JOURNAL OF WORLD CONFERENCE
VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Development of Public Transport Shelter Integrated with Samsat Drive Thru Sidoarjo

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Abstract

The Sidoarjo Transportation Licensing Service Unit (UPPA) office building is located on Jalan Raya Pagerwaja, Ds Gelam, Kec. Temple, Kab. Sidoarjo, East Java, hasbeen used by the local district government as a Samsat Drive Thru since 2021, where people can pay vehicle taxes from motorbikes or cars. Dishub will also develop a public transportshelter. especially those through the UPPA Building such as Angkot / MPU, Inter-City In-Province Transport (AKDP), and the planned Bus Rapid Transit which will operate in 2022. The method of calculating shelter needs used in this preparation uses the Single Channel - Single Phase & Multi Channel - Single Phase formula so that the final result of this study is the number of needs for each vehicle that carries out activities in the area. From the calculations that have been obtained from this study, the results obtained for vehicles; 1. The motorbike shows that the service level is optimal where there is one facility and one service stage using the Single Channel – Single Phase formula, 2. The carshows that the service level is optimal where there is one facility and one service stage using the Single Chanel formula – Single Phase, 3. City In-Province Transportation (AKDP) & Angkot / MPU based on calculations and data analysis showing shelter needs, namely 3 channels using the Multi Chanel - Single Phase formula, 4. Bus Rapid Transit (BRT) MPU based on calculations and data analysis shows the need for shelter, namely 2 channels using the Multi Channel - Single Phase formula.

Keyword :
Public Transport Shelter Planning

1. Preliminary

1.1. Background

Good public transportation services are needed in Sidoarjo Regency considering the population is quite dense and people are buzzing with activities. City transportation facilitiesthat are used as the main reference for the community are the existence of passenger publictransportation and good service performance. In this case, the Sidoarjo Transportation Licensing Service Unit (UPPA) office building is located on Jalan Raya Pagerwaja, Ds Gelam, Kec. Temple, Kab. Sidoarjo, East Java is used by the local government as a Samsat*Drive Thru*.

Dishub will also develop the area into a temporary stop for public transportation. especially those through the Samsat Drive Thru route such as MPU, Inter-City Within Province (AKDP), and the planned Bus Rapid Transit which will operate in 2022

1.2. Formulation in the Problem

In this preparation, the problems that need to be considered are as follows:

1. What is the arrival frequency for Angkot / MPU, Inter-City In-Province Transport(AKDP) and Planned Bus Rapid Transit (BRT) at Samsat *Drive Thru* Sidoarjo?
2. What is the optimal number of shelters for Angkot / MPU, Inter-City In-Province Transport (AKDP) and Bus Rapid Transit plans at Samsat *Drive Thru* Sidoarjo?
3. What is the optimal number of shelters for four-wheeled and two-wheeled vehicles atSamsat *Drive Thru* Sidoarjo

2. Literature Review

2.1. Infrastucture / Shelter

Shelters are infrastructure provided for passengers when they get out from public transportation and in order to be protected from unfavorable natural climate. Because of itsspecial function, not all stops are equipped with shelters or it can be said that not all publictransport stops can be classified as shelters but on the contrary all shelters must be public transport stops. Basically, shelters are built so that the interaction process between public transport and passengers takes place safely and comfortably.

2.2. Queue Structure

On the basis of the nature of the service process, the queue can be classified as service facilities in a channel or channel that will form a different queuing structure. According to White & Pharoah (2000), there are four queuing structure models, namely:

1. Single Channel – Single Phase : Here the facilities served will come, enter and form a queue in one line/service flow and then will face one service operation facility.
2. Single Channel – Multi Phase : Here the facilities served will come, enter and form a queue on several lines/service flows and will then be faced with a service operating facility. As shown in the following image.
3. Multi Channel – Single Phase : Here the facilities served will come, enter and form a queue in one line/service flow and then will be faced with several service operating facilities.
4. Multi Channel – Multi Phase : Where here the arrival of the facilities to be served will be included in theservice system which is operated from one facility to another service facility.

3.

2.3. Queuing Model

There are four models that are most often used by companies according to each situation and condition. By optimizing the service system, it is possible to determine the service time, the number of queuing channels, and the right number of services using queuing models. The four queuing models are (Heizer & Render, 2005).

1. (M/M/1) : (FCFS/∞/∞), is a queue with a Poisson distribution of arrivals and departures, the number of services comes first. Represents the queue length and unlimited resources.
2. (M/M/S) : (FCFS/∞/∞), queuing model as above with the number of servicestations more than one (S).
3. (M/M/1) : (GD/N/∞), queuing model with Poisson arrival distribution, single service station and queuing capacity of N. GD service discipline means general service discipline (FCFS/ LCFS/ SIRO).
4. (M/M/S) : (GD/N/∞), queuing model as above with the number of servicesmore than one.

4.

