Analysis of Queue System Simulation on Banks with Arena System Modeling

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Abstract

Today the banking world is experiencing a very rapid development. Therefore, it needs a service system that is able to provide satisfactory service for customers. One of the problems that often occur in the service system at the bank is the occurrence of queues that cause customers to wait too long to get services. The queue that arises is due to the number of customers who will be served beyond the available service capacity. The purpose of this research is to improve the efficiency of services that occur in this bank by reducing waiting time and work in progress on its service system. In this case, the researchers used Software Arena Simulation with discrete event simulation whose output results describe the characteristics and behaviors of the observedsystem. This study resulted in two senarioimprovements, namely adding one additional server and adding one operator in an existing server. As a result, the waiting time decreased to 13,2392 minutes and the work in progress decreased to 26.0288 for scenario one, and the decrease in waiting time to 3.3675 minutes and the decrease in work in progress to 3.8696 for scenario two. Therefore, it is recommended for this bank to add one operator in an existing server to speed up service times and reduce queue numbers.

Keywords
Queue Simulation, Bank, Waiting Time, Work in Progress, Arena

1. Introduction

Queues often occur in everyday life. Generally, everyone has been waiting in a waiting line at a service facility before getting the service they need. One place that is inseparable from the queue problem is thebank. Acommon problem with the bank's service system is the occurrence of queues that cause customers to wait too long to get services. The queue that arises is due to the number of customers who will be served beyond the available service capacity. Currently the bank is one of the most important actors in the economy of a country,m assyrian general and industry is in desperate need of bank services to facilitate its activities.

According to Kasmir (2002), banks can simply be interpreted as financial institutions whose business activities are to raise funds from the community and channel the funds back to the community and provide other bank services. One of the things that can be done by banks to increase the number of customers is by providing satisfactory service for customers, for example by speeding up service times and reducing queues at banks. In terms of customer satisfaction to this service, can not be separated from the role of bank tellers and customer service that interact directly with customers when making transactions. The length of waiting time in the queue can affect customer satisfaction with the bank's services.

To improve customer satisfaction by accelerating the service,it is necessary to simulate queues with the aim to improve the efficiency of services that occur in this bank by reducing waiting time and work in progress on sistem services. In this case, the researchers used Arena Simulation software with discrete event simulation whose output results describe the characteristics and behaviors of the observed system. This research was conducted at This bank located in Pondok Bambu, East Jakarta. At thebank, it was found there were still queues in the service process causes less efficient service and can affect customer satisfaction.

1.1 Simulation Objectives

This research aims to improve the efficiency of services that occur in this bank by reducing waiting time and work in progress on sistem services by proposing two scenarios to reduce the number of queues. will test both of these improvements on Arena software to get utilization value, wait time, and productivity.

This study resulted in two improvement scenarios, namely adding one additional server and adding one operator in an existing server. As a result, there is a decrease in waiting time and a decrease in work in progress for each scenario.

1.2 Scope of Problem

This research is focused on discussions with several scopes of the following issues:

a. This research was conducted at the bank and focused on the queue system in the teller service and customer service section.
b. The study only coversarrivals, length ofservice, and queues that occur in the waiting room.
c. The research was conducted using Arena 14.0 software to simulate a queue system that would be an improvement.
d. This study looked at the utility factors of customer service and teller works and customer arrival and exits at this bank.
e. This study does not count for changing shift work/changing rest hours.

1.3 Assumptions

In the process of creating this large task report, the following assumptions are used:

a. Customer arrivals are the same throughout work time, no busyness and free time.
b. The simulation system we designed worked for 12 hours, from 08.00 to 16.00.
c. In deciding to queue at the teller or customer service, the chances of the customer entering the queue for the teller 20% and for customer service 15%.

2. Literature Review

According to Heizer and Render (2005), there are three components in the queue system, namely:

a. The arrival or input of the arrival system has characteristics such as population size, behavior and statistical distribution.
b. The discipline of queuing or queuing alone. Characteristics of queues include whether the number of queues is limited or the length is unlimited and the materials or people in them.
c. Service facilities characteristics include the design and distribution of service time statistics.

