

Analysis of Production Scheduling In “Abadi” Malang Rackets And Sport Equipment Company

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Abstract

Racket and Sports Equipment Company "Abadi" Malang is engaged in manufacturing. As a result of the covid-19, the company only produces midangan. The purpose of this research is to find out and find the optimal scheduling method so that it can overcome the problem of delays in order completion. The method used is the priority rule consisting of first come first serve (FCFS), shortest processing time (SPT), longest processing time (LPT), and earliest due date (EDD). The results of the study indicate that the SPT method is a method that has the most optimal measure of effectiveness compared to the FCFS, LPT, and EDD methods. The SPT method produces an average value of 21 days of completion, 31.74% utility, an average number of jobs in the system 3.15 jobs, and a delay of 12.5 days.

Keywords: *production schedulling; first come first serve (FCFS); shortest processing time (SPT); longest processing time (LPT); earliest due date (EDD).*

Abstrak

Perusahaan Raket dan Alat Olahraga “Abadi” Malang bergerak di bidang manufaktur. Akibat adanya covid-19 mengakibatkan perusahaan hanya memproduksi midangan. Tujuan dari penelitian ini adalah untuk mengetahui dan mencari metode penjadwalan yang optimal sehingga dapat mengatasi permasalahan keterlambatan dalam penyelesaian pesanan. Metode yang digunakan adalah aturan prioritas yang terdiri dari *first come first serve* (FCFS), *shortest processing time* (SPT), *longest processing time* (LPT), dan *earliest due date* (EDD). Hasil dari penelitian menunjukkan bahwa metode SPT merupakan metode yang memiliki nilai ukuran efektivitas paling optimal dibandingkan dengan metode FCFS, LPT, dan EDD. Metode SPT menghasilkan nilai rata-rata waktu penyelesaian 21 days, utilitas 31,74%, rata-rata jumlah jobs di sistem 3,15 jobs, dan keterlambatan selama 12,5 days.

Kata kunci: *penjadwalan produksi; first come first serve (FCFS); shortest processing time (SPT); longest processing time (LPT); earliest due date (EDD).*

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INTRODUCTION

Each company always gives the effort and the best results to consumers. Product quality and company service quality can be seen from how the company provides services to consumers, as well as the company's ability to meet demand and complete consumer orders in a timely manner (Safitri, 2019). The arrangement of production scheduling at the company is very important. Arranging the right production scheduling can increase the effectiveness of existing resources in the company, so that the right scheduling is an important activity in planning and controlling production (Irvantoro & Ellyawati, 2012). Scheduling is the time of operational activities which includes the distribution of facilities, equipment and labor for an operational activity and determines the sequence of the company's operational activities (Muharni, 2019) Scheduling is done to maximize company performance, with the right scheduling method, the company can increase the number or quantity of products and minimize delays in completing orders in the company (Krisnanti & Sudiarso, 2012).

Previous research on production scheduling was carried out by Febianti & Mardiana (2019). The results showed the scheduling method at the manufacturing company PT. XYZ is the most optimal by using the method of *Earliest Due Date* (EDD) because it can minimize the delay time than other methods. The company "Abadi" Malang is a company engaged in manufacturing. The production method used by the company since its inception is the method *First Come First Serve* (FCFS). So far, the FCFS method still experiences delays in completing orders. These conditions are shown in the table below:

Table 1. Production Data of the Company Racket and Sports Equipment "Abadi" Malang

No.	Order	Number of Orders	Date. Orders Login	Date Maturity	Date. Orders Exit	Late
1.	Usaha Jaya	1.008	01-09-2020	11-09-2020	14-09-2020	3 days
2.	Om Rudi Malang	648	04-09-2020	12-09-2020	15-09-2020	3 days
3.	Sinar Maju Baru	300	15-09-2020	23-09-2020	25-09-2020	2 days
4.	Subur	180	18-09-2020	26-09-2020	28-09-2020	2 days
5.	Sinar Maju Baru	144	21-09-2020	24-09-2020	25-09-2020	1 days
6.	Burhani	4.400	24-09-2020	06-10-2020	10-10-2020	4 days