2.4. Steady-State Measure Of Performance

Steady-State is a condition when the properties of a system do not changewith the passage of time or in other words constant. Steady-State measure of service system performance can be obtained from the number of arrivals at the research object and service time data by calculating the probability of the servicesystem. Steady-State conditions must be met so that it can be seen that the average number of services reaches stability. To reach steady-state then: = /(kμ) = < 1 where ,

p = steady-state
λ = service level
μ = arrival rate
k = possible number of servers/shelters

Steady-state conditions can be met if p < 1 which means that < kμ . Meanwhile, if p > 1 then the arrival occurs at a faster speed than the server accommodates, the situation applies if p = 1.

3. Methodology

A. A. The steps in the analysis of the Integrated Public Transport Shelter Developmentwith the Sidoarjo Drive Thru Samsat are outlined in this flow chart.

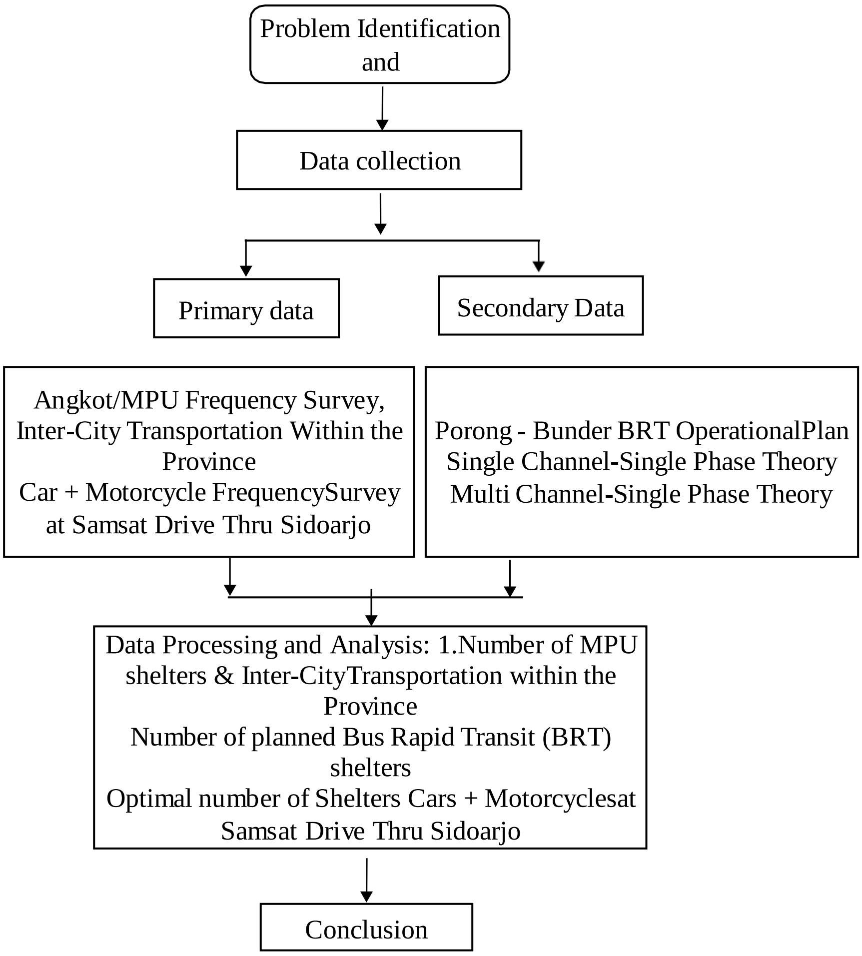


Figure 1. Integrated Public Transport Shelter Development

4. Survey Result Table

Table 1. Average arrival rate (λ) of Angkot / MPU on weekdays via Samsat Drive Thru Sidoarjo

Rute	Time period (o'clock)	Number offrequencies hourly arrival	Total working hours	Arrival rate(λ)
Terminal pasar Larangan - Sidoarjo – Porong	06.00 - 08.00	15	2 hours	10,333 ~ 11
	11.00 - 13.00	15	2 hours	
	16.00 - 18.00	0	2 hours	
	Total	30		
Terminal Joyoboyo - Sidoarjo – Porong	06.00 - 08.00	12	2 hours	
	11.00 - 13.00	8	2 hours	
	16.00 - 18.00	12	2 hours	
	Total	32		
Grand Total		62	6 hours	11 units per hour

Source: Survey Results, 2022.

JOURNAL OF WORLD CONFERENCE
VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Table 2. Average service level (μ) of Angkot / MPU that go through Samsat Driv`e Thru Sidoarjo

Trans portati on type	Time period (o'clock)	Number of frequencies hourlyarrival	Total working hours	Average arrivals perhour		Arrival rate (μ)
Angkot / MPU	06.00 - 08.00	27	6 jam	4,5 ~	5	11 units perjam
	11.00 - 13.00	23		3,83 ~	4	
	16.00 - 18.00	12		2 ~	2	
	Total	44			11	

Source: Survey Results, 2022.

