Analysis of the Effectiveness of Cashier Service with a Simulation of the Queue System

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Abstract: The highly competitive nature of the retail industry, especially in the daily household needs segment, is influenced by various factors that impact consumer behaviour. These factors include product pricing, availability, discounts, warranties, supporting facilities, and customer service. Trasmart and Superindo are two major retailers that offer a complete range of products and frequently provide discounts and gifts to their customers. However, customers experience dissatisfaction due to an average waiting time of 5 to 7 minutes at their six servers, which may result in cancelled purchases. The Arena software simulation results indicate that adding one server can reduce waiting time to 3.2 minutes per customer, at an additional cost of IDR 125,000 per day. Meanwhile, adding one server to Trasmart can decrease waiting time to 4.7 minutes per customer, at an extra cost of IDR 142,000 per day. Alternatively, investing in cashier worker training, without adding servers, can reduce waiting time to 3.8 minutes per customer in Superindo, with an investment cost of IDR 3.4 million, and 3.5 minutes per customer, with an investment cost of IDR 4.1 million. In conclusion, this research highlights the importance of efficient queuing systems and customer service in enhancing customer satisfaction and retail profitability.

1 INTRODUCTION

We often see queuing problems happening around us, for example, as queuing for services at Minimarkets, refueling at POM, queuing when we want to cut hair at a salon, queuing when making transactions at a bank, or when we visit a shopping center, many visitors waiting in line to make payment at the cashier. Queuing certainly causes a sense of saturation and boredom, or we must queue when buying food at the street vendors, even annoyed the queue, primarily if the column occurs for a long time (Wei et al., 2017). Services are fast-paced and the most sought-after economic place in people's lives today (Keshanchi et al., 2017). However, we find many queuing problems in the service sector because the service sector has an irregular/random staff (Bahadori et al., 2014). We can see that upon arrival, or the services needed to serve customers in the service sector.

The best service is to maximize service to customers/consumers effectively so that there are no long queues and consumers do not wait long and feel satisfied with our services (Wei et al., 2017) (Kierzkowski and Kisiel, 2017). Consumers complain about our services whenever the service must evaluate the system because of many problems. Therefore, the service is updated at any time to make consumer confidence in the service not disappointing and will make consumers very happy if the service we do is high-speed and effective (Tychalas and Karatza, 2020). This is important because those queuing for services have different ages and fatigue levels. So, consumers will feel less comfortable if there is always a reasonably dense queue. Shopping centers for daily needs are in more than just traditional markets, such as supermarkets. Supermarkets play an essential role in selling daily necessities. Supermarkets are ready to serve consumers who need their daily needs, one of which is Transmart Supermarket and Superindo in Surabaya. The two supermarkets are ready to serve consumers who need certain goods that do not exist in traditional markets.

2 LITERATURE REVIEW

The waiting line (queue) is the number of queues in the form of people/goods to be served (Pan et al., 2015). Queues are a condition where the number of

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physical units (visitors) of people/goods to get services from inadequate facilities (servers) causes people/goods to wait a long time (Hu et al., 2018). The arrival of visitors or customers is predicted at the same time as the facility. The form highly depends on the number of customers/goods available in the facility (Huihui et al., 2016). The service form is greatly influenced by the time of service for customers/goods (Bahadori et al., 2014) (Tuan, 2020). Many customers/goods are in the service facility and may be independent during the old state. The number of services for consumers/goods or service points in a facility may include one or more service facilities (Mutingi et al., 2015).

2.1 Queue System

Server capability depends on the number of customers/goods who queue and are served by the server (Monteiro et al., 2021). There is a facility with a server that can accommodate any number of consumers/goods, arguably has no limit, or frees the number of customers to queue (Banerjee and Hecker, 2016). On the other hand, there is also a facility with a server that can only accommodate a few consumers/goods because it has a minimal capacity. Queue waiting time highly depends on a service being available and operating at the facility (Pan et al., 2015) (McCormack and Coates, 2015). The more effective service in a second level or facility is that the waiting time will be shorter and shorter. If there is service, then the waiting time for the sangha takes quite a long time. In essence, the creation of queues is due to the service or service needing to be more effective at work and the crowds of consumers and customers (Alodhaibi et al., 2018).

Therefore, the effectiveness of a queue is very dependent on the facilities provided. In addition, the support facilities will be excellent because consumers/goods do not experience long queues. A queuing system with facilities must pay full attention to when a crowd of consumers/goods comes so there is no buildup. Queue structure has two components (Sudtachat et al., 2016): (1) waiting line, (2) facility service, and (3) facility services are facilities that provide good or bad facilities because they can affect the time of servicing customers/goods.