Source: Data Order Midangan "Timeless" Unfortunate

Table 1 explains the delay companies in completing midangan orders. Of the 6 orders that were executed during September 2020, the most delays occurred in Burhani's orders with a total delay of 4 days. Meanwhile, the one with the least amount of delay was in Sinar Maju Baru orders with a delay of 1 day. Based on the state of the production method used by the "Abadi" Company using the FCFS method, delays occur due to several reasons such as uncertain natural resources, the number of workers that are sometimes erratic, and there is no scheduling in the process between machines which is carried out correctly. frequent buildup and delays in completing orders. "Eternal" companies only use forecasts in completing orders and have never planned on using *Gantt Charts*.

Based on the problems that occur, it requires various experimental methods that should be used so that the company knows the optimal production scheduling method to be applied in the company. Therefore, the formulation of the problem in this study is "What are the results of the implementation of production scheduling in the company Abadi Malang using the Gantt Chart?" and "Which is the optimal priority method rule for the company Abadi Malang to complete customer orders?"

LITERATURE REVIEW

Scheduling (*scheduling*) is an important activity to do in a company. In a company, scheduling or *scheduling* is related to the timing of the use of specific resources from the company. Scheduling is related to the use of equipment, human activities, and facilities Stevenson & Chuong (2014). Krajewski & Ritzman (2005) stated that basically scheduling is the allocation of resources from time to time to support the implementation and completion of a specific work activity. According to Haming & Nurnajamuddin (2017) the general scheduling function is to make efficient use of resources, if the production schedule is not good, the level of capacity use and input will be less efficient. And make effective use of resources. A good schedule will lead to the provision of resources including production capacity according to processing needs.

According to Heizer & Render (2014) Determination of short-term schedules, will translate capacity decisions, aggregate plans, and master schedules into a sequence of work and assignments of workers, machines, and specific materials. Jacobs & Chase (2016) the process of determining the order of work on several machines or on several work centers is called priority sequencing. Meanwhile, according to Heizer & Render (2014) priority rules are applied for process-oriented facilities. Priority rules seek to minimize turnaround time, number of jobs in a system, and delays in work while making maximum use of the facility space. Gantt Chart is used to help plan and track work. Gantt Chart is a type of bar chart that depicts tasks and time allocations. The Gantt Chart is used for project planning as well as for coordinating a number of scheduled activities Jacobs & Chase (2016). Based on the background, problem formulations, objectives and literature reviews previously described, a conceptual framework can be drawn up as follows:

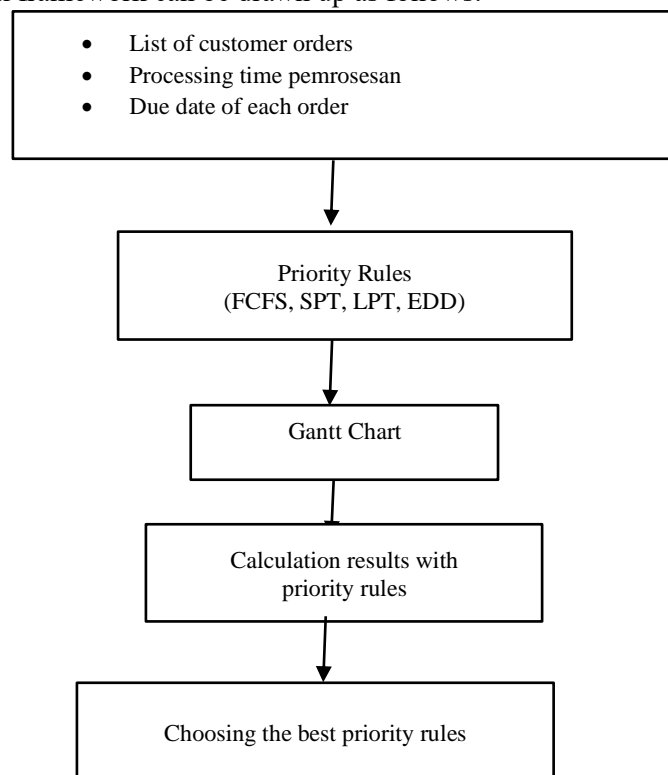


Figure 1. Conceptual Framework (Heizer & Render, 2014)

