Design of Electronic Ticketing System (E-Ticketing) at Kariangau Ferry Port, East Kalimantan Province

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Abstract. Kariangau Ferry Port, located in Kariangau, West Balikpapan, East Kalimantan, serves three commercial routes: Balikpapan-Penajam, Balikpapan-Taipa, and Balikpapan-Mamuju. Based on the results of the field survey, it was found that there was a long vehicle queue to make 4 lanes of queues with existing conditions, and there are only two vehicle counters. This study aims to determine the queue of vehicles at Kariangau Ferry Port and design a suitable ticketing system. The methods used in this study include an analysis of vehicle queues based on queuing theory and an analysis of the design of an electronic ticketing system (e-ticketing). Based on the vehicle queue analysis results, it is obtained that the addition of counters is yet to be needed in the existing condition of two counters. With the utility level of counter 1 is ρ=0,413<1 and the vehicle arrival rate of 62 vehicles/hour, and an average vehicle queue of 2 meters long. While the utility level of counter 2 is ρ=0,24<1 and the vehicle arrival rate of 36 vehicles/hour, and an average vehicle queue of 1 meter long. Furthermore, the e-ticketing system design analysis resulted in an application design named FerryNow, which can be applied at the Kariangau Ferry Port.

Keywords: Utility level Vehicle Queue electronic ticketing system (e-ticketing) Kariangau Ferry Port

1. INTRODUCTION

Kariangau Ferry Port is a port located in Kariangau, West Balikpapan, East Kalimantan which connects Balikpapan City with Penajam Paser Utara Regency, Balikpapan with Taipa and Balikpapan with Mamuju. Kariangau Ferry Port is an access for people in and out of Balikpapan and outside which operates every day, making Kariangau Ferry Port a vital object that is important for the economic life of the surrounding community.

Kariangau Ferry Port, in addition to being a vital object for the community's economy, is also a connecting bridge with the Indonesian Capital City (IKN). Based on this, Kariangau Ferry Port is one of the busiest ports in Indonesia, therefore the number

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of vehicles crossing Kariangau Ferry Port is certainly busy so that it can cause long queues at the ticket purchase counter.

The vehicle queues that occur at the Kariangau Ferry Port are a significant challenge, especially in terms of managing passenger and vehicle flow. Currently, the vehicle queue at the Kariangau Ferry Port reaches 2 meters, which causes the formation of 4 queue lanes in the ticket counter area. This condition is caused by the limited number of vehicle counters available, namely only 2 counters are operating, so they are unable to accommodate the surge in the number of incoming vehicles.

This situation causes inconvenience for service users and has the potential to disrupt the smooth operation of the port. This situation must be addressed and managed through policies that regulate passenger queue patterns at the Kariangau Port counter in accordance with the Regulation of the Director General of Land Transportation Number: KP.5062 / AP.005 / DRJD / 2020 concerning Guidelines for Assessment of the Implementation of Ferry Port Service Standards.

In addition to policies related to vehicle queue patterns, one of the efforts to overcome vehicle queues is to implement an e-ticketing system in accordance with the Regulation of the Ministry of Transportation PM No. 19 of 2020 concerning the Implementation of Electronic Ferry Tickets which is planned to be implemented in 2025. Although in 2023 the Kariangau Ferry Port has adapted a non-cash payment system for ticket payments, where service users are required to make payments using e-wallets, Qris, virtual accounts, or e-money, there are still several obstacles faced, such as service users who do not keep up with the times, service users who do not have e-wallets, e-money or mobile banking, and errors in the EDC (Electronic Data Capture) machine or an unstable internet network which often causes long queues at the vehicle counter.

With fast service and equipped with the right system has the ability to meet the needs of service users and overcome challenges, such as vehicle queues at the port. Utilizing the latest system that combines technological advances can greatly improve the efficiency and effectiveness of services, which ultimately simplifies operations for service users, shipping companies, and BPTD.

