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Production Process Scheduling Using the FCFS (First Come First Served) Method, at CV. Clean Industry Unit

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ABSTRACT

CV. Unit Clean Industry, a household cleaning equipment manufacturer, faces significant production delays due to inefficient scheduling using the First Come First Served (FCFS) method, with 35% of orders delayed by 5–7 days in 2023. This study aims to evaluate the effectiveness of FCFS and identify root causes of delays, focusing on material shortages and machine maintenance issues. Using a mixed-method approach, primary data from interviews and observations were combined with secondary production records from November 2019 to April 2025. Critical Ratio (CR) analysis and comparative evaluation of FCFS against SPT, LPT, and EDD methods were conducted. Results showed FCFS achieved the shortest average completion time (10.75 days) and lowest average delay (4.5 days), despite minor utilization (44.18%) and work-in-process (2.26 jobs) disadvantages. The study concludes that FCFS remains effective for CV. Unit Clean Industry but recommends improving material supply chain and machine maintenance to further reduce delays.

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1. Introduction

In the era of globalization marked by increasingly tight business competition, the manufacturing industry is required to be able to adapt to complex market dynamics. The manufacturing sector, as one of the industries that contributes significantly to the economy, faces major challenges in meeting the ever-growing consumer expectations (Syafruddin & Darwis, 2021). Modern consumers not only prioritize the practical function of a product, but also pay attention to aesthetic value, psychological comfort, and punctuality of delivery (Febriani & Dewi, 2019). This change in preference encourages manufacturers to optimize all aspects of production, from planning to distribution, in order to maintain competitiveness in the market (Heizer et al., 2020).

However, these challenges are not balanced with adequate capacity, especially in Micro, Small, and Medium Enterprises (MSMEs). Most MSMEs are still struggling with limited resources, both in terms of materials, machines, and labor, thus hampering the production process (Mafrohah, 2019). This condition is exacerbated by an inefficient scheduling system , which often results in late order

fulfillment and decreased customer satisfaction. In fact, in a fast-moving industry, punctuality is one of the determining factors for consumer loyalty.

CV. Unit Clean Industry, a manufacturer of cleaning equipment branded "Hidhoshi Star" in Pasuruan, is a real example of this problem. The company, which was founded in 1999, adopts a make-to-order system with the First Come First Served (FCFS) scheduling method. Although the FCFS method is considered fair because it prioritizes the first orders received, its practice actually causes problems when the volume of orders exceeds production capacity. Internal company data shows that 35% of orders experienced an average delivery delay of 5-7 days in 2023. This delay not only impacts customer satisfaction, but also has the potential to harm the company financially and in terms of reputation.

Based on the initial analysis, the root of the problem lies in two main things: (1) the imbalance between order volume and production capacity, and (2) the application of the FCFS method which does not consider the complexity and duration of each order. The rigid FCFS method tends to ignore factors such as order size, production difficulty level, and delivery deadline, thus potentially creating inefficient queues (Kurniawati & Irsyad, 2018; Stevenson, 2018).

Therefore, this study aims to identify the specific causes of production delays at CV. Clean Industry Unit and evaluate the effectiveness of the FCFS method in the context of the company's operations. The results of the study are expected to not only provide solutions that can improve the company's production performance, but also be a reference for similar MSMEs facing similar challenges. Thus, this study is expected to contribute to the development of operations management literature, especially in the application of scheduling methods in small-scale industries.

2. Literature Review

a. Production Planning

Production planning or known as aggregate planning is an approach to determining the quality and timing of production in the medium term (usually between 3 and 18 months ahead) (Eunike et al., 2021). Operations managers try to determine the best way to meet predicted demand by adjusting production rates, labor levels, inventory levels, overtime, subcontracting levels, and other controlled variables.

b. Production Scheduling

Production scheduling is the process of allocating resources to complete work according to established priorities (Annisya & Saifudin, 2020). In the context of manufacturing, effective scheduling must consider three main aspects: time, cost, and quality. According to Heizer et al (2020), good scheduling can increase efficiency by up to 30% by minimizing idle time and maximizing machine utilization.

The main objectives of production scheduling include:

1) Meet order delivery deadlines
2) Minimize production costs
3) Increase customer satisfaction

c. First Come First Served (FCFS) Method

FCFS is the most basic scheduling method where orders are processed in the order they arrive (Fadli et al., 2020). The main advantages of this method are:

1) Justice in service
2) Simple implementation
3) Suitable for companies with a steady flow of orders

3. Methodology

1) Research Location

This research was conducted at CV. Unit Clean Industry, a household cleaning equipment manufacturing company located at Jl. Sumber Keling No. 27, Karangrejo Village, Purwosari District, Pasuruan Regency, East Java. This company was chosen as the object of research because it faced significant production delay problems, especially in scheduling orders using the FCFS (First Come First Served) method.