A frame of mind describes the process to be carried out in the research. The framework in this study uses four methods, namely FCFS (First Come First Serve), SPT (Shortest Processing Time), LPT (Longest Processing Time), and EDD (Earliest Due Date) at the “Abadi” Malang Racquet and Sports Equipment Company.

RESEARCH METHOD

This research was conducted at the “Abadi” Malang Racquet and Sports Equipment Company, which is located at JL. Klayatan 1 No. 4, Bandungrejosari, Kec. Sukun, Malang City. The research conducted is a type of applied research. In the research, the writer used method job sequencing which consisted of FCFS (First Come First Serve), SPT (Shortest Processing Time), LPT (Longest Processing Time), and EDD (Earliest Due Date). Then implemented in a Gantt chart. The calculation of the effectiveness size of the four methods is as follows:

- 1) Average completion time = $\frac{\text{Total time flow}}{\text{Total work}}$
- 2) Utilization = $\frac{\text{Total time process}}{\text{Total time flow}}$
- 3) Average number of jobs in the system = $\frac{\text{Total time flow}}{\text{Total time process}}$
- 4) Average delay in work = $\frac{\text{Total late}}{\text{Total work}}$

The results of the calculation of the effectiveness measure will be compared and the best results will be recommended to the company.

RESULT AND DISCUSSION

Data that is owned by the company, the data obtained is used for analysis to improve the production scheduling at the Company Racket and Sports Equipment Company Abadi Malang. The production scheduling analysis of the Racket and Sports Equipment Company of Abadi Malang requires order data in the form of order types, units ordered, processing time and due date. The data used in the study is order data in September 2020 which is shown in the following table:

Table 2. Order Data for the September 2020 Period

No.	Date Book	Buyer	Number of orders (pcs)	M1 Rollin Machine (Days)	M2 Machine Polishing (Days)	M3 Machine Perajang (Days)
1.	01-09-2020	Usaha Jaya	1.008	3	2	2
2.	04-09-2020	Om Rudi Malang	648	2	2	2
3.	15-09-2020	Sinar Maju Baru	300	1	2	3
4.	18-09-2020	Subur	180	1	2	3
5.	21-09-2020	Sinar Maju Baru	144	1	2	2
6.	24-09-2020	Burhani	4.400	4	3	3

Source: Racket and Sport Equipment Company "Abadi" Malang

Data obtained cannot be used directly but through processing first, first it is necessary to know the processing time and maturity of orders as in the following table:

Table 3. Table Processing Time

No.	Date Book	Buyer	Number of orders (pcs)	M1 Rollin Machine (Days)	M2 Machine Polishing (Days)	M3 Machine Chopper (Days)	Time Processing (Days)
1.	01-09-2020	Usaha Jaya	1.008	3	2	2	7
2.	04-09-2020	Om Rudi Malang	648	2	2	2	6
3.	15-09-2020	Sinar Maju Baru	300	1	2	3	6
4.	18-09-2020	Subur	180	1	2	3	6
5.	21-09-2020	Sinar Maju Baru	144	1	2	2	5
6.	24-09-2020	Burhani	4.400	4	3	3	10

Source: Data of Malang Abadi Racket and Sports Equipment company

Table 4. Maturity Table

No.	Buyer	Date Book	Due Date	Date of maturity (Days)
1.	Usaha Jaya	01-09-2020	11-09-2020	10
2.	Om Rudi Malang	04-09-2020	12-09-2020	8
3.	Sinar Maju Baru	15-09-2020	23-09-2020	8
4.	Subur	18-09-2020	26-09-2020	8
5.	Sinar Maju Baru	21-09-2020	24-09-2020	6

