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APPLICATION OF NON-PREEMPTIVE PRIORITY SCHEDULING METHOD FOR WORK ORDER SCHEDULING SYSTEM

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Abstract— Work order allocation is one of the problems experienced by PT Indomobil Trada Nasional. Companies need tools to make it easier to allocate work orders effectively, namely an optimal work order scheduling system. Work order allocation data for the last three months was 3,817, with 15 technicians. This work order exceeds the company's target, namely to have a difference of 1.2 work orders per technician daily. These work orders have a priority order in their processing. The work order scheduling method used in this research is the non-preemptive priority scheduling method. The non-preemptive priority scheduling method is used because it can determine which work orders are in the queue and ready to be allocated according to the priority order without disturbing work orders that are being worked on when new work orders arrive. The work order scheduling system that was built provides adequate scheduling time and produces a smaller average waiting time, namely 12.97 minutes. The average waiting time in the scheduling system without priority non-preemptive scheduling is 52.18, and the difference in average waiting time for the 34 existing work orders is 39.12 minutes. Applying the non-preemptive priority scheduling method helps companies allocate work orders optimally.

Keywords*: allocation, non-preemptive scheduling, priority scheduling, scheduling, work orders.*

Intisari- *Alokasi work order merupakan salah satu permasalahan yang dialami oleh PT Indomobil Trada Nasional. Perusahaan memerlukan alat untuk mempermudah dalam mengalokasikan work order secara efektif, yaitu sistem penjadwalan work order yang optimal. Data alokasi work order selama tiga bulan terakhir sebanyak 3817, dengan jumlah teknisi 15 orang. Work order ini melebihi target perusahaan yaitu memiliki selisih 1.2 work order per teknisi setiap harinya. Work order tersebut memiliki urutan prioritas dalam pengerjaannya. Metode penjadwalan work order yang digunakan dalam penelitian ini adalah metode priority scheduling non preemptive. Metode priority scheduling non preemptive digunakan karena dapat menentukan work order manakah yang ada di antrian dan siap untuk dialokasikan sesuai dengan urutan prioritas work order tanpa menggangu work order yang sedang dikerjakan pada saat ada work order yang baru datang. Sistem penjadwalan work order yang dibangun memberikan waktu penjadwalan yang efektif dan menghasilkan average waiting time yang lebih kecil yaitu 12.97 menit. Average waiting time pada sistem penjadwalan tanpa priority scheduling non preemptive 52.18, selisih average waiting time dari 34 work order yang ada didapatkan sebesar 39.12 menit. Penerapan metode priority scheduling non preemptive sangat membantu perusahaan dalam mengalokasikan work order secara optimal.*

Kata Kunci*:* alokasi, penjadwalan, *priority scheduling, priority scheduling non preemptive, work order*.

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INTRODUCTION

PT Indomobil Trada Nasional is an authorized dealer for Nissan and Datsun brand vehicles. This company operates in the automotive sector and provides three primary services: Sales, Service, and Spare Parts. There are several business processes in the service workshop section, one of which is processing vehicle service work orders[1]. A work order is an order for a vehicle service job in the form of a printed document created by the service advisor, which the job controller allocates to the technician to be carried out. The job controller is allocating work orders to technicians. There are 16 priority orders in work orders, as shown in Table 1, and each work order created by the service advisor every day has a different priority order according to its criteria. Four criteria are used: arrival time, queue status, processing time, and vehicle status. Work orders can be carried out based on a predetermined routine schedule or work requests & failure reports previously submitted [2].

Work order data from the last three months at PT Indomobil Trada Nasional reached 3817 work orders. The total number of technicians at PT Indomobil Trada Nasional is 15 technicians. If you average the total work orders and the number of technicians available, then the average work order carried out by each technician per day reaches 3.7 work orders. This data is quite large when compared to the target given by the company, namely only 2.5 work orders per technician every day, and This creates a problem, namely the difficulty of the job controller in allocating existing work orders optimally according to the priority order of work orders and the availability of technicians who will work on them. These difficulties can hamper allocating work orders so that the waiting time for the work order to be carried out becomes longer and results in wasted technician time while waiting for the allocation of work orders. Apart from that, this also results in reduced customer satisfaction and company losses.

Work order scheduling is needed to help make it easier to allocate work orders. Scheduling is allocating existing resources or machines to carry out tasks within a specific period [3][4]. This research aims to apply a non-preemptive priority scheduling algorithm to the work order scheduling information system, which can optimize work order processing at PT Indomobil Trada Nasional. The non-preemptive priority scheduling method can determine which processes in the queue are ready to be executed following the priority order without disrupting ongoing processes when new processes arrive [5][6]. Process scheduling is a collection of policies and mechanisms in the operating system related to the computer system's sequence of work [7]. Scheduling decides which processes must run, when, and how long they run[8][9][10]. The scheduling can be done more optimally by applying a computational model so that response time is faster [11].

In scheduling, there are two scheduling strategies: 1) Non-preemptive scheduling, namely, when the processor gives a process a time allotment, then another process cannot take over the processor until the process is complete [11]. 2) Preemptive scheduling, namely when a process is given a time slot by the processor, then the processor can be taken over by another process so that the process is interrupted before it is finished and must continue waiting for the processor's time slot to arrive again for that process[12][5][13].

