International Journal of Research and Review
Vol. 10; Issue: 9; September 2023
Website: www.ijrrjournal.com
E-ISSN: 2349-9788; P-ISSN: 2454-2237

Research Paper

Comparison of FCFS, SPT, LPT, and EDD Methods at the Utility Level and Production Scheduling of Huller Machines

Nos Sutrisno[1], Healthy Aldriany Prasetyo[2], Sekar Utami[3]

[1,2,3]Faculty of Engineering, Universitas Medan Area, Medan, Indonesia.

Corresponding Author: Nos Sutrisno

DOI: https://doi.org/10.52403/ijrr.20230920

ABSTRACT

Machines play an important role in the production process. A huller machine is one of the tools in a company that runs in coffee production that used to peel the coffee skin. However, effectiveness of the production schedule by using the FCFS method is slightly waste more times. Hence, the other methods should be compared in determining the utility level to enhance the production and minimizes completion time by sequencing a particular work. The results shows that FCFS method have the completion time of 32.54 days, with 2.82 total works and 19.24 days of delay, with the utility of 35.40% for two active machines. On the other hand, SPT method has the completion time of 32.44 days, 2.81 total works, 19.26 days of delay with the utility of 35.51%. Nevertheless, the other method outcomes are various. The study also pointed out that the average utility of the five huller machines is 87.46%. We concluded that the SPT method as the most appropriate among the others to production scheduling of huller machine's purpose.

Keywords: Huller, Scheduling, FCFS, SPT, LPT, EDD.

INTRODUCTION

The coffee processing industry is a production process that involves many factors involved in the production of coffee cherries, including machinery, labor and raw materials (Sarirahayu & Aprianingsih, 2018). Optimal machine operation is required to ensure the best ground coffee production (Afriliana, 2018). Despite the machining, machine design is also an important part of the production process. Moreover, production machine planning in industry is the primary key as a form of the decision making. A poor planned scheduling often resulting delayed processing time, overtime, and underutilized resources (Ghaleb et al., 2021; Nur & Suyuti, 2017). Additionally, the inaccuracy of the order receiving schedule and the different levels of customization sometimes occur and causes inappropriate or sub-optimal production scheduling (Prastyabudi et al., 2019).

The coffee processing companies usually provides six kinds of production machines for the treatment, including drum dryers, hullers, washers, mucilage, pulpers and boiler machines (Adugna, 2021; Cercado, 2019; e Silva et al., 2021; Nogueira & Koziorowski, 2019; Silalahi & Indriani, 2019; Wiranata et al., 2021). The huller machine is a tool to simpler of removing the covers of dried coffee cherries and get the coffee beans out of it (Haile & Kang, 2019). Hence, this machine necessity in coffee processing should be stressed by a company to enhance the production quality (Cercado, 2019).

The machine planning should become the company concern for the production sustainability and effectiveness. The FCFS (First Come First Served) method is usually applied by the company as the scheduling method with its shortcomings (Tarigan et al., 2021). In term of coffee processing, the FCFS method resulting the longer the coffee beans are piled up, but abandoned and were not processed, causing the rawer materials are damaged. The company requires workers to work overtime to complete the work within the allotted time to avoid this issue (Parthanadee & Buddhakulsomsiri, 2010).

Therefore, the company should manage another scheduling method that suits the current situation. There are several alternative scheduling methods that can be used by the company, including SPT (Short Processing Time), LPT (Long Processing Time), or Earliest Due Date (EDD) (Safitri, 2019). Hence, this paper provides the comparison between these scheduling methods to determine the shortest completion time, and the highest utility score of huller machine.

LITERATURE

Scheduling

Scheduling and planning are the two kinds of axis in industry (Parente et al., 2020). In general, planning is defined as a form of decision-making regarding the coordination of activities and resources to completion a qualified series of works in time (Nadal-Roig et al., 2019). Meanwhile, scheduling can be defined as the allocating a set of resources to perform a series of tasks or operations within a certain period of time. Scheduling is a decision-making process that plays a very important role in the manufacturing and service industries. Allocate the existing resources presents align with company objectives and business specifications (Dolgui et al., 2019).