Source: Company data of Abadi Racket and Sport Equipment company Malang,

1) *First Come First Serve*

Table 5. Processing Time Using First Come First Serve (FCFS) Method

Number of Orders (pcs)	(M1) Machines Rolling (Days)	(M2) Machine Polishing (Day)	(M3) machine chopper (Days)	Processing time (days)
1.008	3	2	2	7
648	2	2	2	6
300	1	2	3	6
180	1	2	3	6
144	1	2	2	5
4.400	4	3	3	10

Source: Racket and Sports Equipment Company "Abadi" Malang

Figure 2. Implementation of *Gantt Chart* FCFS method

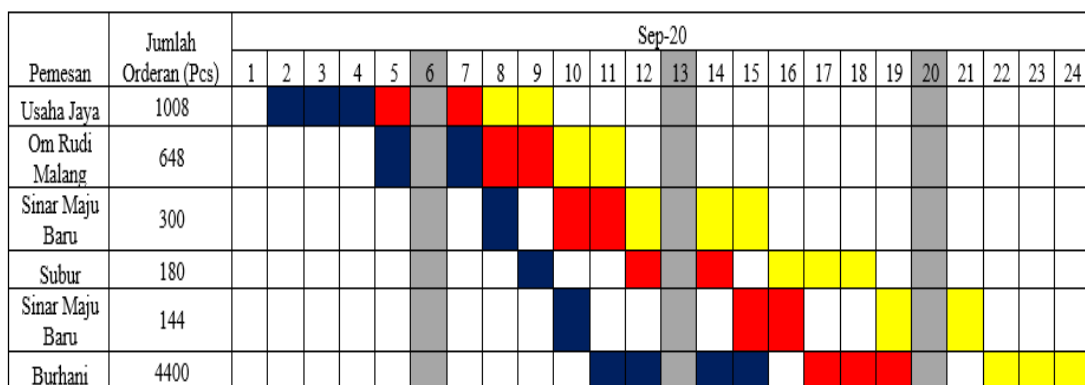


Table 6. Calculation of FCFS Performance

No.	Number of Orders (pcs)	Time Processing(Days)	Flow Time (Days)	Due (Days)	Delay (Days)
1	1.008	7	7	10	0
2	648	6	13	8	5
3	300	6	19	8	11
4	180	6	25	8	17
5	144	5	30	6	24
6	4.400	10	40	12	28
Total		40	134		85

Source: Company data of Malang Eternal Racket and Sports Equipment, processed

With the performance calculation in the table above, then the data is reprocessed to calculate the effectiveness of the first come serve method with the following calculations:

- a. Average time of completion = $134/6 = 22.3$ days
- b. Utilization = $(40/134) \times 100\% = 29.85\%$
- c. Average number of jobs in the system = $134/40 = 3.35$ jobs
- d. Average delay in work = $85/6 = 14.16$ days

Table 7. Processing time for Shortest Processing Time (SPT) method

Number of Orders (pcs)	(M1) Machine Rolling (Days)	(M2) Machine Polishing (Days)	(M3) Machine Chopper (Days)	Processing Time (Days)
144	1	2	2	5
648	2	2	2	6
300	1	2	3	6
180	1	2	3	6
1.008	3	2	2	7
4.400	4	3	3	10

Source: Company data, processed.