Table 3. Average arrival rate (λ) of motorbikes making payments at Samsat Drive Thru Sidoarjo

Trans portation type	Time period (o'clock)	Number offrequencies hourlyarrival	Total working hours	Arrival Rate (λ)
Motorcycle	08.00 - 09.00	12	1 hours	6,285 ~ 7
	09.00 - 10.00	8	1 hours	
	10.00 - 11.00	5	1 hours	
	11.00 - 12.00	6	1 hours	
	14.00 - 15.00	3	1 hours	
	15.00 - 16.00	2	1 hours	
	16.00 - 17.00	8	1 hours	
	Total	44	7 hours	7 unit/hours

Source: Survey Results, 2022.

Table 4. Average service level (μ) of motorbikes making payments at Samsat Drive Thru Sidoarjo

Trans portation type	Time period (o'clock)	Number of frequencies hourlyarrival	Total working hours	Average arrivals per hour		Service level (μ)
Motorcycle	08.00 - 09.00	12	7 hours	1,71 ~	2	10 unit/hours
	09.00 - 10.00	8		1,14 ~	2	
	10.00 - 11.00	5		0,71 ~	1	
	11.00 - 12.00	6		0,85 ~	1	
	14.00 - 15.00	3		0,42 ~	1	
	15.00 - 16.00	2		0.28 ~	1	
	16.00 - 17.00	8		1,14 ~	2	
	Total	44			10	

Source: Survey Results, 2022

JOURNAL OF WORLD CONFERENCE
VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Table 5. Average arrival rate (λ) of cars making payments at Samsat Drive Thru Sidoarjo

Trans portation type	Time period (o'clock)	Number offrequencies hourlyarrival	Total working hours	Arrival Rate (λ)
Car	08.00 - 09.00	10	1 hours	
	09.00 - 10.00	3	1 hours	
	10.00 - 11.00	6	1 hours	
	11.00 - 12.00	2	1 hours	4,571
	14.00 - 15.00	3	1 hours	~
	15.00 - 16.00	3	1 hours	5
	16.00 - 17.00	5	1 hours	
Total		32	7 hours	1 hours

Source: Survey Results, 2022.

Table 6. Average service level (μ) Cars making payments at Samsat Drive Thru Sidoarjo

Trans portation type	Time period (o'clock)	Number of frequencies hourlyarrival	Total working hours	Average arrivals per hour		Service level (μ)
Mobil	08.00 - 09.00	10	7 hours	1,42 ~	2	8 unit/hours
	09.00 - 10.00	3		0,42 ~	1	
	10.00 - 11.00	6		0,85 ~	1	
	11.00 - 12.00	2		0,28 ~	1	
	14.00 - 15.00	3		0,42 ~	1	
	15.00 - 16.00	3		0,42 ~	1	
	16.00 - 17.00	5		0,71 ~	1	
Total		32			8	

Source: Survey Results, 2022.

Table 7. Average arrival rate (λ) of the planned BRT Bus passing through Samsat Drive Thru Sidoarjo

Route	Time period (o'clock)	Number of frequencies hourlyarrival	Total working hours	Arrival Rate (λ)
Porong - Terminal Bungurasih - Terminal bunder	06.00 - 08.00	4	2	2
	11.00 - 13.00	4	2	
	16.00 - 18.00	4	2	
	Total	12	6 hours	2 bus/hours

Source: East Java Provincial Transportation Office 2022

Table 8. Average service level (μ) of the planned BRT Bus through Samsat Drive Thru Sidoarjo

Trans portati on type	Time period (o'clock)	Number of frequencies hourly arrival	Total working hours	Average arrivals per hour		Service level (μ)
Bus BRT	06.00 - 08.00	4	6 hours	0,66 ~	1	3 bus/hours
	11.00 - 13.00	4		0,66 ~	1	
	16.00 - 18.00	4		0,66 ~	1	
	Total	12			3	

Source: East Java Provincial Transportation Office 2022

Table 9. Average arrival rate (λ) of City In-Province Transport (AKDP) on weekdays via Samsat Drive Thru Sidoarjo

Route	Time period(o'clock)	Number offrequencies hourlyarrival	Total working hours	Arrival Rate (λ)
Terminal Joyoboyo - Bangil – Pasuruan	06.00 - 08.00	9	2 hours	9,333 ~ 10
	11.00 - 13.00	12	2 hours	
	16.00 - 18.00	9	2 hours	
	Total	30		
Terminal Joyoboyo - Gempol – Malang	06.00 - 08.00	7	2 hours	
	11.00 - 13.00	10	2 hours	
	16.00 - 18.00	9	2 hours	
	Total	25		
Grand Total		56	6 hours	10

Source: Survey Results, 2022.

Table 10. Average service level (μ) of City-In-Provincial Transportation (AKDP) through Samsat Drive Thru Sidoarjo

Transportation type	Time period (o'clock)	Number of frequencies hourly arrival	Total working hours	Average arrivals per hour		Service level (μ)
AKDP	06.00 - 08.00	16	6 hours	2,66 ~	3	10 unit/hours
	11.00 - 13.00	22		3,66 ~	4	
	16.00 - 18.00	18		3	3	
	Total	44			10	

Source: Survey Results, 2022.