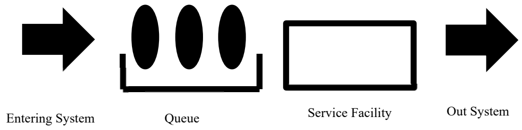


Figure 1. General Structure of the Queuing Model (Huihui et al., 2016)

The queuing method model makes it easy to balance service costs by using queuing costs (Tychalas and Karatza, 2020) (Monteiro et al., 2021): (1) the Time or Hours of Consumers when queuing (McCormack and Coates, 2015); (2) The number of queues made by consumers; (3) The time required by consumers in queuing (Hu et al., 2018) (Gani et al., 2018); (4) How many customers are waiting in line?

Queuing discipline shows that the first person/customer who arrives must be served first. There are four disciplines in the queue (Tuan, 2020) (Banerjee and Hecker, 2016):

- FIFO means the service must serve the first visitor (Pan et al., 2015). So, for example, in Pharmacy counters, Cinemas, Gas Stations, etc., in FIFO, the first visitor to come or enter must be the first visitor to be served or finished.
- LIFO means visitors or people who come and arrive last first out (Alodhaibi et al., 2018). For example, the queuing system in the elevator for the same floor.
- SIRO means that the service is carried out randomly and does not necessarily mean that the first person to come must be served (Fang et al., 2016).
- PS means that services are focused or prioritized on visitors who have specific problems and must have top priority over customers who do not have health problems, even if the customer or consumer comes at the beginning or is the first to arrive (Alodhaibi et al., 2018). Like the elderly 65 and over than others at a puskesmas or other health service.

2.2 Queue Formulation

Some of the formulations used in this study are as follows (Bahadori et al., 2014):

- The average time between arrivals = $\frac{Total\ arrival\ time}{(production\ quantity)-1}$ (1)
- Average Processing Time = $\frac{Total\ processing\ time}{production\ quantity}$ (2)
- Average Waiting Time (Queue Time) = $\frac{Total\ queue\ time}{production\ quantity}$ (3)
- Average Processing Delay Time (Delay Time) = $\frac{Total\ processing\ delay\ time}{production\ quantity}$ (4)
- Average Queue Length = $\frac{production\ quantity}{total\ service\ time}$ (5)

- Average Time in the System $= \frac{Total\ product\ time\ ini\ system}{production\ quantity}$ (6)
- Probability of customers waiting in the queue $= \frac{Total\ raw\ materials\ waiting}{quantity\ of\ raw\ materials}$ (7)
- System utility $= 1 - \frac{Process\ delay\ time}{total\ observation\ time}$ (8)

3 RESEARCH METHODS

This study conducted direct observation at the Transmart and Superindo supermarkets in the Surabaya area. In observing supermarket cashier services, two samples or servers were taken each to represent the number of cashiers in the supermarket. Then the data is processed using Ms. Excel before proceeding with modelling using Arena. Finally, the observation data results are processed using the Arena Software approach to determine the effectiveness of the two supermarkets, Transmart and Superindo.

- Problem Determination
  Each research must determine what problems are obtained; with problems, the research will be successful.
- Data Collection and Model
  Data collection was obtained from direct observation (Transmart and Superindo), and random data was used for the model.
- Validation
  Validation is essential when conducting simulation studies because of the validity of the data we examine.
- Program the computer
  Model builder to be used for simulation studies.
- Running the program
  Run the program to find out the output/input for validation purposes.
- Validation
  The second validation is used to test the validity of the input and output models.

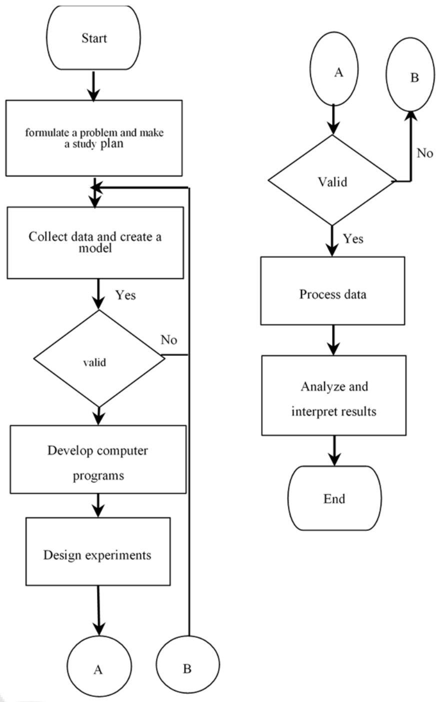


Figure 2. Flowchart.