2. METHOD

The type of research used in this study is quantitative research. According to Sugiyono (2013) in his book entitled "Quantitative, Qualitative, and R&D Research Methods", quantitative research is a systematic scientific study of parts and phenomena and their relationships. The methods used to collect research data are:

a. Observation Method

According to Mundir (2013) in his book entitled "Qualitative and Quantitative Research Methods", the observation method is a data collection technique carried out by directly observing phenomena or research objects in their natural environment. The activities carried out include:

1. Average Daily Traffic Survey

   This survey was conducted by filling out a form based on the results of observations of existing conditions at the Kariangau Ferry Port.

2. Passenger and vehicle productivity data recording in 1 month

b. Library Method

According to Sugiyono (2013) in his book entitled "Quantitative, Qualitative, and R&D Research Methods", the library method is a method of collecting data by reviewing and analyzing various library sources or references that are relevant to the research topic.

c. Institutional Method

According to Sugiyono (2013) in his book entitled "Quantitative, Qualitative, and R&D Research Methods", the institutional method is an analytical approach that focuses on the role of institutions in forming social structures and organizational behavior. This method collects data from various related agencies, namely:

1. East Kalimantan Class II Land Transportation Management Center.
2. Kariangau Ferry Port Service Unit.
3. Central Statistics Agency (BPS) of Balikpapan City.

3. Result and Discussion

3.1 Vehicle queue analysis

Queues occur because the process of traffic flow movement is disrupted by a service activity that must be passed. The following calculations are carried out by taking sample data on Wednesday, April 11, 2024.

In the calculation analysis for the counter queue using the FIFO queue discipline, namely the first passenger to arrive at a service location will be served first. In the FIFO queue calculation using service time (WP). The calculation of the vehicle counter uses the following equation:

a. Average Vehicle Arrival at the counter:

$$\lambda=1/n(\Sigma xi) \quad (4.1)$$

b. Average Service Time (WP) of vehicles at the counter:

$$WP=1/n(\Sigma xi) \quad (4.2)$$

c. Average Passenger Service Level:

$$\mu=(\text{time interval})/WP \quad (4.3)$$

d. Utility Level

$$\rho=\lambda/\mu<1 \quad (4.4)$$

e. Average Queue Length (L):

$$L=(\lambda \times t)/3600 \quad (4.5)$$

Where:

ρ = utility level indicator
n = amount of time for data collection
$\boldsymbol{\lambda}$ = arrival rate/hour
μ = service level/hour
Σxi = number of vehicles arriving in a certain time period

L = Queue length in meters
t = duration of green phase in seconds

The following is the calculation of the average vehicle arrivals/hour:

a. Average vehicle arrival at counter 1:
λ=(number of vehicles arriving)/hour (4.6)
λ=1.488/24
λ=62 vehicles/hour (1)

b. Average Service Time (WP) of vehicles at counter 1:
WP=1/n(Σxi) (4.7)
WP=1/62 (1.488)
WP=23.99 seconds
WP≈24 seconds (2)

c. Average Service Level of Vehicles at counter 1:
μ=(time interval)/WP (4.8)
μ=(3,600 seconds)/(24 seconds)
μ=150 vehicles/hour (3)

d. Utility level (counter 1)
Number of counters required (ρ)=λ/μ
Information:
P = number of counters required
λ= arrival rate/hour
μ = service level/hour

Where:
λ=62 vehicles/hour (1)
μ=150 vehicles/hour (3)
So that:
ρ=λ/μ (4.9)
ρ=(62 vehicles\/hour)/(150 vehicles\/hour)
ρ=0.413<1

Based on the existing service hours on April 11, 2024, it can be concluded that operating only one counter for vehicle services is sufficient to serve all vehicles per day, especially on April 11, 2024 which has an arrival rate of 62 vehicles/hour.

a. Average vehicle arrival at counter 2:
λ=(number of vehicles arriving)/hour (4.10)
λ=841/24
λ=35.04 vehicles/hour

λ≈36 vehicles/hour (4)

b. Average Service Time (WP) of vehicles at counter 2:

WP=1/n(Σxi) (4.11)

WP=1/36 (841)

WP=23.36 seconds

WP≈24 seconds (5)

c. Average Service Level of Vehicles at counter 2:

