



Fertilizer Loading Queue System Analysis at PT Meroke Tetap Jaya

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ABSTRACT

PT Meroke Tetap Jaya is a company which operates in fertilizer distribution and has many warehouses across many areas. The problem often faced by this company is the occurrence of a very long queue and frequent loading overtime, which results in reduced customer satisfaction. To avoid long queue, it is necessary to determine the number of servers and workforces. This sparks an interest in the researcher to analyze a type of queuing system called Single Channel Multi Phase at the company's warehouses. This research uses a queuing system method to analyze the amount and average time of queue as well as SPSS software to test the data distribution. Based on the results of the study, the calculation shows that the queue time for each truck is about 2 hours. To reduce the queuing time, consider increasing the number of workforces or modify the queuing system into Multi Channel Single Phase.



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1. Introduction

In the era of globalization, the demand for goods and services is very high. The high demand that exceeds the service capacity can cause a queue. This problem becomes the company's concern in product distribution. The company does not have the intention of slowing down the loading process because of a long queue that causes the service to not be optimal. To prevent the long queue, it is necessary to determine the number of servers and workforces to minimize the queuing time.

PT. Meroke Tetap Jaya operates as a fertilizer distribution company which has many warehouses across many areas such as, Medan, Palembang, Pekan baru, Jakarta and Surabaya. One of the warehouses is located at Jl.pulau nusa barung No.6 KIM 1 Medan and every day, there are many trucks from the customers that are waiting to be loaded from many areas. The warehouse at KIM 1 only has one server which handles administration process and weighing. PT Meroke Tetap Jaya only operates until 5 o'clock every day, whereas on certain hours, there is a long queue of loading trucks. Because every single truck that enters and exits must be weighed, no matter how much the amount of goods the truck is carrying. Besides the number of limited servers, the parking area and the entry and exit lanes of the warehouse isn't wide enough, also causes long queues and slow movements of the trucks.

Therefore, to prevent the problem related to the queue, a research is conducted where the suitable and efficient queuing system will be determined. Through this research, it is expected the company will be able to improve its service quality to be better.

2. Literature Review

In this literature review there are several references that researchers use to guide in conducting the following research.

1. According to F.A. Mukarrama, Nur'Eni, Fadryani (2017) research on single channel multi phase queues conducted by them aims to reduce and streamline queue times and taxpayer services in Palu city. After the research is seen the time required by a taxpayer in managing his tax is above 30 minutes which is not in accordance with the SOP made by samsat that is no more than 30 minutes. Through this research the conclusion they made is to reduce the length of service and the density of taxpayer queues, it can be improved by increasing the number of servers.
2. Zamzami, Yuvi Darmayunata, and Mariza Devega (2019) Research that analyzes the single channel-multiple phase queue system at puskesmas in Riau city. This study used Kolgo-morov-Smirnov to test the model fit and arrival rate, after which several patient samples were taken to be tested for service rate per phase. The results of the study can be concluded that the time it takes the patient to register takes about 5 minutes and does not include other service time. So that the service is more maximal at least the waiting time can be minimized.
3. Furqon ilhamsyah, Hery T Sutanto, Yuliani Puji A (2017) this study analyzes about truck loading queues at PT. Nestle, using SPSS 20 software to test the number of arrival times and services, and compares multiple server numbers to make the loading process more effective and not incur large operational costs. The results of this study showed the length of time the truck waited for the optimal loading process is not more than 4 hours and added 1 more server from the previous number of 2 servers to 3 servers.

3. Methodology

This research is conducted at PT. Meroke Tetap Jaya's warehouse in Medan. Data collecting and compiling is done by method as follows:

- Data Collecting
Primary data is collected by direct observation in the field. Whereas secondary data is collected from the internet and journals.
- Data Processing
After all the datas are collected, it is processed using SPSS software and calculation using the formula below.
 - Calculating truck arrival data

$$\lambda = \frac{t(\text{time of arrival})}{n}$$
 - Calculating truck service data

$$\mu = \frac{t(\text{time of service})}{n}$$
 - Level of facility service function

$$P_s = \frac{\lambda}{c\mu}$$
 - The average amount of customers on queue

$$Lq = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

- The average amount of customers in the system

$$Ls = \frac{\lambda}{\mu - \lambda}$$

- The average time of customers on queue

$$Wq = \frac{\lambda}{\mu(\mu - \lambda)}$$

- The average time of customers in the system

$$Ws = \frac{1}{\mu - \lambda}$$

4. Results and Discussion

Datas that are used are based on the researcher's observation and collected footage from the timespan of January 30th 2021 until February 6th 2021 and February 15th 2021 until February 19th 2021, at 8 am to 5pm.