Figure 3. Implementation *Gantt Chart* SPT method

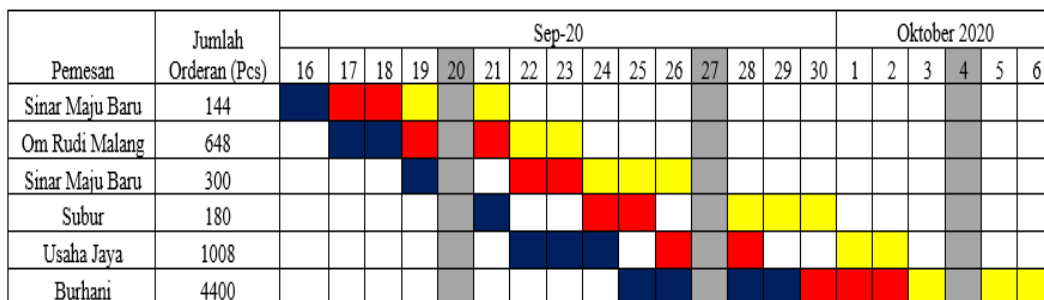


Table 8. SPT Performance Calculation

No.	Number of orders (pcs)	Time Processing(Days)	Flow Time (Days)	Maturity (Days)	Delay (Days)
1	144	5	5	6	0
2	648	6	11	8	3
3	300	6	17	8	9
4	180	6	23	8	15
5	1.008	7	30	10	20
6	4.400	10	40	12	28
Total		40	126		75

Source: Company data, processed

By calculating the performance in the table above, then the data is reprocessed to calculate the effectiveness of the shortest processing time method with the following calculations:

- a. Average time of completion = $126/6 = 21$ days
- b. Utilization = $40/126 \times 100\% = 31,74\%$
- c. Average number of jobs in the system = $126/40 = 3,15$ jobs
- d. Average delay in work = $75/6 = 12,5$ days

Table 9. Processing Time of the Longest Processing Time (LPT) Method

Number of Orders (pcs)	(M1) Machine Rolling (Days)	(M2) Polishing Machine (Days)	(M3) Machine Chopper (Days)	Processing Time (Days)
144	1	2	2	5
648	2	2	2	6
300	1	2	3	6
180	1	2	3	6
1.008	3	2	2	7
4.400	4	3	3	10

Source: “Abadi” Malang Racquet and Sports Equipment Company.

Figure 4. Implementation of the *Gantt Chart* for the LPT method.

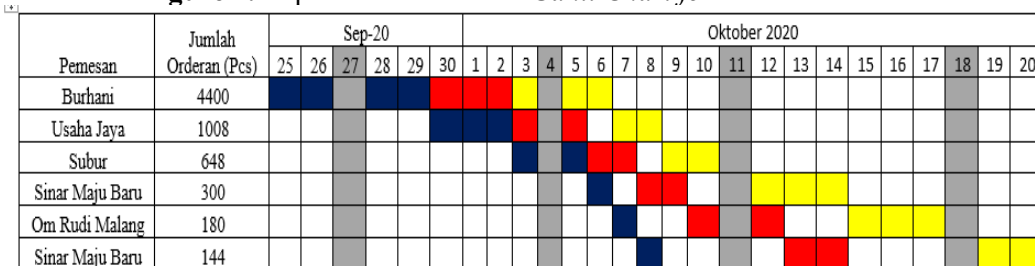


Table 10. Calculation of LPT Performance

No.	Number of Orders (pcs)	Time Processing(Days)	Flow Time (Days)	Due (Days)	Delay (Days)
1	4.400	10	10	12	0
2	1.008	7	17	10	7
3	648	6	23	8	15
4	300	6	29	8	21
5	180	6	35	8	27
6	144	5	40	6	34
Total		40	154		104

Source: Company data, processed

By calculating the performance in the table above, then the data is reprocessed for the following calculations:

- a. Average time of completion = $154/6 = 25,67$ days
- b. Utilization = $40/154 \times 100\% = 25,97\%$
- c. Average number of jobs in the system = $154/40 = 3,85$ jobs
- d. Average delay in work = $104/6 = 17,34$ days

Table 11 Processing Time of Earliest Due Date (EDD) Method

Number of Orders (pcs)	(M1) Machine Rolling (Days)	(M2) Polishing Machine (Days)	(M3) Machine Chopper (Days)	Time Processing (Days)
1.008	3	2	2	7
648	2	2	2	6
300	1	2	3	6
144	1	2	2	5
180	1	2	3	6
4.400	4	3	3	10