5. Discussion

5.1. Motorcycle

Payment of motorcycle tax at the Samsat Drive Thru in Sidoarjo uses the Single Channel Single Phase (M/M/1) queue model where there is only 1 (one) service counter. In addition, the discipline of service carried out is First Come First Served (FCFS) where those who come first will get the first service at the counter or server.

From the results of data testing, it is known that the arrival rate of motorbikes paying taxes is (λ) 6.285 or 7 people per hour, while it is known that the Service Time for motorbikes that make payments is (μ) 10 people per hour. Then it can be seen the value of intensity or usagefactor (ρ) = /(kμ) = (6.285)/(1(10)) = 0.6285 < 1

Queue performance that occurs is;

1. $p\ (n)$ = Possible presence of precise and vehicles in the system

$$p\ (n) = (\tfrac{\lambda}{\mu})^{n}\ (1-\tfrac{\lambda}{\mu})$$
$$= \left(\tfrac{6{,}385}{10}\right)^{0} (1-\tfrac{6{,}385}{10})$$
$$= (0{,}6285)^{0}(1-0{,}6285)$$
$$= (1)(0{,}6285)$$
$$= 0{,}3715 = 37{,}15\ \%$$

ISSN: 2656-1174 (online)

2. n = the average number of vehicles in the system
$n = \frac{\lambda}{\mu-\lambda}$
$= \frac{6{,}285}{10-6{,}285}$
$= 1{,}69 \sim 2\ unit$

3. (n) = n number of vehicles in the system
$(n) = \frac{\lambda\mu}{(\mu-\lambda)^2}$
$= \frac{6{,}285\ (10)}{(10-6{,}285)^2}$
$= \frac{62{,}85}{13{,}80}$
$= 4{,}55 \sim 5\ unit$

4. q = average queue length
$q = \frac{\lambda^2}{\mu(\mu-\lambda)}$
$= \frac{6{,}285^2}{10(10-6{,}285)}$
$= \frac{39{,}50}{10(3{,}715)}$
$= 1.06 \sim 2\ unit$

5. d = average time used in the system
$d = \frac{1}{\mu-\lambda}$
$= \frac{1}{10-6{,}285}$
$= 0{,}169\ hours\ or\ 10\ minute$

6. t(d) = possibility to use time d in the system
$t(d) = (\mu-\lambda)e^{(\lambda-\mu)d}$
$= (10-6{,}285)2{,}71^{(6{,}285-10)0{,}169}$
$= (10-6{,}285)2{,}71^{-0{,}627}$
$= 1{,}98$

7. w = average waiting time in queue
$w = \frac{\lambda}{\mu(\mu-\lambda)}$
$= \frac{6{,}285}{10(10-6{,}285)}$
$= 0{,}169\ hours\ or\ 10\ minute$

8. P(d<t) = possibility to use time t or less in System
$p(d < t) = 1 - e^{-(t-p)\mu t}$
$= 1 - e^{-(1-0{,}628)10(0{,}169)}$
$= 1 - e^{-0{,}62}$
$= 1 - 0{,}53 = 0{,}47$

9. P(w<t) = possibility to use time t or less in Queue
$p(w < t) = 1 - pe^{-(t-p)\mu t}$
$= 1 - 0{,}628e^{-(1-0{,}628)10(0{,}169)}$
$= 1 - 0{,}628e^{-0{,}62}$
$= 1 - 0{,}33 = 0{,}67$

Discussion :

From the results of the service analysis of the motorcycle queuing system using the Single Channel Single Phase (M/M/1) model, it can show the optimal level of service, because it meets the steady-state condition where = /(kμ) = (6,285)/(1(10)) = 0.6285 < 1 indicates that the average number of services reaches stability or is still able to serve the arrival of vehicles in the queue. then based on the average vehicle in the n system is 1.69 2 units, the number of vehicles in the system (n) is 4.55 5 units, the average queue length is 1.06 2

JOURNAL OF WORLD CONFERENCE
VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

units, the average number usedin the system is 0.169 hours or 10 minutes and the average waiting time in the queue is 0.169 hours or 10 minutes.

5.2. Car

Payment of car tax at the Samsat Drive Thru in Sidoarjo uses a single line queue (M/M/1) model where there is only 1 (one) service counter. In addition, the service discipline applied is firstcome first served (FCFS) where the first come first will get the first service at the counter or server. From the results of data testing, it is known that the arrival rate of cars paying taxes is (λ) 4.57 or 5 people per hour, while it is known that the service time for cars that make payments is (μ) 8 people per hour. Then it can be seen the value of the intensity or usage factor = /(kμ) = (4,57
)/(1(8)) = 0,571<1

The queue performance that occurs is;

1. $p\ (n)$ = Possible presence of precise and vehicles in the system
   $p\ (n) = (\frac{\lambda}{\mu})^n\ (1 - \frac{\lambda}{\mu})$
   $= \left(\frac{4,57}{8}\right)^0 (1 - \frac{4,57}{8})$
   $= (0,571)^0(1 - 0,429)$
   = 0,571 = 57,1 %

