
MEMORANDUM

DATE: 11/15/2006
TO: PROFESSOR MATTHEW FORD
FROM: MICHAEL MURPHY
RE: SCHEDULING DETERMINATION REVISION #1

The following is an analysis of Positrol Workholding's current practice for scheduling customer orders. The focus is to compare the current policy to two alternative sequencing policies (Shortest Processing Time and Earliest Due Date). The intent is to determine which of the three policies is most effective when compared on the basis of average flow time, number of late jobs, and average lateness.

Findings

First Come, First Served (FCFS). First come, first served is the current policy being used. The average flow time for FCFS is 15.25. There are three late jobs. The average lateness is -1.92. FCFS is the second best performer.

Shortest Processing Time (SOT). Shortest processing time is the first alternative under consideration. The average flow time for SOT is 11.12. There are 3 late jobs. The average lateness is -6.05. SOT is the best performer.

Earliest Due Date (EDD). Earliest due date is the second alternative under consideration. The average flow time for EDD is 15.6. There are two late jobs. The average lateness is -1.57. EDD is the worst performer.

Analysis

Method

Scheduling information was obtained from William Henderson, director of operations for Positrol Workholding¹. The data included the jobs (A-F), due dates, and job time required for each job. Three different sequencing policies were compared by using average flow time, number of late jobs, and average lateness. The three sequencing policies were First Come, First Served (FCFS), Shortest Processing Time (SOT), and Earliest Due Date.

¹ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

First Come, First Served is the current policy. This policy schedules all orders in the order they were received².

Shortest Processing Time is the first alternative under consideration. It schedules orders according to the job time required for each job. Jobs with the shortest time requirements are scheduled first³.

Earliest Due Date is the second alternative under consideration. It schedules jobs based on the due dates. The earliest due date orders are processed first⁴.

Flow time is calculated using the job time for each job. It is the time required for a job to be completed at a particular workstation⁵. When calculating flow time, after the first job, every other job in the sequence determines its flow time by adding its job time to the flow time from the order above. The average flow time is calculated by adding the flow times from all jobs and dividing by the total number of jobs.

Lateness can be determined after the flow times are calculated. It is the amount of time needed to complete the job that exceeds the due date⁶. Lateness is calculated by subtracting the due date from the flow time for each job. This number can be positive or negative. A positive lateness means the order will be late. A negative lateness means the order will be early. The average lateness is calculated by adding the lateness numbers for all jobs and dividing by the total number of jobs.

There are several assumptions to be considered. The jobs (A-F) are known. Once the sequence is determined, no new orders are added and none of the current orders are cancelled. Setup times can be determined and are independent of the sequence. Processing times can be determined and they do not vary. No interruptions in processing will occur⁷.

FCFS (Current Policy)

FCFS schedules orders based on the order they were received. FCFS results in three late jobs and three early jobs (Table 1). The average flow time is 15.25 (Table 1). The average lateness is -1.92 (Table 1).

² Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

³ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

⁴ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

⁵ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

⁶ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

⁷ Stevenson, William J. 2007. *Operations Management – 9th Edition*. New York: The McGraw-Hill Companies.

Table 1: FCFS Analysis

Job Sequence	Job Time(days)	Flow Time	Due Date	Lateness
A	4.5	4.5	10	-5.5
B	6.0	10.5	17	-6.5
C	5.2	15.7	12	3.7
D	1.6	17.3	27	-9.7
E	2.8	20.1	18	2.1
F	3.3	23.4	19	4.4
		Avg= 15.25		Avg= -1.92

SOT (First Alternative)

SOT schedules orders based on the job time needed for each job. Jobs with the shortest job times are scheduled first. SOT results in three late jobs and three early jobs (Table 2). The average flow time is 11.12 (Table 2). The average lateness is -6.05 (table 2). When compared to FCFS, SOT results in a 27.1% reduction in flow time and a 315% reduction in lateness.

Table 2: SOT Analysis

Job Sequence	Job Time (days)	Flow Time	Due Date	Lateness
D	1.6	1.6	27	-25.4
E	2.8	4.4	18	-13.6
F	3.3	7.7	19	-11.3
A	4.5	12.2	10	2.2
C	5.2	17.4	12	5.4
B	6.0	23.4	17	6.4
		Avg= 11.12		Avg= -6.05

EDD (Second Alternative)

EDD schedules jobs based on the due dates. The earliest due date is processed first. EDD results in two late jobs and four early jobs (Table 3). The average flow time is 15.6 (Table 3). The average lateness is -6.05 (Table 3). When compared to FCFS, EDD results in a 2.3% increase in flow time and an 18.2% increase in lateness. Since the average flow time and average lateness are worse than FCFS, this alternative doesn't appear to be a viable one.

Table 3: EDD Analysis

Job Sequence	Job Time (days)	Flow Time	Due Date	Lateness
A	4.5	4.5	10	-5.5
C	5.2	9.7	12	-2.3
B	6.0	15.7	17	-1.3
E	2.8	18.5	18	.5
F	3.3	21.8	19	2.8
D	1.6	23.4	27	-3.6
		Avg= 15.6		Avg= -1.57

Limitations

The comparison of these policies is based on several assumptions previously stated. The data presented here can only be expected to remain valid if all the assumptions are upheld. If any of the assumptions are not upheld, changes in the sequence will need to be made. Any changes can have a negative impact on average flow time and average lateness. In this analysis, the number of orders is small. Significantly increasing the number of orders could change the outcome of this analysis.

Implementation

When comparing the two alternatives to the current FCFS policy, only SOT improves on the performance of FCFS. As stated previously, EDD results in higher average flow time and higher average lateness and should not be considered a valid alternative.

Table 4: Summary Comparison of 3 Sequencing Policies

	First Come, First Served (FCFS)	Shortest Processing Time (SOT)	Earliest Due Date (EDD)
Average Flow Time	15.25	11.12	15.6
Number of Late Jobs	3	3	2
Average Lateness	-1.92	-6.05	-1.57

The conservative next step is to do a secondary analysis with a higher number of orders. This secondary analysis could cover either one week or one month's orders. With a larger number of orders that are more representative of actual circumstances, the analysis may be quite different than the analysis presented here. The secondary analysis could support this analysis (SOT is best performer) or give totally different results. This is an important step before considering implementation of any new policies.