The sequencing method is a method for solving work order scheduling problems in order to determine the best scheduling process based on the sequencing process to produce optimal scheduling (Faris & Handayani, 2022). Inaccuracies in the assignment of workers and the machines they use can lead to ineffectiveness and inefficiency in assigning works. There are several sequencing methods of scheduling to solve this issue, namely (Safitri, 2019):

1. FCFS (First Come First Served), focused on processing raw materials in the order received. In other words, the first raw materials come, it will be served first.
2. LPT (Long Processing Time), prioritizing orders that take longer to process, namely orders that process longer.
3. SPT (Short Processing Time), prioritizing orders with the shortest processing time to be completed first.
4. EDD (Earliest Due Date), prioritizing orders that have the earliest deadline for completion.

Implementing of those methods are two-headed coin for the companies. Some of them are suitable in certain production, or perhaps they could cause losses. Thus, the company should be more selective regarding this issue (Rahman et al., 2021). To ensure the method are fit, several points should be collected to illustrate the appropriateness, namely: production processing time, total time flow, production deadline, and production delays (Subroto & Herdi, 2019). Conventionally, the measure of effectiveness is usually employed to analyze which of these scheduling methods are appropriate to be applied in the company. This measure including Average Completion Time, Utilities, Average Number of Works, and Work Delays (Jay & Barry, 2020).

1. Average Completion Time (ACT).
   ACT can be calculated by dividing the total flow of all works by the number of works as listed in Equation (1). The shorter value of ACT leads to reduction of the amount of work-in-process inventory and can ultimately speed up processing.

$$ACT = \frac{Total\ time\ flow}{Total\ Works} \quad (1)$$

2. Utilities (UT).
   Utilities (UT) is the total amount of processing time divided by the total time spent on all works as illustrated in Equation (2). The more efficient, the higher the level of work completion.

$$UT = \frac{Total\ Production\ Processing\ Time}{Total\ time\ flow} \quad (2)$$

3. Average Number of Works (ANW)
   The ANW is the mean score of the entire works of machine while performing its' task. Equation (3) is used to determine the ANW value. A low value of ANW indicates a slack or under full operation.

$$ANW = \frac{Total\ time\ flow}{Total\ Production\ Processing\ Time} \quad (3)$$

4. Work Delays (WD).
   WD is calculated by dividing the number of days of delay by the number of jobs as shown in Equation (4). The lower the delay rate, the faster the delivery time.

$$WD = \frac{Total\ of\ production\ delay}{Total\ Works} \quad (4)$$

Machine Utility

The machine utilities used to discover its' performance in production process. Utilities describes the entire machines that used to enable the processes involved to be carried out effectively and economically to achieve optimal results (Parinduri et al., 2020). Theoretically, the maximum profit size is 100% yet it is rarely to be reached due to the downtime machine, operator absence, or work stoppage. The level of machine utility is be presented by Equation (5) and (6).

$$Machine\ Utility = \frac{Total\ Operation\ Time}{Total\ of\ Availability\ of\ Labor\ Hours} \quad (5)$$

$$Average\ Machine\ Utility = \frac{Total\ Utility}{Total\ Machine} \quad (6)$$

MATERIALS AND METHOD

We present case study research, aiming to provides a detailed description of a case through deep investigation intensively the problems that occur in a company. The data collection process was conducted in the period January - June 2022 in the means of observations and documentations. Figure 1 shows the flowchart of study progress.

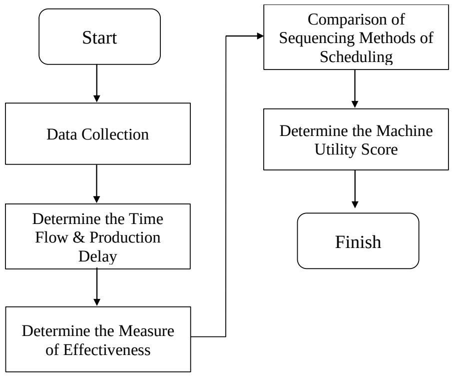

Figure 1 Research Flowchart

Data Collection

At first, the study collected data from one of company who runs of coffee production. The company has total of five huller machines to be operated. There are two types of Ideal and three types of Yuema. Data were collected from the machines are the capacity, production process time, production deadline, production demand, available labour hours, and operation time. Table 1 shows the five kinds of the machine along with their capacity.