2. n = the average number of vehicles in the system
   $n = \frac{\lambda}{\mu - \lambda}$
   $= \frac{4,57}{8 - 4,57}$
   $= 1,33 \sim 2\ unit$

3. (n) = n number of vehicles in the system
   $(n) = \frac{\lambda\mu}{(\mu - \lambda)^2}$
   $= \frac{4,57\ (8)}{(8 - 4,57)^2}$
   $= \frac{36,56}{11,7}$
   $= 3,12 \sim 4\ unit$

4. q = average queue length
   $q = \frac{\lambda^2}{\mu(\mu - \lambda)}$
   $= \frac{4,57^2}{8(8 - 4,57)}$
   $= \frac{20,88}{37,15}$
   $= 0,56 \sim 1\ unit$

5. d = average time used in the system
   $d = \frac{1}{\mu - \lambda}$
   $= \frac{1}{8 - 4,57}$
   $= 0,29\ hours\ or\ 17\ minute$

6. $t(d)$ = possibility to use time d in the system
   $t(d) = (\mu - \lambda)e^{(\lambda - \mu)d}$
   $= (8 - 4,57)2,71^{(4,57 - 8)0,169}$
   $= (8 - 4,57)2,71^{-0,338}$
   $= 1,42$

7. w = average waiting time in queue
   $w = \frac{\lambda}{\mu(\mu - \lambda)}$
   $= \frac{4,57}{8(8 - 4,57)}$
   $= 0,166\ hours\ or\ 10\ minute$

8. P(d<t) = possibility to use time t or less in System

$$p(d < t) = 1 - e^{-(t-p)\mu t}$$
$$= 1 - e^{-(1-0,571)8(0,29)}$$
$$= 1 - e^{-0,99}$$
$$= 1 - 0,371 = 0,629$$

9. P(w<t) = possibility to use time t or less in Queue

$$p(w < t) = 1 - pe^{-(t-p)\mu t}$$
$$= 1 - 0,571e^{-(1-0,571)8(0,29)}$$
$$= 1 - 0,571e^{-0,99}$$
$$= 1 - 0,211 = 0,789$$

Discussion :

From the results of the analysis of the car queuing system service using the Single Channel Single Phase (M/M/1) model, it can show the optimal service level, because it meets the steady- state condition where = /(kμ) = (4,57)/ (1(8)) = 0.59 < 1 indicates that the average number of services reaches stability or is still able to serve the arrival of vehicles in the queue. then based onthe average vehicle in the n system is 1.33 2 units, the number of vehicles in the system (n) is 3.144 units, the average queue length is 0.56 1 unit, the average number used in the system is 0.29 hoursor 17 minutes and the average waiting time in the queue is 0.166 hours or 10 minutes.

5.3. City In-Province Transport (AKDP) and Angkot / MPU

The author plans public transportation such as City Transportation in Provision (AKDP) and Angkot / MPU using the same shelter / server, where the queue uses Multi Channel - Single Phase, namely the facilities served will come, enter and form a queue on one line / service flow and Next, you will be faced with several available facilities or shelters. Then the results of the frequency of arrival rate data (λ) for City In-Province Transport (AKDP) in table 4.1 & Angkot / MPU in table 4.10 are added up, where the average arrival of City In-Province Transport (AKDP)(λ) is 11 people per hour + Angkot / MPU 10 people per hour = 21 units per hour. Likewise, the level of service (μ) for City In-Province Transportation (AKDP) in table 4.12 & Angkot / MPU intable 4.3 are added up, where the average level of service for City In-Province Transport (AKDP)(μ) is 12 people per hour + Angkot / MPU (μ) 11 people per hour = 23 units per hour. is known :

Arrival Rate (λ) = 21 units per hour
Service Rate (μ) = 23 units per hour
Possible Number of Shelters (k) = 3
Intensity or usage factor (ρ) = /(kμ) = (2)/(3(23)) = 0.304 < 1
Queue performance that occurs is:

1. p (n) = the possibility of the presence of the right and the vehicle in the system 0 ≤ $n < k$

$$= \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n \rho(0)$$
$$= \frac{1}{0!}\left(\frac{21}{23}\right)^{\cup} 0,304$$
$$= \frac{1}{1!}\left(\frac{21}{23}\right)^{\cup} 0,304$$
$$= 0,304$$

2. p (n) = the possibility of the presence of the right and the vehicle in the system n≥k

$$\frac{1}{(k!k)^{n-k}}\frac{\lambda^n}{\mu}\rho(0)$$
$$\frac{1}{(3!3)^{3-3}}\frac{21^3}{23}\rho(0,304)$$
$$\frac{1}{(9)^{\cup}}(0,913)^3\ 0,304$$
$$= 0,277$$

3. P(0) = the probability that there are zero vehicles in the system

$$= \frac{1}{\left[\sum_{n=0}^{k-1}(\frac{\lambda/\mu}{n!})^n\right] + \frac{1}{k!}(\frac{\lambda}{\mu})^k\frac{k\mu}{k\mu-\lambda}}$$
$$= \frac{1}{(\frac{21/23}{0!})^0(\frac{21/23}{1!})^1(\frac{21/23}{2!})^2 + \frac{1}{3!}(\frac{21}{23})^3(\frac{2(23)}{2(23)-21})}$$
$$= \frac{1}{(1)(1)+(0,416)+(0,166)(0,761)(1,84)}$$