Source: Company Rackets and Sports Equipment"Abadi" Malang

Figure 5. Implementation *Gantt Chart* EDD method

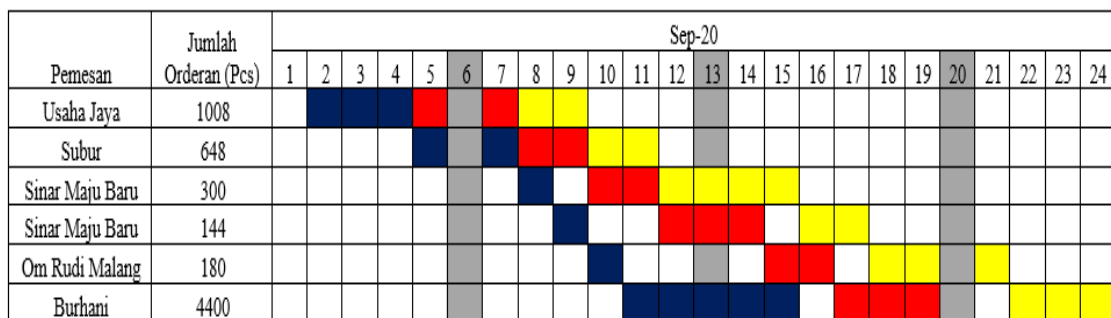


Table 12. EDD Performance Calculation

No.	Number of orders (pcs)	Time Processing(Days)	Flow Time (Days)	Maturity (Days)	Delay (Days)
1	1.008	7	7	10	0
2	648	6	13	8	5
3	300	6	19	8	11
4	144	5	24	6	18
5	180	6	30	8	22
6	4.400	10	40	12	28
Total		40	133		84

Source: Company data, processed

By calculating the performance in the table above, then the data is reprocessed for the following calculations:

- a. Average time of completion = $133/6 = 22,16$ days
- b. Utilization = $40 / 133 \times 100\% = 30,07\%$
- c. Average number of jobs in the system = $133/40 = 3,325$ jobs
- d. Average delay in work = $84/6 = 14$ days

Table 13. Comparison of Criteria for Measures Effectiveness

Measures of Effectiveness	FCFS	SPT	LPT	EDD
Average time of completion	22,3 days	21 days	25,67 days	22,16 days
Utilities	29,85%	31,74%	25,97%	30,07%
average number of jobs in the system	3,35 jobs	3,15 jobs	3,85 jobs	3,325 jobs
The average delays processing	14,16 days	12,5 days	17,34 days	14 days

Source: Data Processing

Results The calculation results show that the *shortest processing time* has an average completion time of 21 days, 31.74% utility, an average number of jobs in the system 3.15 jobs, and a delay of 12.5 days. Based on the analysis of scheduling criteria by comparing the results of the calculation of the effectiveness of the four priority direction methods, the optimal scheduling criteria for proposals to the company Racket and Sports Equipment "Abadi" Malang in scheduling production, namely by using the shortest processing time method to minimize delays in order completion. This is the same as previous research conducted by Kusumawati (2016) entitled "Design and Design of Production Scheduling Applications at CV Aneka Karya Makmur". This study uses the FCFS, SPT, LPT, and EDD methods. Shows the results of the most optimal production method in his research, namely the shortest processing time method. The use of the gantt chart can help the racket and sporting equipment company "Abadi" Malang in determining the flow of time and sequencing of work so that there is a target time for completion with a work schedule, this can minimize the waiting time for work performed by employees.

CONCLUSION

Based on the calculation and data analysis in the discussion, it can be concluded that the optimal priority rule method is the shortest processing time method to minimize delays in completing orders. From the comparison of scheduling criteria, namely minimizing the completion time, maximizing utilization, minimizing the number of jobs in the system, minimizing the delay in work. The result of the shortest processing time method is that it has an average completion time of 21 days, utility 31.74%, an average number of jobs in the system 3.15 jobs, and a delay of 12.5 days. So it is expected that the delay in company scheduling can solve the problem of production delays in the company, and can optimize work according to work time and according to the production flow.

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