Based on this scheduling strategy, there are several scheduling algorithms: 1) Non-preemptive scheduling, including First In, First Out (First Come, First Serve), Shortest Job First, Highest Ratio Next, Priority Scheduling, and Multiple Feedback Queue. 2) Preemptive scheduling, including Round Robin, Shortest Remaining First, Priority Scheduling, and Guaranteed Scheduling[5]. Things considered when preparing a schedule are completion time and limit flow time, which is the sequence of activities, including waiting time and processing time. Proper scheduling will achieve optimal goals by meeting all constraints[14].

Non-Preemptive Scheduling

Non-preemptive scheduling is a scheduling strategy in which the processing system never performs a context switch from one running process to another. The ongoing process cannot be interrupted[15]. Non-preemptive scheduling occurs when there are two conditions, namely: 1) The process only runs from the running state to the waiting state, and 2) The process is stopped[5][12][14].

Referring to several previous studies, it can be concluded that the process cannot be stopped before the process is completed using the non-preemptive scheduling method. This principle is relevant for work order scheduling at the PT Indomobil Trada Nasional Nissan Datsun Pajajaran Bogor branch. Work order scheduling is determined based on the priority order of the work order, as shown in Table 1.

Priority Scheduling Algorithm

Priority scheduling is a priority scheduling algorithm. Each process has a priority number (the smallest integer value is usually the most significant

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priority). Work prioritizes the processes that have the greatest priority. If several processes have the same priority, the First Come First Served Scheduling (FCFS) algorithm will be used [16][17].

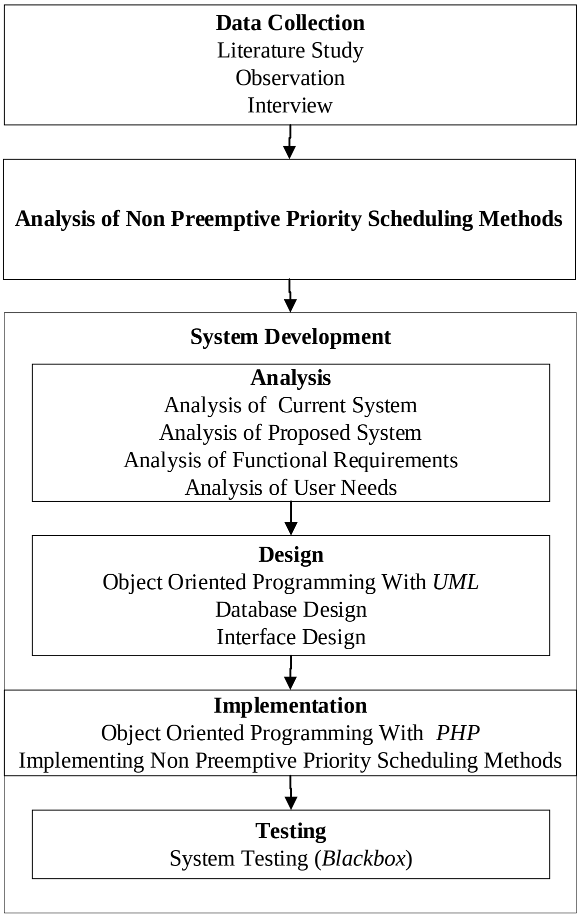
The problem of priority scheduling can be run preemptively or non-preemptively. In preemptive, if a newly arrived process has a higher priority than the currently running process, the currently running process is stopped and then redirected to the newly arrived process. Meanwhile, in non-preemptive, newly arrived processes cannot interfere with presently running processes but are only placed at the front of the queue [18][19]. If a process P1 arrives while P0 is running, it will see the priority of P1. If the priority of P1 is greater than the priority of P0, then in non-preemptive mode, the algorithm will still complete P0 until it is finished and put P1 in the head queue position. If there are the same priorities, the process that comes first is done first / First in, out (FIFO)[19].

MATERIALS AND METHODS

The waterfall model is the system development method applied in this research [20]. The steps taken refer to the waterfall model shown in Figure 1.

Data collection

Data collection was carried out through observation and interviews. Observations were conducted directly at the PT Indomobil Trada Nasional Nissan Datsun Pajajaran Bogor branch. The interview was conducted with the question and answer of Anjar Ramdani, the job controller of PT Indomobil Trada Nasional Nissan Datsun Pajajaran Bogor branch. Interviews are conducted to understand ongoing business processes. At this stage, work order data for three months is obtained, as shown in Table 2, technician data, and work order priority data in Table 1.