2) Processing Techniques

The collected data is analyzed using the following steps:

a. Identification of problems:
   1. View production delay patterns based on historical records.
   2. Analyze the root causes of delays, such as raw material delays or machine breakdowns.

b. FCFS Method Evaluation:
   1. Comparing the performance of the FCFS method with alternative methods (SPT, LPT, EDD) using four criteria:
      - Average completion time.
      - Utilization of production facilities.
      - Average number of jobs in the system.
      - Average delay.

c. The calculation is done using the Critical Ratio (CR) formula and comparative table analysis.

4. Results and Discussion

In carrying out the production process, there are factors that inhibit the production process, including the elements of management itself. The following are the elements of management: *Man, Money, Materials, Machines, Methods* .

From the five elements above, the researcher found the causes of delays in the production process that often occur in the company, namely the first in Machines (Machines) this obstacle may be quite familiar in other companies that occur in the production process, because there is a lack of checking and maintenance on the machine this can cause damage to the machine. The second problem of the cause of delays in the production process is in Materials (Raw Materials) this occurs due to delays in ordering raw materials and running out of stock of raw materials in the company of raw materials needed such as thread etc. According to research, the main cause that often occurs and causes delays in the production process at CV. Unit Clean Industri is the raw material itself.

In the interview conducted by the researcher and admin that the scheduling carried out at CV. Unit Clean Industri is to adopt the Sequencing system . Where in this sequencing system is based on priority, namely there are 4 (four) the first FCFS (First Come First Served), SPT (Short Processing Time), EDD (Earlist Due Date) and LPT (Long Processing Time).

Table 1 Sample of Production Process Scheduling CV. Clean Industry Unit

Pesanan	Waktu Pesan	Waktu Jadi	Jumlah (keseluruhan)	WDR
P1	4 November 2019	10 November 2019	700	5
P2	6 November 2019	10 November 2019	2500	3
P3	16 November 2019	20 November 2019	3000	3
P4	20 November 2019	29 November 2019	1000	8

Information:
P1-P4 = Orders
WDR = Work Days Remaining

Based on the CV Unit Clean Industry order data table as of November 2019, the Critical Ratio (CR) can be calculated as follows:

$$CR = \frac{Time\ Remaining\ (TR)}{Work\ Time\ Remaining\ (WR)}$$

$$CR = \frac{Due\ Data - Today\ Data}{Lead\ Time\ Remaining}$$

Orders A Critical Ratio = (Due date – Now)/ Work days Remaining
= (4November2019 – 10 November 2019)/5
= 7 days TR / 5 days WR
= 1,4

Pesanan B Critical Ratio = (Due date – Now)/ Work days Remaining
= (6November 2019 – 10 November 2019)/3
= 5 days TR / 3 days WR
= 1,67

Pesanan C Critical Ratio = (Due date – Now)/ Work days Remaining
= (16November 2019 – 20 November 2019)/3
= 5 days TR / 3 days WR
= 1,67

Pesanan D Critical Ratio = (Due date – Now)/ Work days Remaining
= (20November 2019 – 29 November 2019)/8
= 10 days TR / 3 days WR
= 3,33

The results of the Critical Ratio calculation above can be concluded as follows:

Table 2 CR Calculation

Pesanan (Produk)	Critical Ratio (CR)	Urutan Prioritas
P1	(4-10)/5=1,4	1
P2	(6-10)/3=1,67	2
P3	(16-20)/3=1,67	3
P4	(20-29)/8=3,33	4

Based on the order data that has been obtained and calculated in the order table and CR, the next step is to calculate the average completion time, utility, average work time and delays using the formula calculation below as follows.

1) First Come First Served (FCFS)

Table 3 Sample Calculation Using FCFS Method

Urutan Pekerjaan	Waktu Pemrosesan (Hari)	Aliran Waktu (Hari)	Batas Waktu Pekerjaan (Hari)	Keterlambatan (Hari)
(1)	(2)	(3)	(4)	((3)-(4))
P1	5	5	7	0
P2	3	8	5	3
P3	3	11	5	6
P4	8	19	10	9
	19	43	27	18

Average completion time = 43/4 = 10.75 Days i
Utility = 19/43 = 44.18%
Average number of jobs = 43/19 = 2.26 jobs
Average delay = 18/4 = 4.5 days

2) SPT (Short Processing Time)

Table 4 Sample Calculation Using SPT Method

Urutan Pekerjaan	Waktu Pemrosesan (Hari)	Aliran Waktu (Hari)	Batas Waktu Pekerjaan (Hari)	Keterlambatan (Hari)
(1)	(2)	(3)	(4)	((3)-(4))
P1	5	5	7	0
P2	3	8	5	3
P3	4	12	5	7
P4	9	21	10	11
	21	46	27	21

Average completion time = 4 6/4 = 11.5 Days
Utility = 21/46 = 45.65%
Average number of jobs = 4 6/21 = 2.19 jobs
Average delay = 21/4 = 5.25 days

3) LPT (Long Processing Time)

Table 5 Sample Calculation Using LPT Method

Urutan Pekerjaan	Waktu Pemrosesan (Hari)	Aliran Waktu (Hari)	Batas Waktu Pekerjaan (Hari)	Keterlambatan (Hari)
(1)	(2)	(3)	(4)	((3)-(4))
P3	3	3	5	0
P4	9	12	10	2
P1	5	17	7	10
P2	3	20	5	15
	20	52	27	27

