Evaluation of The Need for Arrival Piers at Ampera Lower Pier, South Sumatra Province

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Abstract. A queue is a line of people or goods waiting to be served and leaving the line after being served and leaving the line after being served. To optimize and determine the service time of the problem using one of the method models, namely *the Multi Channel Single Phase* method. The purpose of this study is to determine the suitability of the capacity needs of the arrival pier with the number of ship arrivals at the Ampera Lower Pier The first step is to take data on the arrival rate of ship queues and the average time of service level. The results of the calculation with the *Multi Channel Single Phase* model at the arrival pier apply a disciplined queue, namely *First Come First Server*.

The Poisson distributed ship arrival pattern and the exponentially distributed service pattern. The optimal number of piers in ship service is 10 piers. From the results of the calculation, the average number of ships waiting in the queue is 0.0000 ships/minute. Meanwhile, the average number of ships waiting in the system is 0.2953 ships/minute. The average waiting time in the queue is 0 minutes. Meanwhile, the average waiting time in the system is 0.6774 minutes. From the results of this study, the need for the number of arrival piers is optimal.

Keywords: Queue**,** Multi Channel, Single Phase, Arrival Dock, Capacity

1. INTRODUCTION

The city of Palembang is the second largest city on the island of Sumatra. Geographically located between 2°52′ to 3°5′ South Latitude and 104°37′ to 104°52′ East Longitude with an average elevation of 8 m above sea level. The city of Palembang has an area of 400.61 km^2 and is administratively divided into 107 urban villages and 16 sub-districts. One of the piers in Palembang City, Ampera Lower Pier, has an important role in the development and economy of the South Sumatra region as a gateway for goods and passengers so that the need for river port services is increasing (Idrus, Z et al. 2018:172).

The port dock provides safe, effective and efficient service, as well as quality loading and unloading operations, proper inspections and the implementation of strict safety rules and procedures. Port service users will benefit from the provision of port facilities, but port service users will be disadvantaged if the provision of facilities is insufficient because it has an impact

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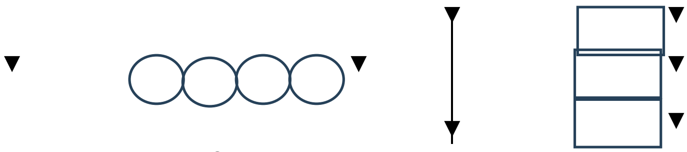
on the smooth flow of ship docking facilities. A queue is a line of people or goods waiting to be served, leaving the queue after the service (Heizer & Render, 2005:221).

Queue theory is an important part of operations and is also a valuable tool in operations management. The application of queue theory often occurs in everyday life. The queue is caused by a longer waiting time than the service time. The limited number of servers to fulfill customer service requests (ships) resulted in long queues. Basically, queue theory deals with all aspects of the situation where customers (ships) have to queue to get services (Zulfin & Silaban, 2014:19). In this waiting activity, sometimes there are irregularities. In this case, an example can be taken at the Arrival Terminal. In general, the ketek that crosses from 7 Ulu to the Ampera Lower Pier drops off passengers at the arrival terminal. There are 10 arrival piers available at the Ampera lower port, but it is necessary to evaluate the adequacy of the number of piers to optimize the performance of port managers.

2. QUEUE

The type of research in this study uses a type of descriptive quantitative research with a Multi Channel Single Phase model. Quantitative research is an attempt by a person to conduct research on an object, a condition, or other phenomenon with natural or real conditions (without an experimental situation) to make a systematic overview or a detailed description that is factual and accurate. The descriptive method is a research method that conveys facts by describing what is seen, obtained and felt. The service system in the queue at the arrival pier is a double lane with one stage (Multi Channel Single Phase).



Queue

Server

Figure 1. *Multi Channel – Single Phase*

The distribution of service time is used exponentially because each ship served has a different time. For the arrival behavior in this study, namely the distribution of poissons because at a certain time the number of ships that arrive is random. The population of the queue is an unlimited population, meaning that the number of ships coming is not limited. Then the arrival pattern of this research is discipline, the queue at the pier is First Come First Served (FCFS) or First In First Out (FIFO) meaning that the first ship to come is the first ship to be served by the pier.

3. METHOD

Here are the stages in the calculation:

3.1 The first thing to do is to collect arrival data and service times. To obtain the number of arrivals per unit of time (λ) the author divides the total arrivals by the observation time. For the amount served per unit of time (μ) the author divides the unit of time by the loading and unloading time.