Source: (Research Results, 2024)
Figure 1. Research Methods

Table 1. Work Order Priority Order

Order of Priority	Arrival Time		Queque Status		Processing Time		Vehicle Status	
	Erlier	Slower	Appoinment	Non Appoinment	Shorter	Longer	Awaited	Left
1	√		√		√		√	
2	√		√		√			√
3	√		√			√	√	
4	√		√			√		√
5	√			√	√		√	
6	√			√	√			√
7	√			√		√	√	
8	√			√		√		√
9		√	√		√		√	
10		√	√		√			√
11		√	√			√	√	
12		√	√			√		√
13		√		√	√		√	
14		√		√	√			√
15		√		√		√	√	
16		√		√		√		√

Source: (Research Results, 2024)

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Analysis of Non-Preemptive Priority Scheduling Methods

In the non-preemptive priority scheduling method, newly arrived processes cannot interfere with ongoing processes but are only placed at the front of the queue. The calculation analysis of the non-preemptive priority scheduling method consists of 5 stages consisting of:

1. Determine the priority order for each work order according to the priority order presented in Table 1. The work order with the smallest integer value will be carried out first.
2. Plot the allocation of work orders to technicians according to the number of technicians available based on priority order.
3. Determine the allocation of the following work order available in the queue to technicians who have finished working on the previous work order.
4. Calculating the waiting time for each work order, namely by calculating the difference between start time minus arrival time, the waiting time formula is shown in equation 1.
   $(Wt = St - At)$ (1)
5. Calculating the average waiting time for work orders, namely by dividing the total waiting time for all work orders by the number of work orders.
   $(AWt = \sum Wt : P)$ (2)

The system development

The system development stages start with analyzing requirements, designing, implementing, and testing the system.

1. Analysis

At this stage, several stages are carried out, including:

a. Identify work order scheduling problems by studying ongoing business processes at PT Indomobil Trada Nasional.
b. Understand the existing scheduling system using data collection techniques: observation, interviews with Mr. Anjar Ramdani as job controller, and taking work order samples.
c. Analyze research results to determine system weaknesses and user needs in the work order scheduling system.

2. System Design

The system design stage was carried out using an object-oriented design (OOD) approach described using unified modelling language (UML) version 2.5. The UML diagrams used include use case, activity, sequence, class, and deployment diagrams. Apart from that, database design and interface design are also carried out at this stage.

3. Implementation (Coding)

The design results are implemented through object-oriented programming using PHP at this stage. A non-preemptive priority scheduling method is implemented at this stage by executing a scheduling system in the program unit.

4. System Testing

At this stage, system testing uses the black box method to ensure the input produces appropriate output. System testing is also done to test the system's functionality by validating the system's results when a command is executed.

RESULTS AND DISCUSSION

Analysis of Non-Preemptive Priority Scheduling Methods

The analysis of the non-preemptive priority scheduling method consists of four stages: determining the work order priority order, work order allocation, calculating the waiting time for work orders, and calculating the average waiting time for work orders. The work order data used in the research is shown in Table 2.

Table 2. Work Order Data

No	No. Work Order	Arrival Time (At)	Burst Time (hour)	Queue Status	Vehicle Status
1	1783	8:10	3.08	Appoinment	Awaited
2	1784	8:40	1.33	Appoinment	Awaited
3	1785	8:40	2.33	Non Appoinment	Left
4	1786	8:40	0.25	Appoinment	Awaited
5	1790	9:25	3.00	Non Appoinment	Awaited
.....	....	....	....	....	....
.....	....	....	....	....	....
.....	....	....	....	....	....
30	8343	10:55	0.75	Non Appoinment	Left
31	8344	10:55	0.42	Non Appoinment	Awaited
32	8346	11:13	0.50	Non Appoinment	Left
33	8347	13:29	0.50	Non Appoinment	Awaited
34	8348	8:10	2.25	Non Appoinment	Awaited

Source: (Research Results, 2024)

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Determining Work Order Priority Order

The results of determining work order priorities using the non-preemptive priority scheduling method are presented in Table 3.

Table 3 shows that work order number 8322 has the first priority order, work order number 8321 has the second priority order, and so on. Meanwhile, the final priority order is in work order number 8347.

Table 3. Results of Determining Work Order Priorities Using the Non-Preemptive Priority Scheduling Method

No	No. Work Order	Arrival Time (At)	Burst Time (hour)	Queue Status	Vehicle Status	Order of Priority
1	8322	7:40	0.17	Appoinment	Awaited	1
2	8321	7:40	0.83	Non Appoinment	Awaited	2
3	8334	8:10	0.33	Appoinment	Awaited	3
4	8327	8:10	1.42	Appoinment	Awaited	4
5	1783	8:10	3.08	Appoinment	Awaited	5
.....	....	....	....	....	....	....
.....	....	....	....	....	....	....
.....	....	....	....	....	....	....
30	8344	10:55	0.42	Non Appoinment	Awaited	30
31	8343	10:55	0.75	Non Appoinment	Left	31
32	8346	11:13	0.50	Non Appoinment	Left	32
33	1793	13:08	0.50	Non Appoinment	Left	33
34	8347	13:29	0.50	Non Appoinment	Awaited	34

Source: (Research Results, 2024)

Work Order Allocation

The results of work order allocation without the non-preemptive priority scheduling method are presented in Table 4 and Figure 2. Based on Table 4, 34 work orders were allocated to 13 technicians, but the allocation did not follow the priority order. Some technicians received work orders with lower priority earlier than those with higher priority. This inefficient allocation resulted in increased waiting times and idle periods for certain technicians, reducing overall operational efficiency. Figure 2 illustrates the idle time for each technician before being allocated a work order, highlighting the gaps in productivity caused by the lack of a structured priority system. From these observations, it can be concluded that work order allocation without the non-preemptive priority scheduling method is not well managed and is not optimal.

