57
Lot 15	164.9	2	7	28.57
Lot 16	319.75	2	7	28.57
Lot 17	111.631	3	7	42.86
Lot 18	302.212	5	7	71.43
Lot 19	179.548	3	7	42.86
Lot 20	281.5	5	7	71.43
Lot 21	55.137	2	7	28.57
Lot 22	84.325	3	7	42.86
Lot 23	219.99	3	7	42.86
Lot 24	184.1	2	7	28.57
Lot 25	220.738	6	7	85.71
Lot 26	213.743	4	7	57.14
Lot 27	212.634	3	7	42.86
Lot 28	279.638	4	7	57.14
Lot 29	253.008	4	7	57.14
Lot 30	147.536	5	7	71.43

Table 2: Process time and shop loading with multiple lots scheduling

Lot No.	Processing Time	No. of M/c Used	Total No. of Machines	Shop Loading (%)
Lot 1 Lot22	219.66	7	7	100
Lot 2	253.1	4	7	57.14
Lot 3 Lot 17	154.4	6	7	85.71
Lot 4	82.253	3	7	42.86
Lot 5	64.368	4	7	57.14
Lot 6 Lot 19	179.55	6	7	85.71
Lot 7 Lot23	268.42	4	7	57.14
Lot 8	159.41	4	7	57.14
Lot 9 Lot27	213.44	6	7	85.71
Lot 10	275.31	6	7	85.71
Lot 11	386.65	4	7	57.14
Lot 12	422.4	5	7	71.43
Lot 13 Lot 24	184.1	6	7	85.71
Lot 14 Lot 28	279.64	6	7	85.71
Lot 15 Lot 18	302.21	7	7	100
Lot 16	319.75	2	7	28.57
Lot 20	281.5	5	7	71.43
Lot 21	55.137	2	7	28.57
Lot 25	220.74	6	7	85.71
Lot 26	213.74	4	7	57.14
Lot 29	253.01	4	7	57.14
Lot 30	147.54	5	7	71.43

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