Average completion time = 52/4 = 14 Days
Utility = 2 0/52 = 38.46%
Average number of jobs = 52/20 = 2.6 jobs
Average delay = 2 4/7 = 3.4 days

4) EDD (Early Due Date)

Table 6 Sample Calculation Using EDD Method

Urutan Pekerjaan	Waktu Pemrosesan (Hari)	Aliran Waktu (Hari)	Batas Waktu Pekerjaan (Hari)	Keterlambatan (Hari)
(1)	(2)	(3)	(4)	((3)-(4))
P1	5	5	7	0
P2	4	9	5	4
P3	3	12	5	7
P4	8	20	10	10
	20	46	27	21

Average completion time = 46/4 = 11.5 Days
Utility = 2 0/46 = 43.47%
Average number of jobs = 46/2 0 = 2.3 jobs

Average delay = 21/4 = 5.25 days

From the calculation of the effectiveness measurement of the FCFS (First Come First Served) method carried out by researchers by comparing or discussing other methods in it. Then conclusions can be drawn and data is presented in the form of a sequencing method effectiveness table.

Table 7 Comparison of 4 Methods

METODE	Waktu penyelesaian rata-rata (Hari)	Utilitas (porsentase)	Jumlah Pekerjaan rata-rata (Hari)	Keterlambatan pekerjaan rata-rata (Hari)
FCFS	10,75	44,18	2,26	4,5
SPT	11,5	45,65	2,19	5,25
LPT	13	38,46	2,6	6,75
EDD	11,5	43,47	2,3	5,25

Based on table 4.11 above, it can be concluded that CV. Unit Clean Industry is correct in using the FCFS (First Come First Served) method. This can be seen from the review that is in accordance with the theory of production scheduling criteria consisting of four. The scheduling criteria consisting of four are:

a. Minimize turnaround time.

The first criterion is minimizing the completion time, this criterion is evaluated by determining the average completion time for each job. This can be seen in the calculation table of the four methods, namely FCFS (First Come First Served) has an average completion time of 10.75 days, the SPT (Short Processing Time) method with a completion time of 11.5 days, the LPT (Long Processing Time) method with an average completion time of 13 days and EDD (Earlist Due Date) with an average completion time of 11.5 days. It can be concluded that CV. Unit Clean Industry has entered the right scheduling criteria with the smallest completion time of 10.75 days.

b. Maximizing utilization.

The second criterion is this criterion is evaluated by calculating the percentage of time a facility is used. According to the data above, the percentage of FCFS (First Come First Served) Utilization is 44.18%, SPT (Short Processing Time) is 45.65%, LPT (Long Processing Time) is 38.46% and EDD (Earlist Due Date) is 43.47%. With the data obtained, FCFS and SPT have almost the same or close percentages. However, FCFS is still considered to have the highest percentage even though it is ranked no. 2 after SPT (Short Processing Time).

c. Minimize the inventory time of semi-finished goods (work in process – WIP).

The third criterion is this criterion is evaluated by determining the average number of jobs in the system. The relationship between the number of jobs in the system and WIP inventory will be high. Therefore, if there are fewer jobs in the system, then the existing inventory is lower. The average number of jobs by looking at the data available above the FCFS method has a count of 2.26. This is considered good for CV. Clean Industry Unit by considering other things as well before.

d. Minimize customer waiting time.

The last criterion is this criterion is evaluated by determining the average amount of delay. In minimizing the average delay, the most suitable method to use is the FCFS (First Come First Served) method with the smallest delay of 4.5 days, the SPT (Short Processing Time) method of 5.25 days, the LPT (Long Processing Time) method of 6.75 days and EDD (Earlist Processing Time) of 5.25 days.

In accordance with the scheduling criteria above, it can be concluded that the FCFS method used by CV. Clean Industry Unit has the first effectiveness among the four methods in the priority rule. With an average completion time of 10.75 days with a utility percentage of 44.18% and an average

number of jobs of 2.26 jobs with an average job delay of 4.5 days, the smallest of the four other methods.

5. Conclusion

The delay in the production process that occurred at CV. Clean Industry Unit is located in one of the elements of management itself. The elements of management in the production process itself are known to be 5, namely man (human resources), money (capital), materials (raw materials), machines (machines) and methods (methods). After conducting research, the delays that occurred were due to 2, namely machines and raw materials. However, the main delay occurred due to raw materials that often arrived late.

The effectiveness of the FCFS (*First Come First Served*) method in the application of the production process at CV. Clean Industry Unit according to the results of data processing shows that the FCFS method applied at CV. Clean Industry Unit has an average completion time of 10.75 days and has a utility percentage of 44.18%. Has an average number of jobs of 2.26 jobs with an average delay of 4.5 days. Based on these data, the FCFS method can be said to have quite good effectiveness because the average completion time and average delay time are the lowest among the other four methods, while the average number of jobs and utility percentage are still slightly higher than the SPT method. Therefore, the effectiveness of the FCFS method can be said to be quite good compared to other methods.

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