Meanwhile, work order allocation using the non-preemptive priority scheduling method is shown in Table 5 and Figure 3. Based on Table 5, 34 work orders were allocated to 13 technicians following the priority order. Each technician was assigned tasks in accordance with their priority level, ensuring that high-priority work orders were completed first. This structured approach significantly reduced idle time and minimized unnecessary waiting periods.

Table 4. Allocation of Work Orders without the Non-Preemptive Priority Scheduling Method

No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (hour)	Start Time (St)	Technician	Order of Priority
1	B1083KVJ	8321	7:40	0.83	8:10	Imam	2
2	DD1171LB	1783	8:10	3.08	8:15	Sunjay	3
3	F1649DG	8326	8:11	2.75	8:15	Huda	8
4	F1851AK	8327	8:10	1.42	8:20	Dede	5
5	F1504PH	8323	8:25	0.42	8:25	Miyanto	10
10	F1466EM	8322	7:40	0.17	8:50	Danis	1
.....	....	....	....	....	....	....	.....
.....	....	....	....	....	....	....	.....
.....	....	....	....	....	....	....	.....
30	F1804AN	8348	8:10	2.25	11:45	Adit	7
31	D1550UAD	8340	10:40	0.50	13:00	Danis	27
32	F1085HS	8344	10:55	0.42	13:30	Dede	30
33	F1766AD	1793	13:08	0.50	13:30	Syaiful	33
34	B1045EKF	8347	13:29	0.50	13:30	Yoga	34

Source: (Research Results, 2024)

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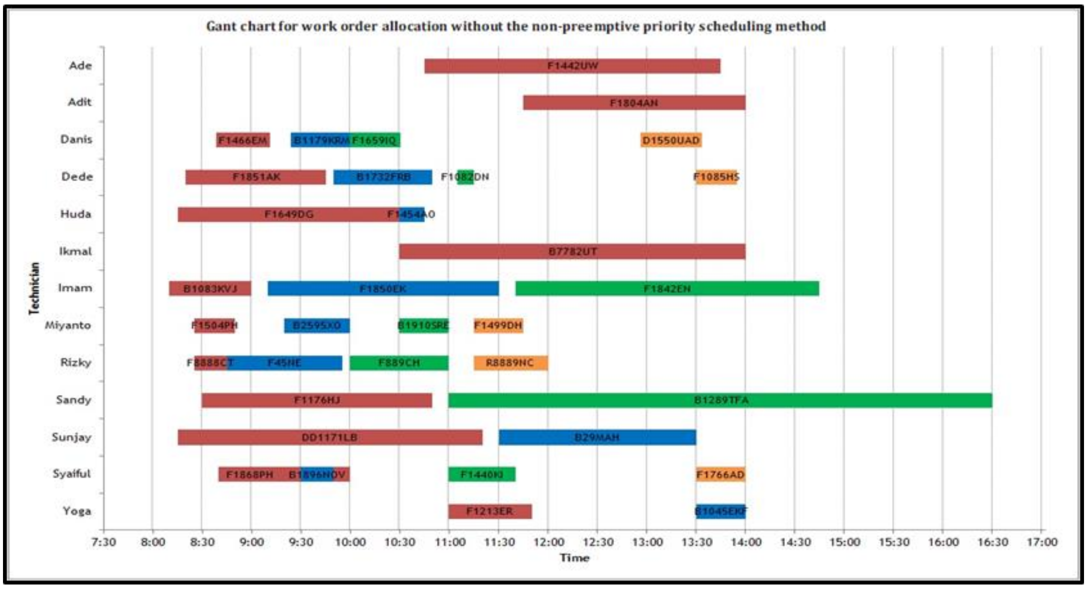
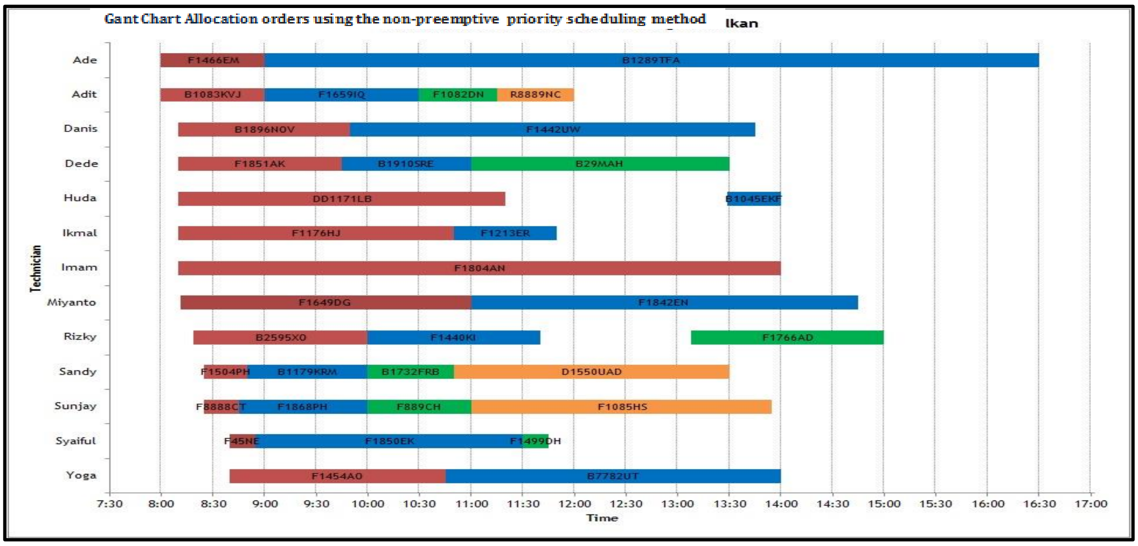