Table 1. Production Capacity of Huller Machine

No	Machine Type	Capacity
1	Ideal (A1)	75 Kg/hour
2	Ideal (A2)	75 Kg/hour
3	Yuema (B1)	55 Kg/hour
4	Yuema (B2)	55 Kg/hour
5	Yuema (B3)	55 Kg/hour
Total Capacity		315 Kg/hour

Based on Table 1, there are 2 Ideal type of huller machines with the capacity of 75 kg/hour each of them. Then, there are 3 units of Yuema type huller machines with a capacity of 55 kg/hour each of them. The total capacity of the five machines is 315 kg. Moreover, the research also collected production process time for each machine along with their production deadline. The processing times are varied as well as the deadline, depends on their capabilities in peeling the covers of dried coffee cherries.

Table 2 presents the machines' production process time along with the deadline

Table 2. Production Process Time and Deadline

No	Machine Type	Production Process Time (day)	Deadline (day)
1	Ideal (A1)	9.5	10
2	Ideal (A2)	9.4	10.5
3	Yuema (B1)	13	16
4	Yuema (B2)	12.9	15.5
5	Yuema (B3)	12.8	15

Furthermore, the study collected the production demand in the period January - June 2022. In line with this, the availability of labor hours data also gathered in the same period. Table 3 shows the production demand and Table 4 shows the availability of labor hours for each month.

Table 3. Production Demand in January-June 2022

Month	Production Demand (Kg)
January	4,129
February	5,836
March	5,914
April	6,786
May	5,112
June	6,539

Table 4. Availability of Labour Hours in January-June 2022

Month	Total of Working Hours per day	Total of Working Days	Total of Availability of Labor Hours
January	8	25	200
February	8	23	184
March	8	26	208
April	8	23	184
May	8	23	184
June	8	26	208
Total		146	1168

Based on Table 4, the working hours are available in January by implementing a system of one work shift, the number of hours worked per day is 8 hours with a total working day of 25 days, so the number of available hours is 200 hours. And so on for the months of February to June, so that the total number of hours available is 1168 hours. Meanwhile, Table 3 highlights the demand for coffee beans in January-June 2022 are 4,129 kg, 5,836 kg, 5,914 kg, 6,786 kg, 5,112 kg and 6,539 kg respectively.

Finally, the study also gathered the operation time of all machines that are commonly used by operators on huller machines. The machines' operation times are fluctuating in every month. For instance, the machines are frequently functioned in March. They are operated more than 180 hours. Conversely, the machines are only performing tasks in average of 160 hours in April and May. The summary of machines' operation times is depicted in Table 5.

Table 5. The Huller Machines Operation time

Month	Operation Time (Hours)					Total Time
	A1	A2	B1	B2	B3	
January	175	175	175	175	175	875
February	161	160,5	161	161	161	804,5
March	182	181,5	182	182	182	909,5
April	161	161	161	161	161	805
May	161	160	161	161	161	804
June	182	182	182	182	182	910
Total	1022	1020	1022	1022	1022	5108

Determination of Time Flow and Production Delay

The machines' time flow is gathered by adding the day of each machine's production time. On the other hand, the delay is obtained by subtracting the day of each machine's production time. The value of time flow and delay for each method of scheduling (i.e., FCFS, LPT, SPT, EDD) is contrast. This is due to the ways of sequencing the machine to be operated are vary.

Determination of the Measure of Effectiveness and Comparison between Methods

The measure of effectiveness for each method is conducted to reveal the most appropriate method to be applied for the issue. This measure including ACT, UT, ANW, and WD. In order to gain the score of each measurement, some of the details that collected before are compulsory, such as total time flow, total works, total production processing time, and total days of production delay. Subsequently, the scores from the measures are used to compare between the methods. A proper method should have the lowest score of the ACT and WD whereas the highest score for the ANW and UT. A low score of ACT indicates the fastest process of the huller machines in operating their works in certain sequence. Then, the lower score of WD expresses the appropriateness of the sequence in avoiding overdue. Conversely, ANW score is expected to be high. The more works that can be operated, the more precise the method used. In line with this, a high percentage of UT confirms a better sequence from the method offers.