μ=(time interval)/WP (4.12)

μ=(3,600 seconds)/(24 seconds)

μ=150 vehicles/hour (6)

d. Utility level (counter 2)

Number of counters required (ρ)=λ/μ

Information:

ρ = number of counters required

λ = arrival rate/hour

μ = service level/hour

Where:

λ=36 vehicles/hour (4)

μ=150 vehicles/hour (6)

So that:

ρ=λ/μ (4.13)

ρ=(36 vehicles\/hour)/(150 vehicles\/hour)

ρ=0.24<1

So based on the existing service hours on April 11, 2024, it can be concluded that by only operating one counter for vehicle services, it is sufficient to serve all vehicles per day, especially on April 11, 2024 which has an arrival rate of 36 vehicles/hour.

The following are the results of the calculation of the average queue length:

a. Average Queue Length (L) counter 1:

L1 = (λ×t)/3600 (4.14)

L1 = (62×60)/3600

L1 = 3720/3600

L1 = 1.033

L1 ≈ 2 meters

b. Average Queue Length (L) counter 2:

L_2=(λ×t)/3600 (4.15)

L_2=(36×60)/3600

L_2=2160/3600

L_2=0.6

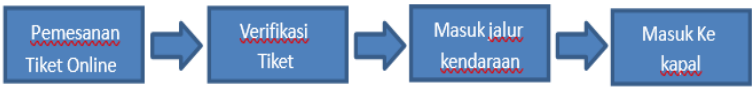
L_2≈1 meter

3.2 Analysis of electronic ticketing system design (e-ticketing)

Based on the results of the research conducted, the Kariangau Ferry Port Service Unit has used a Cashless system, vehicle queues at the ticket sales counter can occur if the incoming vehicles exceed the average number of passengers as usual at normal times (high season), then the ticket sales counter at the Kariangau port only has two operating counters. Therefore, this study aims to change the queue system at the Kariangau Ferry Port which originally used the First In First Out (FIFO) system to be changed to First Vacant First Served (FVFS) to be more optimal and efficient which can be implemented through an electronic ticket sales system (e-ticketing).

Here is the FIFO Port Entry Scheme:

Here is the FVFS Port Entry Scheme:



a. E-ticketing System Based on Android Application

Android is a Linux-based operating system for mobile devices that includes an operating system, middleware and applications. Android provides an open platform for developers to create their applications.

b. Managing Accounts

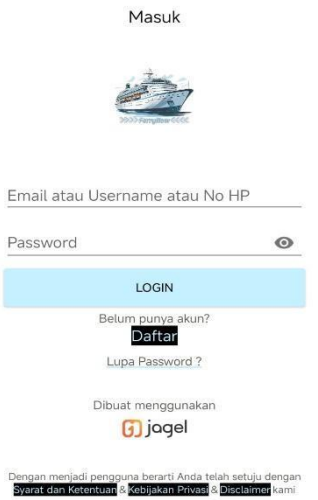
FerryNow is a mobile application for online ticket purchases aimed at the Kariangau Ferry Port in East Kalimantan Province, so that service users who will depart can order tickets directly anywhere and anytime quickly, without queues and efficiently. FerryNow is an application created directly by the author with the aim of facilitating service users in the ticket purchase process. In the remote transaction application system, there is interaction between users and admins. The following are details of users and admins that can be seen in the following table.

User and admin details table

Actor	Description
Users	Users are authenticated actors and can make ticket reservations within the application.
Admin	*Admin*is the authorized party authenticated to arrange ship bookings and verify payments.

c. Application Registration/Login Page

On this page, service users who have just downloaded the FerryNow application fill in their identity for application user registration. Furthermore, service users can log in to the application to move on to the next page.