Source: (Research Results, 2024)
Figure 2. Gant Chart for Work Order Allocation without the Non-Preemptive Priority Scheduling Method

Table 5. Allocation of Work Orders Using the Non-Preemptive Priority Scheduling Method

No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (hour)	Start Time (St)	Technician	Order of Priority
1	F1466EM	8322	7:40	60.00	8:00	Ade	1
2	B1083KVJ	8321	7:40	60.00	8:00	Adit	2
3	B1896NOV	8334	8:10	100.00	8:10	Danis	3
4	F1851AK	8327	8:10	95.00	8:10	Dede	4
5	DD1171LB	1783	8:10	190.00	8:10	Huda	5
.....	....	....	....	....	....	....	.....
.....	....	....	....	....	....	....	.....
.....	....	....	....	....	....	....	.....
30	F1085HS	8344	10:55	175.00	11:00	Sunjay	30
31	R8889NC	8343	10:55	45.00	11:15	Adit	31
32	F1499DH	8346	11:13	15.00	11:30	Syaiful	32
33	F1766AD	1793	13:08	112.00	13:08	Rizky	33
34	B1045EKF	8347	13:29	31.00	13:29	Ikmal	34

Source: (Research Results, 2024)



Source: (Research Results, 2024)
Figure 3. Work Order Allocation Using the Non-Preemptive Priority Scheduling Method

Figure 3 shows the 13 work orders with the highest priority and immediately carried out by the 13 available technicians. The start time (St) for the 13 work orders is the same as the arrival time (At), so the waiting time (Wt) for the 13 work orders is 0 (zero) minutes.

Work order number 1784 (14th priority order) is allocated to Sunjay because Sunjay has the fastest completion time. But even though the arrival time (At) is 8:40, work order no. 1784 will still be carried out when Sunjay has finished working on work order no. 8324, namely at 8:45, because Sunjay cannot be interrupted to work on the following work order (non-preemptive), so the waiting time (Wt) for work order no. 8324 is 5 minutes.

Work order no. 8332 (15th priority order) was allocated to Sandy. However, even though the arrival time (At) is 8:40, work order no. 8332 will still be carried out when Sandy has finished working on work order no. 8323, namely at 8:50, because Sandy cannot be interrupted to carry out the following work order (non-preemptive), so the waiting time (Wt) for work order no. 8332 is 10 minutes

Work order no. 1785 (16th priority order) was allocated to Syaiful. But even though the arrival time (At) is 8:40, work order no. 1785 will still be carried out when Syaiful has finished working on work order no. 8329, namely at 8:55, because Syaiful cannot be interrupted to work on the following work order (non-preemptive), so the waiting time (Wt) for work order no. 1785 is 15 minutes.

Work order no. 8330 (17th priority order) was allocated to Ade. But even though the arrival time (At) is 8:40, work order no. 8330 will still be carried out when Ade has finished working on work order no. 8322, namely at 9:00, because Ade cannot be interrupted to work on the following work order (non-preemptive), so the waiting time (Wt) for work order no. 8330 is 20 minutes.

Work order no. 8331 (18th priority order) was allocated to Adit. But even though the arrival time (At) is 8:41, work order no. 8331 will still be carried out when Adit has finished working on work order no. 8321, namely at 9:00, because Adit cannot be interrupted to work on the following work order (non-preemptive), so the waiting time (Wt) for work order no. 8331 is 19 minutes.

Work order no. 8333 (19th priority order) was allocated to Dede. But even though the arrival time (At) is 8:50, work order no. 8333 will still be carried out when Dede has finished working on work order no. 8327, namely at 9:45, because Dede cannot be interrupted to work on the following work order (non-preemptive), so the waiting time (Wt) for work order no. 8333 is 55 minutes.

Work order no. 1793 (33rd priority order) was allocated to Rizky. Work order no.1793 will be carried out immediately according to the arrival time (At) at 13:08, so the waiting time (Wt) for work order no.1793 is 0 (zero) minutes. But Rizky has 28 minutes of idle time because Rizky has finished working on the previous work order, namely work order no. 8336 at 11:40.

Work order no. 8347 (34th priority order) is the last work order carried out. Work order no.8347 will be carried out immediately according to the arrival time (At) by Ikmal at 13:29, so the waiting time (Wt) for work order no.8347 is 0 (zero) minutes. But Ikmal has 39 minutes of idle time because Ikmal has finished working on the previous work order, namely work order no. 1792 at 11:50.