Table 1. Service Data per Phase

NO	Day / Date	Arrival Time	Truck Unit(s)	Security Check (Second)	ADM Counter	Weigh In	Loading Process	Weigh Out
1	Saturday 30 Jan 2021	08.00 - 10.00	2	15	0:30	0:20	2:10	0:10
		10.00 - 12.00	3	37	0:45	0:30	4:28	0:15
		12.00 - 14.00	-					
		14.00 - 16.00	-					
2	Monday 01 Feb 2021	08.00 - 10.00	4	45	1:00	0:40	3:30	0:20
		10.00 - 12.00	2	20	0:30	0:20	2:35	0:10
		12.00 - 14.00	2	25	0:30	0:20	1:05	0:10
		14.00 - 16.00	5	53	1:15	0:50	3:33	0:25
3	Tuesday 02 Feb 2021	08.00 - 10.00	3	35	0:45	0:30	1:25	0:15
		10.00 - 12.00	1	10	0:15	0:10	0:42	0:05
		12.00 - 14.00	3	39	0:45	0:30	5:15	0:15
		14.00 - 16.00	4	46	1:00	0:40	5:02	0:20
4	Wednesday 03 Feb 2021	08.00 - 10.00	2	18	0:30	0:20	1:58	0:10
		10.00 - 12.00	1	13	0:15	0:10	2:13	0:05
		12.00 - 14.00	3	27	0:45	0:30	2:42	0:15
		14.00 - 16.00	4	38	1:00	0:40	4:30	0:20
5	Thursday 04 Feb 2021	08.00 - 10.00	1	15	0:15	0:10	0:40	0:05
		10.00 - 12.00	3	33	0:45	0:30	1:54	0:15
		12.00 - 14.00	1	20	0:15	0:10	1:18	0:05
		14.00 - 16.00	3	45	0:45	0:30	3:55	0:15
6	Friday 05 Feb 2021	08.00 - 10.00	2	25	0:30	0:20	2:33	0:10
		10.00 - 12.00	1	15	0:15	0:10	3:15	0:05
		12.00 - 14.00	2	28	0:30	0:20	2:42	0:10
		14.00 - 16.00	4	55	1:00	0:40	3:23	0:20

Based on the datas collected on January 30th 2021 until February 6th 2021 and February 15th 2021 until February 19th 2021, the number of truck arrivals are 110 units that were being loaded in the warehouse, with the total of 88 hours of arrival time, which means the average of the truck arrival time is $\lambda = \frac{88}{110} = 0,8$ hour/truck and the result from the test using SPSS software shows the distribution of poisson.

The data for truck service is collected from the amount of time from security check, payment queue at the counter, WB weighing and loading process. Based on the collected datas, the amount to service time for the trucks is 139,65 hours, which means the average time of service is $\mu = \frac{139,65}{110} = 1,27$ hour/truck and the result from the test using SPSS software shows normal distribution.

Based on direct observation and testing, the queuing system used for loading the goods, is Single Channel Multi Phase, meaning there's one channel with many stages, First Come First Serve, meaning who comes first gets served first, truck arrival and service distribution based on poisson and normal distribution and the unlimited source of truck arrivals. It can be concluded that the queuing model in this system is (M/G/I): (FCFS/ ∞/∞). This queuing model can be simulated with the condition that the system must be at steady state.

Therefore, a test is conducted, where, $P_s < 1$. Based on the calculation, the result of $P_s = \frac{0,8}{1,27} = 0,63 < 1$. This means the system is already in steady state condition. Below is the calculation results using the single channel multi phase formula.

Table2.Calculation Results using Single Channel Multi Phase

Server Amount (c)	Ps (Hour)	Lq (Hour)	Ls (Hour)	Wq (Hour)	Ws (Hour)	μ_1 (Hour)	μ_2 (Hour)	μ_3 (Hour)	μ_4 (Hour)	μ_5 (Hour)
1	0,63	1,07	1,70	2,09	2,12	0,003	0,25	0,17	1,15	0,08

Based on table 2, it can be seen that the average truck arrival (λ) is 0,8 hour/truck, meaning in less than 1 hour duration, there is an arrival of 1 truck and the average service time (μ) is 1,27 hour/truck, meaning the service from the moment the truck enters until it is loaded takes more than 1 hour. The average amount of trucks in the queue is 1 unit, the average amount of trucks in the system is 2 units, the average time of trucks waiting in queue is 2 hours and the average time of trucks waiting in the system is 2,1 hours. Whereas the average service time in each phase is 0,003 hours or about 0,18 minutes in security check (μ_1), 0,25 hours or about 15 minutes in administration service counter (μ_2), 0,17 hours or about 10 minutes in entry weighing process (μ_3), 1,15 hours or about 69 minutes in loading process (μ_4), and 0.08 hours or about 5 minutes in exit weighing process (μ_5). Therefore the time average needed to serve one truck since the time of arrival until finished is about 99 minutes.

5. Conclusion

Based on the discussion results, it can be concluded as follows:

1. The queuing system at PT. Meroke Tetap Jaya is a Single Channel Multi Phase, First Come First Serve, truck arrival and service distribution using poisson and normal distribution and the unlimited source of truck arrivals. It can be concluded that this queuing model in this system is (M/G/I) : (FCFS/ ∞/∞). It has a busy period (P_s) of 0,63 or 63% meaning there's a leisure time in the server or counter.

2. The average truck arrival (λ) is 0,8 hour/truck, meaning in less than 1 hour duration, there is an arrival of 1 truck and the average service time (μ) is 1,27 hour/truck, meaning the service from the moment the truck enters until it is loaded takes more than 1 hour.
3. The average amount of trucks in the queue is 1 unit, the average amount of trucks in the system is 2 units, the average time of trucks waiting in queue is 2 hours and the average time of trucks waiting in the system is 2,1 hours
4. The average service time in each phase is 0,003 hours or about 0,18 minutes in security check (μ_1), 0,25 hours or about 15 minutes in administration service counter (μ_2), 0,17 hours or about 10 minutes in entry weighing process (μ_3), 1,15 hours or about 69 minutes in loading process (μ_4), and 0.08 hours or about 5 minutes in exit weighing process (μ_5). Therefore the time average needed to serve one truck since the time of arrival until finished is about 99 minutes.
5. Based on the research conducted, Single Channel Multi Phase queuing system at PT. Meroke Tetap Jaya's warehouse is not efficient, because the administration process alone takes up to 15 minutes assisted by 2 employees, not including the loading process which takes up to 1,2 hours assisted by 20 employees and is assigned to every truck based on the quantity and there's often an overtime when there are a lot of loading quantity and truck arrivals.

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