JOURNAL OF WORLD CONFERENCE

VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

$$= \frac{1}{1,648}$$
$$= 0,60 = 60\%$$

4. n = the average number of vehicles in system

$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0) + \frac{\lambda}{\mu}$$
$$= \frac{21.23(\frac{21}{23})^3}{(3-1)!(3.23-21)^2} 0,60 + \frac{21}{23}$$
$$= \frac{367,56}{4068} 0,60 + \frac{21}{23}$$
$$= (0,09)0,60 + 0,913$$
$$= 0,96 = 1\ unit$$

5. q = average queue length

$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0)$$
$$= \frac{21.23(\frac{21}{23})^3}{(3-1)!(3.23-21)^2} 0,60$$
$$= \frac{483,33}{1250} 0,60$$
$$= (o, 321)0,60$$
$$= 0,19 = 1\ unit$$

6. d = average time spent in the system

$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0) + \frac{1}{\mu}$$
$$= \frac{21.23(\frac{21}{23})^3}{(3-1)!(3.23-21)^2} 0,60 + \frac{1}{23}$$
$$= \frac{17,50}{4068} 0,60 + \frac{1}{23}$$
$$= (0,04)0,60 + 0,043$$
$$= 0,067\ hours\ or\ 4\ minute$$

7. w = average waiting time in the system

$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0)$$
$$= \frac{21.23(\frac{21}{23})^3}{(3-1)!(3.23-21)^2} 0,60$$
$$= \frac{17,50}{4608} 0,60$$
$$= (0,04)0,60$$
$$= (0,04)0,60 = 0,024\ hours\ or\ 1,5\ minute$$

8. p(d≤t) = possibility to use time t or less in the system

$$= 1 - e^{-\mu t} \left\{1 + \frac{p(n \geq k)}{k}\, x\, \frac{1-e^{-\mu k t\left\{1-\left(\frac{\lambda}{\mu k}\right)-\left(\frac{1}{k}\right)\right\}}}{1-\left(\frac{\lambda}{\mu k}\right)-\left(\frac{1}{k}\right)}\right\}$$
$$= 1 - 2,71^{-23(0,06)} \left\{1 + \frac{0,60(3)}{3}\, x\, \frac{1-2,71^{-23(3)(0,06)\left\{1-\left(\frac{21}{23(3)}\right)-\left(\frac{1}{3}\right)\right\}}}{1-\left(\frac{21}{23(3)}\right)-\left(\frac{1}{3}\right)}\right\}$$
$$= 1 - 0,21 \left\{1,6\, x\, \frac{1-2,71^{-1,50}}{1-0,304-0,333}\right\}$$
$$= 0,79\{1,6\, x\, 0,064\} = 0,08 = 4,8\ minute$$

9. p(n≥k) = possibility to have to wait in the queue

$$= \sum_{n-k}^{\infty} p(n) = \left(\frac{\lambda}{\mu}\right)^k \frac{p(0)}{k!\frac{1}{\mu k}}$$
$$= \sum_{n-k}^{\infty} p(n) = \left(\frac{21}{23}\right)^3 \frac{0,60}{3!\frac{1}{23(3)}}$$
$$= \sum_{n-k}^{\infty} p(n) = 0,761\ \frac{0,60}{0,78}$$

$= \sum_{n-k}^{\infty} p(n) = 0{,}58 = 1\ unit$

Discussion :

The type of queuing system used by City In-Province Transport (AKDP) & Angkot / MPU which makes a temporary stop to look for passengers at Drive Thru Sidoarjo is Multi Channel Single Phase which forms a queue on one line / service flow and will then be faced with 3 facilities or available shelters. Basedon the calculations, it shows that the service level is optimal, because it meets the steady-state condition where = /(kμ) = (21)/(3(23)) = 0.304 < 1, indicating that the average number of services is stability or still capable serve the arrival of vehicles in the queue. then the possibility of zero vehicles in the system is 0.6 or 60%, which means the probability of 0 units in the system is still low, the number of vehicles in the system (n) is 0.96 1 unit, the average queue length is 0.19 1 unit, the average number used in the system is

0.067 hours or 4 minutes and the average waiting time in the queue is 0.024 hours or 1.5 minutes, the possibility to use time t or less in the system is 0.08 or 4, 8 minutes and the probability of having to wait inthe queue is 0.58 1 unit.