Based on the work order allocation in Figure 3, all technicians work on the following work order when they have finished working on the previous work order, except for Rizky and Huda, who will work on work order no. 1793 and work order no. 8347 because of the arrival time (At) of both works. This order was slower than Rizky and Huda's completion time when they finished working on the previous work order. Work order no. 8347 was not allocated to Ikmal and Syaiful because they had worked on more than 1 work order, while Huda had only worked on 1 work order. From the observations from Table 5 and Figure 3, it can be concluded that the allocation of work orders using the non-preemptive priority scheduling method has been managed well and optimally.

Calculation of Waiting Time Work Orders

The results of the waiting time (Wt) work order calculation on the running system (without the non-preemptive priority scheduling method) and the work order waiting time (Wt) calculation on the proposed system (with the non-preemptive priority scheduling method) are described as follows. The results of the Waiting Time (Wt) Work Order calculation without using the non-preemptive priority scheduling method are shown in Table 6.

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Table 6. Results of Calculating Waiting Time (Wt) For Work Orders without Non-Preemptive Priority Scheduling

No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (hour)	Start Time (St)	Waiting Time (Wt)	Technician	Order of Priority
1	B1083KVJ	8321	7:40	0.83	8:10	30	Imam	2
2	DD1171LB	1783	8:10	3.08	8:15	5	Sunjay	3
3	F1649DG	8326	8:11	2.75	8:15	4	Huda	8
4	F1851AK	8327	8:10	1.42	8:20	10	Dede	5
5	F1504PH	8323	8:25	0.42	8:25	0	Miyanto	10
.....	....	....	....	....	....	....	.....	....
.....	....	....	....	....	....	....	.....	....
.....	....	....	....	....	....	....	.....	....
30	F1804AN	8348	8:10	2.25	11:45	215	Adit	7
31	D1550UAD	8340	10:40	0.50	13:00	140	Danis	27
32	F1085HS	8344	10:55	0.42	13:30	155	Dede	30
33	F1766AD	1793	13:08	0.50	13:30	22	Syaiful	33
34	B1045EKF	8347	13:29	0.50	13:30	1	Yoga	34

Source: (Research Results, 2024)

From Table 6, we get different waiting time (Wt) work order results depending on arrival time (At) and start time (St). The smallest waiting time (Wt) results for work orders, namely 0 (zero) minutes, are in work order no. 8323, work order no. 8324 and work order no. 1784. Meanwhile, the enormous waiting time (Wt) for work orders, 215 minutes, was for work order no. 8348.

The results of the Waiting Time (Wt) Work Order calculation using the non-preemptive priority scheduling method are shown in Table 7.

From Table 7, the results of waiting time (Wt) for work orders are different depending on arrival time (At) and start time (St). The minor work order waiting time (Wt) results, namely 0 (zero) minutes, were found in 12 work orders, including no. 8334, work order no. 8327 and work order no. 8329. Meanwhile, the enormous waiting time (Wt) for work orders, namely 55 minutes, was for work order no. 8333. From the results of observations from Table 6 and Table 7, it can be concluded that the waiting time (Wt) for work orders using the non-priority scheduling method preemptive in the proposed system is smaller than the waiting time (Wt) in the system currently running, which has a difference of 1333 minutes.

Table 7. Results of Waiting Time (Wt) Work Order Calculations with Non-Preemptive Priority Scheduling

No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (hour)	Start Time (St)	Waiting Time (Wt)	Technician	Order of Priority
1	F1466EM	8322	7:40	60.00	8:00	20	Ade	1
2	B1083KVJ	8321	7:40	60.00	8:00	20	Adit	2
3	B1896NOV	8334	8:10	100.00	8:10	0	Danis	3
4	F1851AK	8327	8:10	95.00	8:10	0	Dede	4
5	DD1171LB	1783	8:10	190.00	8:10	0	Huda	5
.....	....	....	....	....	....	....	.....	....
.....	....	....	....	....	....	....	.....	....
.....	....	....	....	....	....	....	.....	....
29	B29MAH	8342	10:49	150.00	11:00	11	Dede	29
30	F1085HS	8344	10:55	175.00	11:00	5	Sunjay	30
31	R8889NC	8343	10:55	45.00	11:15	20	Adit	31
32	F1499DH	8346	11:13	15.00	11:30	17	Syaiful	32
33	F1766AD	1793	13:08	112.00	13:08	0	Rizky	33
34	B1045EKF	8347	13:29	31.00	13:29	0	Ikmal	34

Source: (Research Results, 2024)

Calculation of Average Waiting Time for Work Orders

The results of the average waiting time (AWt) work order calculation on the running system are shown in Table 8, and the average waiting time (AWt) work order calculation on the proposed system is shown in Table 9.

Table 8 presents the results of the average waiting time (AWt) calculation without the non-preemptive priority scheduling method, where the total waiting time ($\sum$Wt) reaches 1,774 minutes, with an average of 52.18 minutes per work order. Some work orders experience long waiting times because they are not processed based on priority, making technician allocation less efficient.