Determination of the Machine Utility Score

The study determined the machine utility score to explain the entire machines' performance in operating the works. It was examined by using data of operation time in Table 5 and total of labor hours availability in Table 4.

RESULT

The study investigates the appropriateness of each scheduling method in organizing the machines' operation sequence regarding their time flow and production delay along with the scores of measures of effectiveness (i.e., ACT, UT, ANW, WD). Each method has difference in in the order of machine used from the start of the operation to the end. For instance, the FCFS method is emphasizing in processing order according to the incoming material received. In other words, materials that comes first will be operate directly. Production process time and the deadline are neglected. On the contrary, the SPT method sort the machines' operation from the fastest production process time to be early conducted

FCFS Method

The FCFS method is sorting the machine in accordance with the first incoming material received. The method arranged that machine A1 to be operated in the beginning, followed by A2, B1, B2, and B3 for the finale. The arrangement of FCFS method scheduling is shown in Table 6.

Table 6. FCFS Method Scheduling

Machine	Production Process Time	Time Flow	Deadline	Production Delay
A1	9.5	9.5	10	0
A2	9.4	18.9	10.5	8.4
B1	13	31.9	16	15.9
B2	12.9	44.8	15.5	29.3
B3	12.8	57.6	15	42.6
Total	57.6	162.7	67	96.2

Based on the Table 6, the measures of effectiveness can be determined by using Equation (1) to (4). The result of the calculation as follows.

1. **ACT**

$$ACT = \frac{Total\ time\ flow}{Total\ Works}$$

$$ACT = \frac{162.7}{5}$$

$$ACT = 32.54 \text{ days}$$

2. UT

$$UT = \frac{Total\ Production\ Processing\ Time}{Total\ time\ flow}$$

$$UT = \frac{57.6}{162.7}$$

$$UT = 0.3540 = 35.40\%$$

3. ANW

$$ANW = \frac{Total\ time\ flow}{Total\ Production\ Processing\ Time}$$

$$ANW = \frac{162.7}{57.6}$$

$$ANW = 2.82 \text{ works}$$

4. WD

$$WD = \frac{Total\ of\ production\ delay}{Total\ Works}$$

$$ACT = \frac{96.2}{6}$$

$$ACT = 19.24 \text{ days}$$

LPT Method

The LPT method is sorting the machine in accordance with the slowest production processing time. In other words, a longest processing time will be selected first for production. This method managed machine B3 as the first machine to be operated, followed by B2, B1, A2, and A1. The huller machines production process using the LPT method are listed in Table 7.

Table 7. LPT Method Scheduling

Machine	Production Process Time	Time Flow	Deadline	Production Delay
B1	13	13	16	0
B2	12.9	25.9	15.5	10.4
B3	12.8	38.7	15	23.7
A1	9.5	48.2	10	38.2
A2	9.4	57.6	10.5	47.1
Total	57.6	183.4	67	119.4

Based on the Table 7, the measures of effectiveness also determined by using Equation (1) to (4). The result of the calculation as follows.

1. ACT

$$ACT = \frac{Total\ time\ flow}{Total\ Works}$$

$$ACT = \frac{183.4}{5}$$

$$ACT = 36.68 \text{ days}$$

2. UT

$$UT = \frac{Total\ Production\ Processing\ Time}{Total\ time\ flow}$$

$$UT = \frac{57.6}{183.4}$$

$$UT = 0.3140 = 31.40\%$$

3. ANW

$$ANW = \frac{Total\ time\ flow}{Total\ Production\ Processing\ Time}$$

$$ANW = \frac{183.4}{57.6}$$

$$ANW = 3.18 \text{ works}$$

4. WD

$$WD = \frac{Total\ of\ production\ delay}{Total\ Works}$$

$$ACT = \frac{119.4}{5}$$

$$ACT = 23.88 \text{ days}$$

SPT Method

The SPT method is sorting machine with the fastest production process is operated first. In other words, machines with fastest processing time, they will be processed preferentially. The SPT method managed machine A2 as the first machine to be proceed, then followed by A1, B3, B2, and B1. Table 8 illustrates the production schedule by the SPT method.