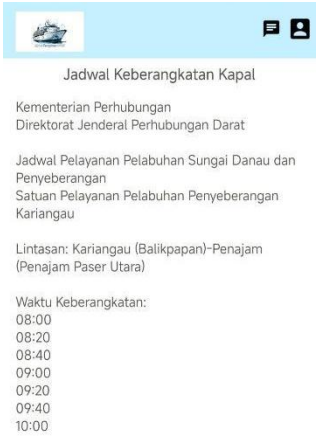
Application Login Page Image

d. Application Home Page

Image of the FerryNow Application Main Page

On the main page of the application there are features such as, Schedule, About FerryNow, Contact Us and Book Tickets

e. Schedule Page



Ship Departure Schedule Image

This page contains information about Ship Departure Schedules, Ship Routes and Policies.

f. About Us Page

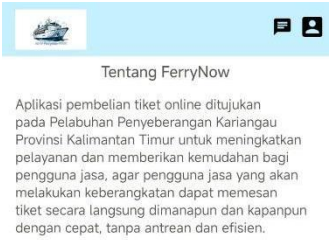


Figure 1 About the FerryNow Application

This feature displays information about the purpose of creating the FerryNow application.

g. Contact Us Page

Kariangau Ferry Port Contact Information Image

This feature contains a page that connects directly to the customer service contact for the Kariangau Ferry Port.

h. Book Tickets

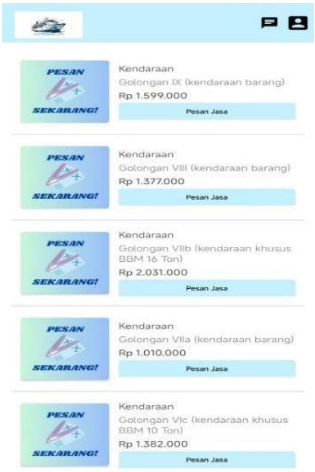


Figure 2 of Ferry Ticket Fares

In this feature, Service Users can order tickets by selecting the type of passenger or vehicle ticket listed in the application.

i. How to book tickets on the FerryNow application:
   1) Service users can press the order ticket button. Then a list of passenger and vehicle departure ticket rates from Class I to Class IX will appear.
   2) Press the Order Service button. (example: Gol.IV A Passenger Car vehicle ticket)
   3) Press the Select Service button. Select the date according to the schedule listed. Then press the Buy button. In the Additional Information column. Service Users are expected to fill in Information related to the Identity of Service Users such as Passenger Name data, Number of Passengers in 1 vehicle and Vehicle Police Number.

Ticket Booking Method Image

j. Payment Methods

Service users can choose direct payment from the FerryNow application by topping up their balance first. Service users can also pay directly to the listed Ticket Sales Account and can also pay directly to the ticket receipt printing counter. This application can also be connected to several types of payments such as Virtual Account Bank BCA, BNI, Mandiri, BRI, BNI, CimbNiaga, PermataBank, OVO, ShopeePay and DANA.

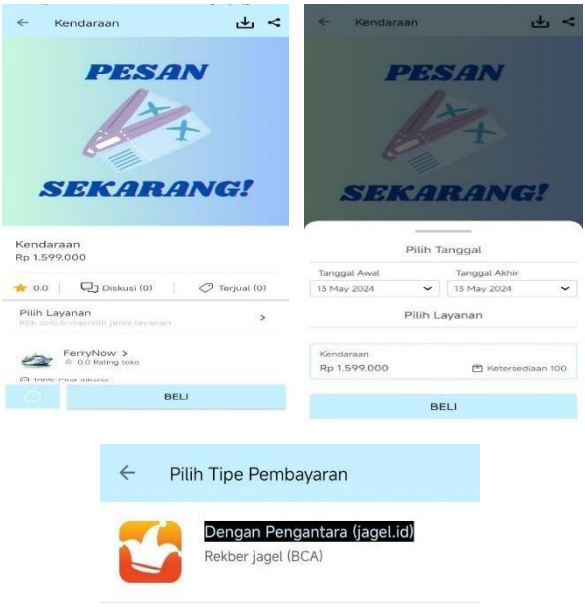


Figure 3 Payment Method Image

k. If all the details have been filled in and the payment method has been selected, the service user can press the Order Now button.

l. Next, a page will appear waiting for the payment process for virtual payments. This application can also be set/added to the direct payment method at the Port/counter that prints the ticket order receipt to get the ticket.