3.2 Furthermore, calculating the simplified formula of the Multi Channel Single Phase queue model, which is to calculate the probability level of having 0 ships in the system (no ships in the system)

$$P_0 = \frac{1}{\lfloor \sum_{n}^{M} \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n \rfloor + \frac{1}{M!}\left(\frac{\lambda}{\mu}\right)^M \frac{M\mu}{M\lambda-\mu}}$$

3.3 Average number of ships waiting in the system

$$\mathbf{Ls} = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^M}{(M-1)!\,(M\mu-\lambda)^2} P_0 + \frac{\lambda}{\mu}$$

3.4 Calculate the average wait in the system (queue + service)

$$\mathbf{Ws} = \frac{Lq}{\lambda}$$

3.5 Calculate the average number of ships waiting in a queue

$$\mathbf{Lq} = \mathbf{Ls} \frac{\lambda}{\mu}$$

3.6 Calculate the average wait in the system (queue + service)

$$\mathbf{Ws} = \frac{Lq}{\lambda}$$

4. RESULTS AND DISCUSSION

Based on the results of observations made by the author at the 7 Ulu river port, South Sumatra Province, the following research results were obtained:

4.1 Average number of arrival rates (λ)

$$\lambda = \frac{\lambda 1 + \lambda 2 + \lambda 3}{3} = \frac{0{,}5578 + 0{,}4289 + 0{,}3211}{3} = 0.4359 \text{ vessels/minute}$$

From 08.00 to 11.00 it can be seen that at that hour the average ship arrival rate is 0.0073 ships/minute.

4.2 Average number of vessels served per unit time (μ)

$$\mu = \frac{\mu 1 + \mu 2 + \mu 3}{3} = \frac{1{,}383 + 1{,}558 + 1{,}487}{3} = 1.476 \text{ vessels/minute}$$

From 08.00 to 11.00 it can be seen that at that hour the number of ships served per unit of time is 1,476 ships/minute.

4.3 Possibility of server idle (Po)

$$P_0 = \frac{1}{\left[\sum_n^M \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n\right] + \frac{1}{M!}\left(\frac{\lambda}{\mu}\right)^M \frac{M\mu}{M\lambda-\mu}}$$

$$= \frac{1}{\left[\sum_n^M \frac{1}{0!}\left(\frac{0{,}4359}{1{,}476}\right)^0 + \frac{1}{10!}\left(\frac{0{,}4359}{1{,}476}\right)^{10}\right] + \frac{1}{10!}\left(\frac{0{,}4359}{1{,}476}\right)^{10} \frac{10x1{,}476}{10x0{,}4359-1{,}476}} = \frac{1}{1{,}2953} = 0.77202$$

The chance of no ship at 08.00-11.00 is 77.20%, meaning that the probability value of no ship served or idle state (P_0) is 77.20%.

4.4 Ships waiting in the system (Ls)

$$\mathbf{Ls} = P_0 + \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^M}{(M-1)!\,(M\mu-\lambda)^2} = 0.9951 + \frac{\lambda}{\mu}\frac{0{,}4359x1{,}476x\left(\frac{0{,}4359}{1{,}476}\right)^{10}}{(10-1)!\,(10x1{,}476-0{,}4359)^2} = \frac{0{,}4359}{1{,}476}$$

= 0.2953 vessels/minute

From 08.00 to 11.00, the average number of ships waiting in the system (Ls) is 0.2953 ships per minute, meaning that the queue of ships from arrival to service process completion is 0.2953 ships per minute.

4.5 In-system wait time (Ws)

$$\mathbf{Ws} = \frac{Ls}{\mu} = \frac{0{,}2953}{1{,}476} = 0.6774 \text{ minutes}$$

From 08.00 to 11.00, the average waiting time needed in the system (Ws) is 0.6,774 minutes, which means that the average waiting time for ships from arrival to the completion of the service process is 0.6774 minutes.

4.6 Ships waiting in line (Lq)

$$\mathbf{Lq} = Ls - \frac{\lambda}{\mu} = 0.2953 - \frac{0{,}4359}{1{,}476} = 0.0000 \text{ vessels/min}$$

From 08.00 to 11.00 the ships waiting in the queue are 0.0000 ships queuing to be served immediately per minute.

4.7 Wait time in queue (Wq)

$$\mathbf{Wq} = \frac{Lq}{\lambda} = \frac{0{,}0000}{0{,}4359} = 0 \text{ minutes}$$

From 08.00 to 11.00 the waiting time needed in the queue is 0 minutes, which means that the ship needs a waiting time to be served immediately, which is 0 minutes.

Based on the above analysis, Po = 77.20% was obtained. This shows that the possibility of no queue of ships that will dock at the arrival pier of Ampera Lower Pier is 77.20%.

5. CONCLUSION

In the results of this study, conclusions were obtained, namely:

5.1 The length of time required for the ship to dock is 0.7232 ships/minute in the first hour, 0.6417 ships/minute in the second hour, and 0.6723 ships/minute in the third hour. So the average length of time required by a ship is 0.6791 ships/minute.

5.2 The effectiveness of the service in the queue system has been said to be optimal by looking at the percentage of idle docks with an average time in the system of 77.20% and an average waiting time in the system of 0.6774 minutes. There is no need to increase the number of berth area capacity at the arrival terminal pier that has been provided.

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