Table 8. SPT Method Scheduling

Machine	Production Process Time	Time Flow	Deadline	Production Delay
A2	9.4	9.4	10.5	0
A1	9.5	18.9	10	8.9
B3	12.8	31.7	15	16.7
B2	12.9	44.6	15.5	29.1
B1	13	57.6	16	41.6
Total	57.6	162.2	67	96.3

The measures of effectiveness for the SPT method also determined by using equation (1) to (4). The result of the calculation as follows.

1. ACT

$$ACT = \frac{Total\ time\ flow}{Total\ Works}$$

$$ACT = \frac{162.2}{5}$$

$$ACT = 32.44 \text{ days}$$

2. UT

$$UT = \frac{Total\ Production\ Processing\ Time}{Total\ time\ flow}$$

$$UT = \frac{57.6}{162.2}$$

$$UT = 0.3551 = 35.51\%$$

3. ANW

$$ANW = \frac{Total\ time\ flow}{Total\ Production\ Processing\ Time}$$

$$ANW = \frac{162.2}{57.6}$$

$$ANW = 2.81 \text{ works}$$

4. WD

$$WD = \frac{Total\ of\ production\ delay}{Total\ Works}$$

$$ACT = \frac{96.3}{5}$$

$$ACT = 19.26 \text{ days}$$

EDD Method

The EDD method is emphasizing the machines' earlier deadlines. The priority is given to producing coffee beans with the earliest ripening schedule. The method scheduled machine A1 to firstly operated, followed by A2, B3, B2, and B1. The huller machine production process using the EDD method is shown in Table 9.

Table 9. EDD Method Scheduling

Machine	Production Process Time	Time Flow	Deadline	Production Delay
A1	9.5	9.5	10	0
A2	9.4	18.9	10.5	8.4
B3	12.8	31.7	15	16.7
B2	12.9	44.6	15.5	29.1
B1	13	57.6	16	41.6
Total	57.6	162.3	67	95.8

Equation (1) to (4) also used to determine the measures of effectiveness for the EDD. The result of the calculation as follows.

1. ACT

$$ACT = \frac{Total\ time\ flow}{Total\ Works}$$

$$ACT = \frac{162.3}{5}$$

$$ACT = 32.46 \text{ days}$$

2. UT

$$UT = \frac{Total\ Production\ Processing\ Time}{Total\ time\ flow}$$

$$UT = \frac{57.6}{162.2}$$

$$UT = 0.3549 = 35.49\%$$

3. ANW

$$ANW = \frac{Total\ time\ flow}{Total\ Production\ Processing\ Time}$$

$$ANW = \frac{162.3}{57.6}$$

$$ANW = 2.81 \text{ works}$$

4. WD

$$WD = \frac{Total\ of\ production\ delay}{Total\ Works}$$

$$ACT = \frac{96.3}{5}$$

$$ACT = 19.16 \text{ days}$$

The Comparison

The results of measuring the effectiveness calculation for the four methods are used as the consideration to determine which method is most suitable for the company. The results of the calculation of coffee bean production scheduling using the FCFS, SPT, LPT and EDD methods are illustrated in Table 10.

Table 9. Method Comparison

Method	ACT (days)	UT (%)	ANW (works)	WD (days)
FCFS	32.54	35.40	2.82	19.24
LPT	36.68	31.40	3.18	23.88
SPT	32.44	35.51	2.81	19.26
EDD	32.46	35.49	2.81	19.16

Based on Table 10, the SPT method has the lowest score of the ACT as 32.44 days, while the LPT method has the highest score of the ACT as 36.68 days. Hence, it indicates that the SPT method allows the huller machine process to be operated faster than others. In term of the utility, the SPT method has the percentage as much as 35.51%, whereas the LPT method is the lowest rank between other methods with the percentage of utility as 31.40%. Thus, the SPT method presents the schedule that has the optimization of machine uptime from the available time.