Table 8. Results of Calculating Average Waiting Time (Awt) For Work Orders without Non-Preemptive Priority Scheduling

No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (hour)	Start Time (St)	Order of Priority	Waiting Time (Wt)	Average Waiting Time (AWt) (Minute)
1	B1083KVJ	8321	7:40	0.83	8:10	2	30	
2	DD1171LB	1783	8:10	3.08	8:15	3	5	
3	F1649DG	8326	8:11	2.75	8:15	8	4	
4	F1851AK	8327	8:10	1.42	8:20	5	10	
5	F1504PH	8323	8:25	0.42	8:25	10	0	
.....	....	....	....	....	....	....	.....	52.18
.....	....	....	....	....	....	....	.....	
.....	....	....	....	....	....	....	.....	
30	F1804AN	8348	8:10	2.25	11:45	7	215	
31	D1550UAD	8340	10:40	0.50	13:00	27	140	
32	F1085HS	8344	10:55	0.42	13:30	30	155	
33	F1766AD	1793	13:08	0.50	13:30	33	22	
34	B1045EKF	8347	13:29	0.50	13:30	34	1	

Source: (Research Results, 2024)

Table 9. Results of Calculating the Average Waiting Time (Awt) For Work Orders with Non-Preemptive Priority Scheduling

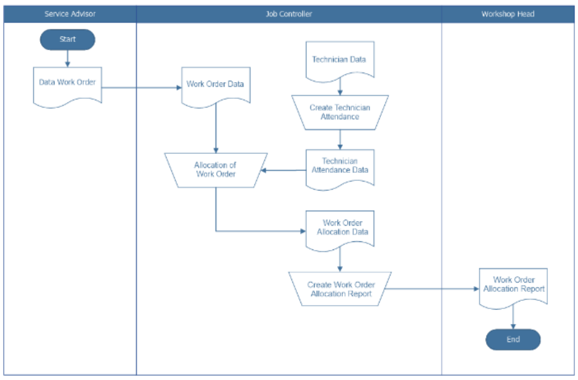
No	Vehicle Registration Number	No. Work Order	Arrival Time (At)	Burst Time (Hour)	Start Time (St)	Order of Priority	Waiting Time (Wt)	Average Waiting Time (AWt) (Minute)
1	F1466EM	8322	7:40	60.00	8:00	1	20	
2	B1083KVJ	8321	7:40	60.00	8:00	2	20	
3	B1896NOV	8334	8:10	100.00	8:10	3	0	
4	F1851AK	8327	8:10	95.00	8:10	4	0	
5	DD1171LB	1783	8:10	190.00	8:10	5	0	
.....	....	....	....	....	....	....	.....	
.....	....	....	....	....	....	....	.....	12.97
.....	....	....	....	....	....	....	.....	
30	F1085HS	8344	10:55	175.00	11:00	30	5	
31	R8889NC	8343	10:55	45.00	11:15	31	20	
32	F1499DH	8346	11:13	15.00	11:30	32	17	
33	F1766AD	1793	13:08	112.00	13:08	33	0	
34	B1045EKF	8347	13:29	31.00	13:29	34	0	

Source: (Research Results, 2024)

Meanwhile, Table 9 shows the results after applying the non-preemptive priority scheduling method. The total waiting time is reduced to 441 minutes, with an average of 12.97 minutes per work order. With this method, work orders are allocated according to their priority, significantly reducing waiting times. From the results of observations from Table 8 and Table 9, it can be concluded that the average waiting time (AWt) for work orders using the non-preemptive priority scheduling method in the proposed system is smaller than the average waiting time (AWt) in the system currently running; namely, there is a difference 39.21 minutes.

System Development

System development is carried out through 4 (four) stages, including system analysis, system design, system implementation, and system testing. The running system analysis is presented in the form of a flow chart. Analysis of the current system is carried out to identify document flow or information flow and procedures carried out in the current system. The flow chart of the running system is shown in Figure 4.



Source: (Research Results, 2024)

Figure 4. Analysis of the Running System

Figure 4 explains the flow of documents and their distribution in the work order allocation system, which involves three main actors: service

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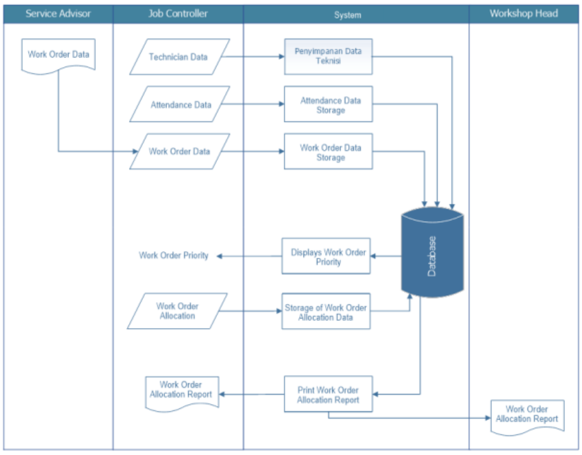
advisor, job controller, and workshop head. Apart from that, the flow chart also explains document processing procedures to obtain accurate information. The job controller records technician attendance and transactions based on field technician attendance data. This transaction is carried out manually via the work order allocation form. The technician's attendance data is used to create work order allocation transactions. In addition to technician attendance data, the job controller uses work order data from the service advisor to create work order allocation transactions.