5.4. Bus Rapid Transit (BRT) Plan

The author plans the Bus Rapid Transit (BRT) public transportation, using the Single

Channel - Single Phase queue, namely the facilities served will come, enter and form a queue on one line / flow of service and will then be faced with one available shelter facility. From the results of data testing, it is known that the arrival rate of Bus Rapid Transit (BRT) is (λ) 2 buses per hour, while the Bus Rapid Transit (BRT) Service Time is () 3 buses per hour. then it can be seen the intensity value or usage factor = /(kμ) = 2/(2(3)) = 0.333 < 1

Queue performance that occurs is:

1. p (n) = the possibility of the presence of the right and the vehicle in the system 0 ≤n <
$$= \frac{1}{n!}\frac{3}{2}^{n}\ \rho(0)$$
$$= \frac{1}{1}\frac{3}{2}^{0}\ 0{,}333$$
$$= 0{,}333 = 33{,}3\%$$

2. p (n) = the possibilty of the presence of the right and the in the system n≥k
$$= \frac{1}{(k!k)^{n-k}}\frac{\lambda}{\mu}^{n}\ \rho(0)$$
$$= \frac{1}{(2!2)^{2-2}}\frac{2}{3}^{1}\ 0{,}333$$
$$= 1(0{,}666)0{,}333$$
$$= 0{,}221$$

3. p (0) = the probability that there are zero vehicles in the system
$$= \frac{1}{\left[\sum_{n=0}^{k-1}(\frac{\lambda/\mu}{n!})^{n}\right]+\frac{1}{k!}(\frac{\lambda}{\mu})^{k}\frac{k\mu}{k\mu-\lambda}}$$
$$= \frac{1}{(\frac{2/3}{0!})^{0}(\frac{2/3}{1!})^{1}+\frac{1}{2!}(\frac{2}{3})^{2}(\frac{2(3)}{2(3)-2})}$$
$$= \frac{1}{(1)(1)+(0{,}5)+(0{,}444)(1{,}5)}$$
$$= \frac{1}{1{,}333}$$
$$= 0{,}75 = 75\%$$

4. n = the average number of vehicles in the system
$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^{k}}{(k-1)!(k\mu-\lambda)^{2}}p(0)+\frac{\lambda}{\mu}$$
$$= \frac{2.3(\frac{2}{3})^{2}}{(2-1)!(2.3-2)^{2}}0{,}75+\frac{2}{3}$$
$$= \frac{2{,}664}{4}0{,}75+\frac{2}{3}$$
$$= (0{,}666)0{,}75+0{,}666$$

$= 1{,}16 = 1\ unit$

5. q = average queue length

$$= \frac{\lambda\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0)$$
$$= \frac{2.3(\frac{2}{3})^2}{(2-1)!(2.3-2)^2} 0{,}75$$
$$= \frac{2{,}664}{4} 0{,}75$$
$$= (0{,}666)0{,}75$$
$$= 0{,}49 = 1\ unit$$

6. d = average time spent in the system

$$= \frac{\mu(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0)$$
$$= \frac{3(\frac{2}{3})^2}{(2-1)!(2.3-2)^2} 0{,}75$$
$$= \frac{1{,}332}{16} 0{,}75$$
$$= (0{,}08)0{,}75$$
$$= 0{,}06\ hours = 3{,}6\ minute$$

7. w = average waiting time in the system

$$= \frac{\lambda(\frac{\lambda}{\mu})^k}{(k-1)!(k\mu-\lambda)^2} p(0)$$
$$= \frac{2(\frac{2}{3})^2}{(2-1)!(2.3-2)^2} 0{,}75$$
$$= \frac{0{,}888}{16} 0{,}75$$
$$= (0{,}05)0{,}75$$
$$= 0{,}041\ hours = 2{,}5\ minute$$

8. p (d≤t) = possibility to use time t or les in the system

$$= 1 - e^{-\mu t}\left\{1 + \frac{p(n\geq k)}{k}\, x\, \frac{1-e^{-\mu k t\left\{1-\left(\frac{\lambda}{\mu k}\right)-\left(\frac{1}{k}\right)\right\}}}{1-\left(\frac{\lambda}{\mu k}\right)-\left(\frac{1}{k}\right)}\right\}$$
$$= 1 - 2{,}71^{-3(0{,}06)}\left\{1 + \frac{0{,}75(2)}{2}\, x\, \frac{1-2{,}71^{-3(2)(0{,}06)\left\{1-\left(\frac{2}{3(2)}\right)-\left(\frac{1}{2}\right)\right\}}}{1-\left(\frac{2}{3(2)}\right)-\left(\frac{1}{2}\right)}\right\}$$
$$= 1 - 0{,}83\left\{1{,}75\, x\, \frac{1-2{,}71^{-0{,}06}}{1-0{,}333-0{,}333}\right\}$$
$$= 0{,}17\{1{,}75\ x\ 0{,}149\} = 0{,}04 = 2{,}4\ minute$$

9. p(n≥k) = possibility to have to wait in the queue

$$= \sum_{n-k}^{\infty} p(n) = \left(\frac{\lambda}{\mu}\right)^k \frac{p(0)}{k!\frac{1}{\mu k}}$$
$$= \sum_{n-k}^{\infty} p(n) = \left(\frac{2}{3}\right)^2 \frac{0{,}75}{2!\frac{1}{3(2)}}$$
$$= \sum_{n-k}^{\infty} p(n) = 0{,}444\ \frac{0{,}75}{0{,}332}$$
$$= \sum_{n-k}^{\infty} p(n) = 1{,}003 = 1\ unit$$