In contrast, Table 10 shows that the LPT method has the highest score of the ANW. The method provides a total of 3.18 works that can be conducted in a month. Meanwhile, both the SPT and the EDD method have the lowest score of ANW as much as 2.81 works. Moreover, the EDD method only excels in term of the WD. The method arranges the schedule that offer a minimum delay of work.

The Machine Utility Score

According to Table 5, each machine has the similar total operation time as much as 1022 hours in 6 months (January-June). Only machine A2 has the total operation time as 1020 hours. Furthermore, Table 4 shows the total of availability of labor hours for all of the huller machine as much as 1168 hours in 6 months. The machine utility score is determined by using Equation (5), while the average score of machine utility is calculated by using Equation (6). The result of the machine utility score shown in Table 11.

Machine	Operation Time (Hours)	Total of Availability of Labor Hours	Machine Utility (%)
A1	1022	1168	87.5
A2	1022	1168	87.32
B1	1022	1168	87.5
B2	1022	1168	87.5
B3	1022	1168	87.5
Total	5108	5840	
Average			87.46

Machine A1 spends 1022 hours while the available time is 1168 hours. Hence, based on Table 11 the utility score of the machine is 87.5%, as well as B1, B2 and B3. Meanwhile, the A2 machine spends 1020 hours and the available time is 1168 hours and presents the utility score as 87.32%.

Table 11 also shows that the average huller machine utility score as a whole is 87.46%. The score pointed that the utilization of five machines simultaneously in production process is the best solution that should be implemented by the company.

CONCLUSION

Scheduling plays an important role for the industry. It allows the process runs effectively and efficiently (Dolgui et al., 2019). In term of coffee production, the huller machine is used to remove the coffee bean skin, then continued to the sorting processes (Haile & Kang, 2019). The study demonstrated four methods to be implemented for huller machine scheduling, including FCFS, LPT, SPT, and EDD method. Four measures of effectiveness are employed to discover which method is appropriate to be applied for the company, including ACT (Average Completion Time), UT (Utility), ANW (Average Number of Works), and WD (Work Delays). The result reveals that these methods have various score for each measure. However, SPT method is the most suitable sequencing method to minimize the completion time of machines work. The method has the fastest completion time and highest utility whether it has less of total works and average of working delay. The method proposes the order of huller machines, namely A2, A1, B3, B2, B1. Furthermore, the utility score for using all the machines in the company is 87.46%. Therefore, the use of five machine units simultaneously in completing production is the best solution for the company

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Adugna, B. G. (2021). Factors Affecting Coffee (Coffea Arabica L.) Quality in Ethiopia: A Review. *American Journal of Agriculture and Forestry*, *9*(5), 283–291.
2. Afriliana, A. (2018). *Teknologi Pengolahan Kopi Terkini* (I. Nuraini (ed.); Pertama). Penerbit: Deepublish.
3. Cercado, A. P. (2019). Hulling Machine: Design, Fabrication, and Performance. *International Journal of Information Research and Review*, *06*(06), 6371–6373.
4. Dolgui, A., Ivanov, D., Sethi, S. P., & Sokolov, B. (2019). Scheduling in Production, Supply Chain and Industry 4.0 Systems by Optimal Control: Fundamentals, State-of-the-Art and Applications. *International Journal of Production Research*, *57*(2), 411–432.
5. e Silva, J. de, Moreli, A. P., Donzeles, S. M. L., Soares, S. F., & Vitor, D. G. (2021). Harvesting, Drying and Storage of Coffee. In *Quality Determinants In Coffee Production* (pp. 1–64). Springer.
6. Faris, M. F., & Handayani, W. (2022). Analisis Penjadwalan Produksi Berdasarkan Pesanan Menggunakan Metode Asas Prioritas pada CV Davero Cemerlang Indonesia Surabaya. *Al-Kharaj: Jurnal Ekonomi, Keuangan \& Bisnis Syariah*, *4*(2), 380–396. https://doi.org/https://doi.org/10.47467/alkharaj.v4i2.676
7. Ghaleb, M., Taghipour, S., & Zolfagharinia, H. (2021). Real-time integrated production-scheduling and maintenance-planning in a flexible job shop with machine deterioration and condition-based maintenance. *Journal of Manufacturing Systems*, *61*, 423–449.
8. Haile, M., & Kang, W. H. (2019). The harvest and post-harvest management practices' impact on coffee quality. *Coffee-Production and Research*, 1–18.
9. Jay, H., & Barry, R. (2020). *Operations Management* (Thirteenth). Pearson.
10. Nadal-Roig, E., Plà-Aragonès, L. M., & Alonso-Ayuso, A. (2019). Production planning of supply chains in the pig industry.