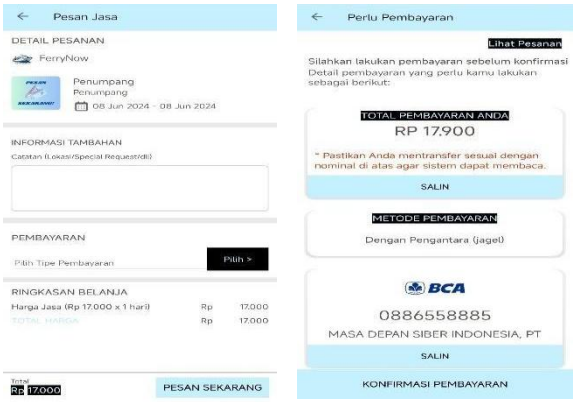


Figure 4 Payment Process Image

m. Ticket Verification

After printing the ticket in the application, at least 30 minutes before departure, verify the ticket at the port entrance counter by providing the ticket code at the port entrance counter so that you can enter the special E-ticketing lane and then enter the ship according to the departure schedule. This process still requires human control for directing special E-ticketing passengers.

4. CLOSING

4.1 Conclusion

Based on the research results obtained at the Kariangau Ferry Port, the following conclusions can be drawn from this research:

a. Based on the calculation results of the vehicle utility level, it is found that there is no need to add counters, meanwhile based on the calculation results of the average service at the counter per vehicle, the service time at the counter per vehicle is 24 seconds, this is in accordance with the Regulation of the Director General of Land Transportation Number: KP.5062 / AP 005 / DRJD / 2020 Concerning Guidelines for Assessment of the Implementation of Ferry Port Service Standards with a service standard of 5 minutes, and an average queue length of 2 meters. Based on this, the service time at the Kariangau Ferry Port is considered appropriate. Therefore, it is necessary to implement an electronic ticket service system (e-ticketing) so that later there will be no vehicle queues if there is a surge in passengers.

b. The design of an electronic ticketing system (e-ticketing) through the FerryNow application is an effort to improve services from purchasing tickets at the port counter to purchasing tickets online, of course this

can make it easier for people who want to use the Ferry Ferry transportation service to get certainty about the departure schedule and place on the ship without having to queue for hours at the port and can reduce vehicle queues at the Kariangau Ferry Port.

4.2 Recommendations

a. According to the results of the vehicle queue calculation, it was found that there was no need for additional vehicle counters. With 2 counters operating, the system already has sufficient capacity to serve all customers with low waiting times and queue lengths, so that it runs efficiently and effectively, therefore it is necessary to implement an electronic ticket system (e-ticketing) to be able to reduce vehicle queues.

b. The Kariangau Ferry Port Service Unit can implement electronic ticket purchases through the FerryNow application to improve service quality, avoid queues at the Port, and make it easier for service users to get information about the Port, and there is a need to build supporting facilities for e-ticketing devices such as building gates with automatic verification signs, special e-ticketing lanes, and improving ferry facilities.

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References

[1] Central Statistics Agency of Balikpapan City. Balikpapan City in Figures 2024. Accessed March 14, 2024, from https://balikpapankota.bps.go.id/publication/2024/02/28/d677bf95323143841668577 3/kota-balikpapan-dalam-angka-2024.html.

[2] Google Earth. Google earth. Retrieved March 17, 2024, from https://earth.google.com/web/search/Pelabuhan+Penyebrangan+Ferry+Penajam++Balikpapan,+Jalan+PenajamKuaro,+Penajam+North+Paser+Regency,+East+Kalimantan/@1.20018668,116.8173527,1.7193833a,1124.69653193d,35y,0h,0t,0r/data=CigiJgokCQWJ1KXS9fK_ESyfF40LfPO_GavG50WVNV1AITkPk_BqM11AOgMKATA.

[3] Hasanuddin. et al. (2023). Analysis of Ticket Purchase Queue System at Gorontalo Ferry Port Using Promodel Application. Jambura Journal of Electrical

and Electronics Engineering, Volume 5 Number 1 January 2023. Retrieved from https://ejurnal.ung.ac.id/index.php/jjeee/article/view/17040, viewed March 7, 2024.