4 RESULT AND DISCUSSION

Through data processing using Software Arena 14.0, the following results are obtained:

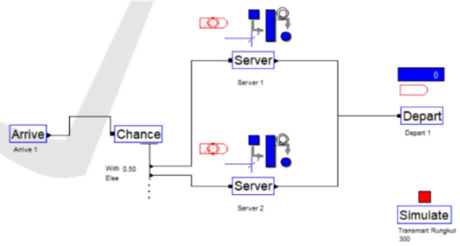


Figure 3. Model Transmart System

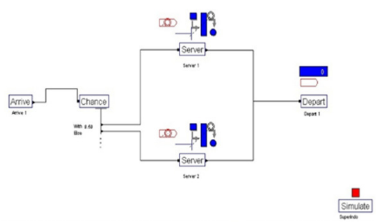
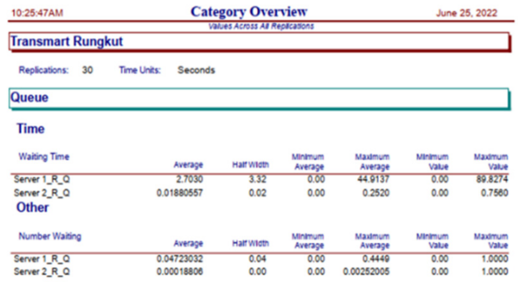


Figure 4. Model Superindo

The results of the data processing method of the Transmart Rungkut Surabaya system based on the approach with the Arena software obtained results such as:

(a)

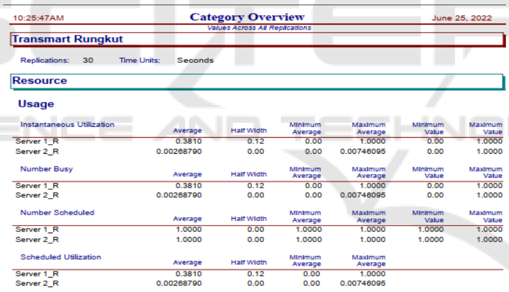


(b)

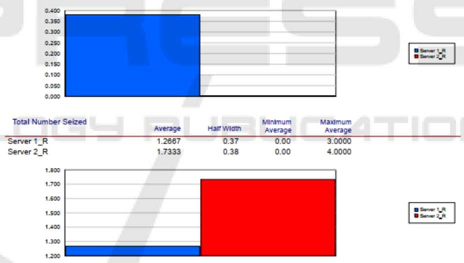
Figure 5. (a) and (b) Output Category Overview Arena Software of Queue for Transmart.

Based on the expenditure of the data obtained as shown above and obtained the following information:

- In the case of waiting time, queues at the Transmart Rungkut Surabaya cashier service have a minimum waiting time of 0.00 minutes, and then the maximum waiting time is 60.8274 minutes. The average waiting time is 2.7030 minutes at the Cashier 1 service at Transmart Rungkut Surabaya.
- In the case of waiting time for the queue at the Transmart Rungkut Surabaya cashier service, the minimum waiting time is 0.00 minutes. Then the maximum waiting time is 0.7530 minutes, and the average waiting time is 0.0188 minutes at the Cashier 2 service at Transmart Rungkut. Surabaya



(a)



(b)

Figure 6. (a) and (b) Output Category Overview Arena Software of Resources for Transmart.

Based on the expenditure of the data obtained as shown above and obtained the following information:

- In processing the Transmart Arena, the average waiting time is 2.7030 on the server or cashier 1 and 0.0188 on the server or cashier 2. From these results, Transmart has an effective cashier service performance in the queuing system, so it does not cause long queues. in service at the cashier.

From these three conclusions, the top service at Super Indo Surabaya was obtained because Overview of Queue for Superindo

- the waiting time was 0.0188 minutes. It was obtained at cashier service two at Transmart Surabaya

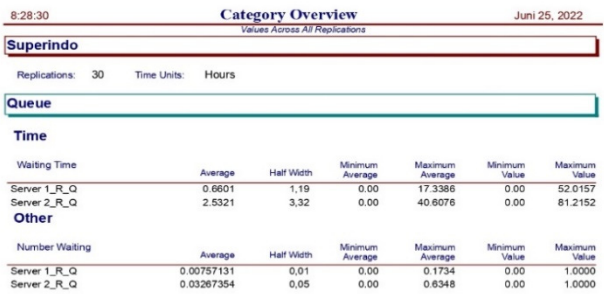
8:28:30 Category Overview Juni 25, 2022
Values Across All Replications

Superindo

Replications: 30 Time Units: Hours

Key Performance Indicators

System	Average
Number Out	3



8:28:30 Category Overview Juni 25, 2022
Values Across All Replications

Superindo

Replications: 30 Time Units: Hours

Queue

Time

Waiting Time	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Server 1_R_Q	0.6601	1,19	0.00	17.3386	0.00	52.0157
Server 2_R_Q	2.5321	3,32	0.00	40.6076	0.00	81.2152