Work order allocation data is obtained from the work order allocation transaction, and then the job controller creates a work order allocation report. The work order allocation report by the job controller is made in two copies, where sheet one is used as a warehouse archive, and sheet two is submitted to the workshop head. There is no work order scheduling process in the running system, and the job controllers have difficulty determining the optimal work order processing schedule.

Analysis of the Proposed System

The results of the proposed system analysis are depicted through the flow chart shown in Figure 5.



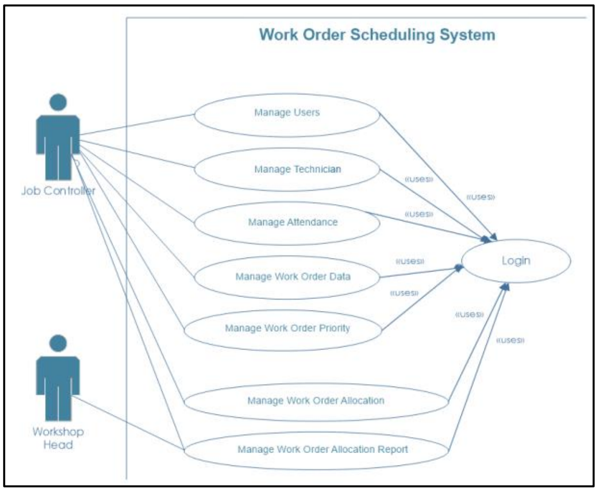
Source: (Research Results, 2024)
Figure 5. Analysis of the Proposed System

All transaction processes in the proposed system are computerized by inputting data and transactions. The data and transactions are then stored in a database so that access to information is faster and more accurate. The proposed system also involves a process of calculating work order priorities every day. Calculations are carried out every day to optimize the work order processing schedule. The calculations refer to work orders' priority and arrival time using the non-preemptive priority scheduling method.

The results of the work order priority calculations produced by the system can be displayed and used by the job controller to allocate work orders. The work order allocation that has been input into the system can be printed by the job controller or workshop head.

Use Case Diagram

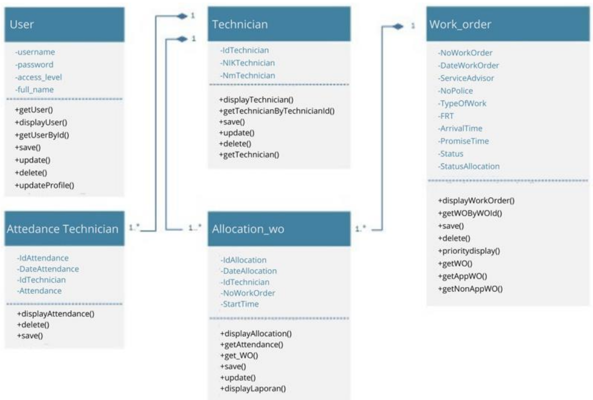
The developed system use case diagram is depicted from the actor and use case identification results. The use case diagram is shown in Figure 6.



Source: (Research Results, 2024)
Figure 6. Use Case Diagram

Class Diagram

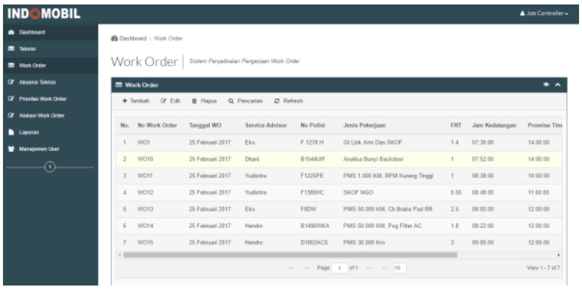
The class diagram of the system shown in Figure 7.



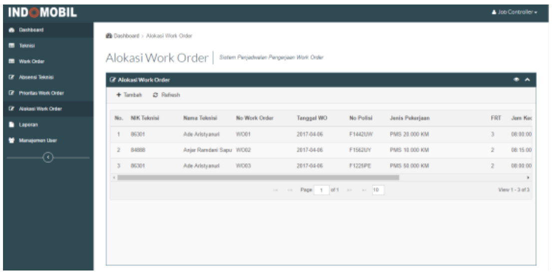
Source: (Research Results, 2024)
Figure 7. Class Diagram

System Implementation

System implementation is done by writing program source code using PHP programming. The result of the implementation is a work order scheduling system that consists of web pages. One of the implementation results is shown in Figure 8, namely the Implementation of the Work Order Page and the Implementation of the Work Order Allocation Page shown in Figure 9.



Source: (Research Results, 2024)
Figure 8. Implementation of the Work Order Page



Source: (Research Results, 2024)
Figure 9. Implementation of the Work Order Allocation Page

CONCLUSION

Using the non-preemptive priority scheduling method at PT Indomobil Trada Nasional, the work order scheduling system can help job controllers record work order allocation data. Optimize work order allocation more effectively. The system that was built is more effective because the average waiting time for processing work orders is smaller compared to the current system, which is a difference of 39.12 minutes from the 34 existing work orders. The system can provide information on the number of work orders carried out by technicians to see technician productivity. The system can support company management in determining the number of technicians.

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