[4] Intari, DE et al. (2019). Evaluation of Queue Performance at the Passenger Counter of Merak Port, Banten. Jurnal Fondasi, Volume 8 No 2. Retrieved from https://jurnal.untirta.ac.id/index.php/jft/article/view/6665, viewed 5 March 2024.

[5] Jailani, MAK (2022). Analysis of Vehicle Queues at the Air Putih Ro-Ro Ferry Port and Design of an E-Ticketing System. http://eprints.polbeng.ac.id/8386/. Riau: Bengkalis State Polytechnic, D-Iv Road and Bridge Design Study Program.

[6] Jogiyanto, HM (2008). Information System Analysis and Design: Structured Approach to Theory and Practice of Business Applications. Yogyakarta: Andi Offset.

[7] Big Indonesian Dictionary. (2024). Big Indonesian Dictionary (KBBI) Online/online dictionary (online). Retrieved July 25, 2024, from https://kbbi.web.id/loket.

[8] Ministry of Transportation Director General of Land Transportation. 2018. Regulation of the Director General of Land Transportation Number: SK.1272/AP.005/DRJD/2018 Concerning the Implementation of Electronic Crossing Transportation Tickets. Director General of Land Transportation. Jakarta.

[9] Ministry of Transportation Director General of Land Transportation. 2020. Regulation of the Director General of Land Transportation concerning Guidelines for Assessment of the Implementation of Ferry Port Service Standards. Director General of Land Transportation. JakartaMinistry of Transportation Director General of Land Transportation. 2018. Regulation of the Director General of Land Transportation Number: SK.1272/AP.005/DRJD/2018 Concerning the Implementation of Electronic Ferry Transportation Tickets. Director General of Land Transportation. Jakarta .

[10] Mayasari, A. (2011). Reservation and Ticketing System of PT. Sriwijaya Air, Solo District. Surakarta: Sebelas Maret University, Faculty of Literature and Fine Arts.

[11] Minister of Transportation of the Republic of Indonesia. 2016. Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 28 of 2016 concerning the Obligation of Passengers of Ferry Transportation to Have Tickets. State Gazette of the Republic of Indonesia 2016 Number 431. Jakarta.

[12] Minister of Transportation of the Republic of Indonesia. 2020. Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 19 of 2020 concerning the Implementation of Electronic Ferry Tickets. State Gazette of the Republic of Indonesia 2020 Number 412. Jakarta.

[13] Mundir. (2013). Qualitative and quantitative research methods. Jember: STAIN Jember Press

[14] Oxford Advanced Learner's Dictionary. (2018). Definition of cashless adjective from the Oxford Advanced American. Retrieved March 10, 2024, from https://www.oxfordlearnersdictionaries.com/.

[15] Government of Indonesia. 2008. Law Number 17 of 2008 concerning Shipping. Supplement to the State Gazette of the Republic of Indonesia No. 4849. State Secretariat. Jakarta.

[16] Balikpapan City Government. Balikpapan Administrative Map. Retrieved March

15, 2024, from https://web.balikpapan.go.id/uploaded/peta/petaadminitrasibalikpapan.jpg.
[17] Setiawan, EB (2015). Analysis of the Influence of Information Technology Value on Company Competitive Advantage (Case Study of E-Ticketing Utilization on Railway Service User Loyalty). Journal of Science, Technology and Industry, Vol. 12, No. 2, June 2015. Retrieved from https://ejournal.uin-suska.ac.id/index.php/sitekin/article/view/929, viewed March 11, 2024.
[18] Silaen, S. (2018). Social research methodology for writing undergraduate and graduate theses. Bogor: In Media.
[19] Sugiyono. (2013). Quantitative, Qualitative and R & D Research Methods. Bandung: Alfabeta.
[20] Tamin, OZ (2003). Transportation Planning & Modeling. Bandung: ITB.
[21] Triatmodjo, B. (2009). Port Planning. Yogyakarta: Beta offset.