Discussion :

The type of queuing system used by the planned Bus Rapid Transit (BRT) which makes a temporary stop to look for passengers at Drive Thru Sidoarjo is Multi Channel Single Phase which forms a queue on one line / service flow and will then be faced with 2 available facilities or shelters. Based on the calculation, it shows that the service level is optimal, because it fulfills the steady-state condition where = /(kμ) = (2)/(2(3)) = 0.333 < 1 indicates that the average number of servicesis stability or still capable serve the arrival of vehicles in the queue. then the possibility of zero vehicles in the system is 0.75 or 75%, which means the probability of 0 units in the system is stilllow, the number of vehicles in the system (n) is 0.96 1 unit, the average queue length is 0.49 1 unit, the average number used in the system is 0.06 hours 3.6 minutes and the average waiting time in the queue is

VOLUME 4 | NUMBER 4 | JULY 2022
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

0.041 hours or 2.5 minutes, the possibility to use time t or less in the system is 0, 04 hours or 2.4 minutes and the probability of having to wait in the queue is 1.003 1 unit.

6. Conclusion

Based on the results of data processing and the discussion in the previous section, the following conclusions can be drawn:

6.1. Motorcycle

The type of queuing system used by motorbikes making payments at Drive Thru Sidoarjo is Single Channel Single Phase (M/M/1) where there is one facility and one service stage by applying the discipline of First Come First Server (FCFS). Based on the calculation, it shows thatthe level of service is optimal, because it meets the steady-state condition where $= /(k\mu) = (6.285)/(1(10)) = 0.6285 < 1$ indicates that the average number of services reaches stability or still able to serve the arrival of vehicles in the queue.

6.2. Car

The type of queuing system used by Cars making payments at Drive Thru Sidoarjo is SingleChannel Single Phase (M/M/1) where there is one facility and one service stage by applying the discipline of First Come First Server (FCFS). Based on the calculation shows that the level of service is optimal, because it meets the steady-state condition where $= /(k\mu) = (4,57)/(1(8)) = 0,571 < 1$ indicates that the average number of services reaches stability or still able to serve the arrival of vehicles in the queue.

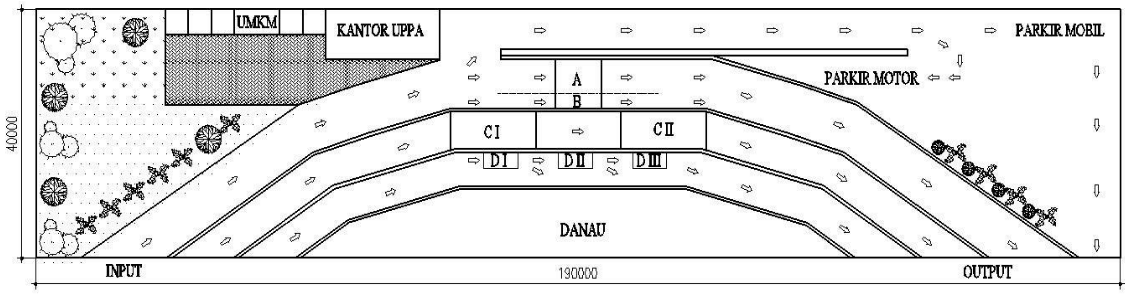
6.3. City In-Province Transport (AKDP) & Angkot / MPU

The type of queuing system used by City Inner Province Transport (AKDP) & Angkot / MPU which makes a temporary stop to look for passengers on the Sidoarjo Drive Thru Disamsat is Multi Channel Single Phase (M/M/3) which forms a queue on one line / service flow and Next,they will be faced with the available facilities or shelters. Based on calculations and data analysis shows the need for shelters, namely 3 channels, where with these 3 shelters the arrival and queue rates are optimal, because they meet the steady-state condition, namely $= /(k\mu) = (21)/(3(23)) = 0.304 < 1$ indicates that the average number of services is stability or is still able to serve the arrivalof vehicles in the queue.

6.4. Bus Rapid Transit (BRT) Plan

The type of queuing system used by Bus Rapid Transit (BRT) which makes temporary stops to look for passengers on the Drive Thru Sidoarjo is Single Channel Single Phase (M/M/2) which forms a queue in one line / service flow and will then face the facility or available shelters. Based on calculations and data analysis shows the need for shelter, namely 2 channels, where with these 2 shelters the arrival and queue rates are optimal, because they meet the steady-state condition, namely $= /(k\mu) = (2)/(2(3)) = 0.333 < 1$ indicates that the average number of services reaches stability or is still able to serve the arrival of vehicles in the queue.

7. Plan Picture



AGENDA	
TYPE	KETERANGAN
A	LOKET PEMBAYARAN MOBIL
B	LOKET PEMBAYARAN SEPEDA MOTOR
C1, C2	SHELTER BUS RAPID TRANSIT (BRT)
D1, D2, D3	SHELTER ANGKUTAN KOTA DALAM PROVINSI (AKDP) & ANGKOT / MPU

Figure 1. Drawing of the plan to add shelter

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