Computers and Electronics in Agriculture, *161*, 72–78.
11. Nogueira, V. M. C., & Koziorowski, T. (2019). Roasting Equipment for Coffee Processing. In *Drying and Roasting of Cocoa and Coffee* (pp. 235–266). CRC Press.
12. Nur, R., & Suyuti, M. A. (2017). *Pengantar Sistem Manufaktur* (H. A. Susanto (ed.); Pertama). Penerbit: Deepublish.
13. Parente, M., Figueira, G., Amorim, P., & Marques, A. (2020). Production scheduling in the context of Industry 4.0: review and trends. *International Journal of Production Research*, *58*(17), 5401–5431.
14. Parinduri, L., Hasdiana, S., Purba, P. B., Sudarso, A., Marzuki, I., Armus, R., Rozaini, N., Purba, B., Purba, S., Ahdiyat, M., & others. (2020). *Manajemen Operasional: Teori dan Strategi* (J. Simarmata (ed.); Pertama). Yayasan Kita Menulis.
15. Parthanadee, P., & Buddhakulsomsiri, J. (2010). Simulation modeling and analysis for production scheduling using real-time dispatching rules: A case study in canned fruit industry. *Computers and Electronics in Agriculture*, *70*(1), 245–255.
16. Prastyabudi, W. A., Adiyanto, O., & Adityo, L. B. (2019). Analisa Kapasitas Produksi di Stasiun Perakitan dengan Metode Penjadwalan Deterministik. *Jurnal Manajemen Industri Dan Logistik*, *3*(01), 1–13.
17. Rahman, H. F., Janardhanan, M. N., Chuen, L. P., & Ponnambalam, S. G. (2021). Flowshop scheduling with sequence dependent setup times and batch delivery in supply chain. *Computers \& Industrial Engineering*, *158*, 107378.
18. Safitri, R. I. (2019). Analisis Sistem Penjadwalan Produksi Berdasarkan Pesanan Pelanggan dengan Metode FCFS, LPT, SPT dan EDD Pada PD. X. *Jurnal Optimasi Teknik Industri*, *1*(2), 26–30.
19. Sarirahayu, K., & Aprianingsih, A. (2018). Strategy to improving smallholder coffee farmers productivity. *The Asian Journal of Technology Management*, *11*(1), 1–9.
20. Silalahi, M., & Indriani, A. (2019). Finite Element Method Analysis for Manufacturing Design Drum Dryer of Rotary Dryer Machine. *IOP Conference Series: Materials Science and Engineering*, *505*(1), 12133.
21. Subroto, W., & Herdi, T. (2019). Sistem Pendukung Keputusan Dalam Menentukan Prioritas Penjadwalan Produksi Menggunakan Metode EDD (Earliest Due Date) dan SPT (Shortest Processing Time) Pada Industri Farmasi. *J. Sist. Inf. Dan E-Bisnis*, *1*(2).
22. Tarigan, U., Siregar, I., Sari, R. M., Syahputri, K., & Rizkya, I. (2021). Comparison of first come first served and ant colony algorithm method for door leaf production scheduling. *IOP Conference Series: Materials Science and Engineering*, *1122*(1), 12057.
23. Wiranata, T. E., Sumiati, R., Yetri, Y., & others. (2021). Design of a coffee pulper machine using an electric motor. *Jurnal Teknik Pertanian Lampung*, *10*(1), 26–32.

How to cite this article: Nos Sutrisno, Healthy Aldriany Prasetyo, Sekar Utami. Comparison of FCFS, SPT, LPT, and EDD methods at the utility level and production scheduling of huller machines. *International Journal of Research and Review*. 2023; 10(9): 177-186. DOI: *https://doi.org/10.52403/ijrr.20230920*

******