Other

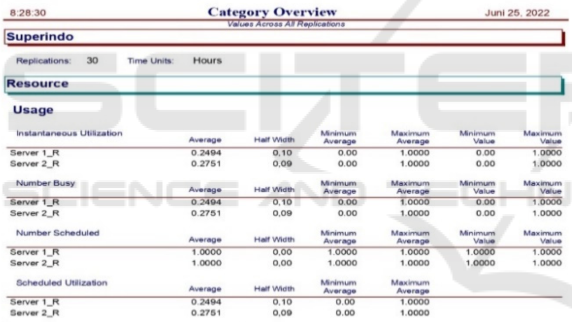
Number Waiting	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Server 1_R_Q	0.00757131	0,01	0.00	0.1734	0.00	1.0000
Server 2_R_Q	0.03267354	0,05	0.00	0.6348	0.00	1.0000

(a) (b)

Figure 7. (a) and (b) Output Arena Software Category.

Based on the expenditure of the data obtained as shown above and obtained the following information:

- In the case of waiting time for the queue at the Super Indo Surabaya cashier service, the minimum waiting time is 0.00 minutes, and then the maximum waiting time is 1.0000 minutes. The average waiting time is 0.6601 minutes at the Cashier 1 service at Super Indo. Surabaya
- In the case of waiting time for the queue at the Superindo Surabaya cashier service, the minimum waiting time is 0.00 minutes. Then the maximum waiting time is 1.0000 minutes. Then the average waiting time is 1.5321 minutes at the Cashier 2 service at Super Indo Surabaya



8:28:30 Category Overview Juni 25, 2022
Values Across All Replications

Superindo

Replications: 30 Time Units: Hours

Resource

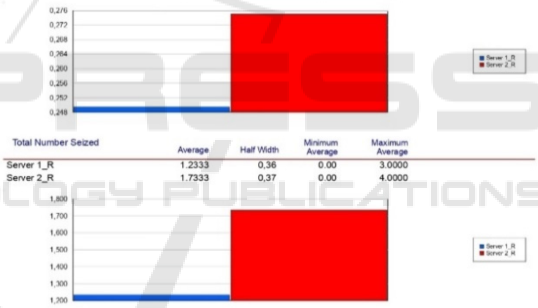
Usage

Instantaneous Utilization	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Server 1_R	0.2494	0,10	0.00	1.0000	0.00	1.0000
Server 2_R	0.2751	0,09	0.00	1.0000	0.00	1.0000

Number Busy	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Server 1_R	0.2494	0,10	0.00	1.0000	0.00	1.0000
Server 2_R	0.2751	0,09	0.00	1.0000	0.00	1.0000

Number Scheduled	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Server 1_R	1.0000	0,00	1.0000	1.0000	1.0000	1.0000
Server 2_R	1.0000	0,00	1.0000	1.0000	1.0000	1.0000

Scheduled Utilization	Average	Half Width	Minimum Average	Maximum Average
Server 1_R	0.2494	0,10	0.00	1.0000
Server 2_R	0.2751	0,09	0.00	1.0000



Total Number Seized	Average	Half Width	Minimum Average	Maximum Average
Server 1_R	1.2333	0,36	0.00	3.0000
Server 2_R	1.7333	0,37	0.00	4.0000

Figure 8. (a) and (b) Output Arena Software Category Overview of Resources for Superindo

Based on the expenditure of the data obtained as shown above and obtained the following information:

- In the processing of Arena Superindo, the average waiting time is 0.6601 on the server or cashier 1 and 2.5321 on the server or cashier 2. From these results, Transmart has an effective cashier service performance in the queuing system, so it does not cause long queues. in service at the cashier.
- From these three conclusions, the top service at Super Indo Surabaya was obtained because the waiting time was 0.6601 minutes. It was obtained at cashier service one at Super Indo Surabaya.

A comparison of Transmart and Superindo Average Time can be seen in the table below:

Table 1: Comparison of Transmart and Superindo Average Time

Waiting Time	Transmart	Superindo
Server 1	2,7030	0,6601
Server 2	0,0188	2,5321
Average	1,3609	1,5961

The entity waiting time at Transmart and Superindo in Surabaya obtained an average waiting time for Transmart Rungkut Surabaya at cashier one and cashier two services 1.3609. For Superindo Surabaya, the average time obtained was 1.5961.

5 CONCLUSIONS

After direct observations and data processing using Arena software, the results showed that cashier services at Transmart supermarkets were more effective than at Superindo supermarkets. This happens in the Transmart queuing system is better because the service provided is high-speed, so it does not cause buildup in an extensive system, and there is no delay in the Transmart queuing system. The average waiting time for the two Transmart cashier samples of 1.3609; this value is smaller than the Superindo supermarket with a value of 1.5961. Because of this, the queuing system and service at Superindo cashiers must be improved to achieve a better level of effectiveness.

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