Queuing disciplines indicate the decision guidelines used to select individuals who enter the queue to be served first. According to Heizer and Render (2005), there are several forms of service discipline used, namely:

a. FCFS (First Come First Served) or FIFO (First in First Out) means, first come (to), first served (out). For example, a queue at the checkout at a supermarket.
b. LCFS (Last Come First Served) or LIFO (Last in First Out) means, the last one arrives first to leave. For example, the system queues in the elevator for the same floor.

2.1 Entities

The entities contained in the modeling of the queue system on this bank are people who want to make transactions, such as cash withdrawals, transfers, or visiting customer service.

2.2 Activities/Relationships

The service queue system at this bank starts with the arrival of the customer and then takes the queue number. Customers can choose to visit the teller or customer service. Customers who have taken the queue number must wait first. After that the customer will be served immediately if the queue number has been called by the officer at the teller or customerservice, according to the customer's needs. Furthermore, customers will be served by visiting the teller or customer service.

2.3 Resources

The service unit in this bank is in the teller section there are 3 tellers and 3 officers. Then in the customer service there are 2 customer service and 2 officers.

3. Study Methodology

Observation methods and literature studies in research are used to collect data. Observation Method is one of the methods that is done by directing to the place that is used as a research object, namely in customer service at this bank located in East Jakarta to get the required data. The data is the data of the number of customer arrivals and service times at tellers and customerservice. The data collection process is done for 2 hours at09.00-11. 000 WIB. Literature studies are conducted by studying various theories that have to do with their research and as a supporting researcher using reference books, journals, and websites related to the theory about queues.

3.1 Structural Data

At this stage itis explained the structure and flow of bankdata, which contains all the processes available in it so that it can be an observation reference to analyze from the queue system.

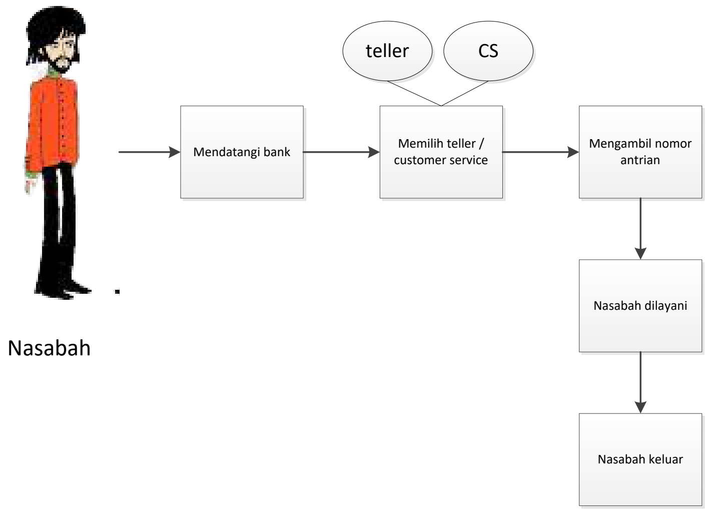

Figure 1. Structure data of Bank Model

3.2 Operational Data

In addition, the phase to measure performance is done by changing the relationship between entities into a model that converts structural data into operational data. Therefore, operational data is related to strategic operations between entities. This study categorizes the relationship strategy between customers and cashier operators using the First Come First Served (FCFS) service discipline method where customers arrive early at the checkout system and will be served first.

3.3 Numerical Data

Table 1XYZ Bank Model numerical data

Operasi	Resources	expression	Time (Minutes)	Benda
Kedatangan	Customer	Beta	6.5 + 7 * (0.596, 0. 749)	
Select Server	Customer			20% teller service 15% customer service
Teller service	Teller	Triangular	1.5, 2.5, 3.5	
Customer service	Customer service	Normal	35.9, 6.62	

4. Performance Measurement

Performance measurement is performed to assess the attributes that have been obtained through arena software modeling that represents customer relationships and teller or customer service. Performance measurements obtained through several steps including actual system model, verification and validation, results of experiments and analysis, and proposedimprovement scenarios.

4.1 Actual System Models

The cashier queue system at this bank was then created a simulation model using Arena Simulation software with the following layout results:

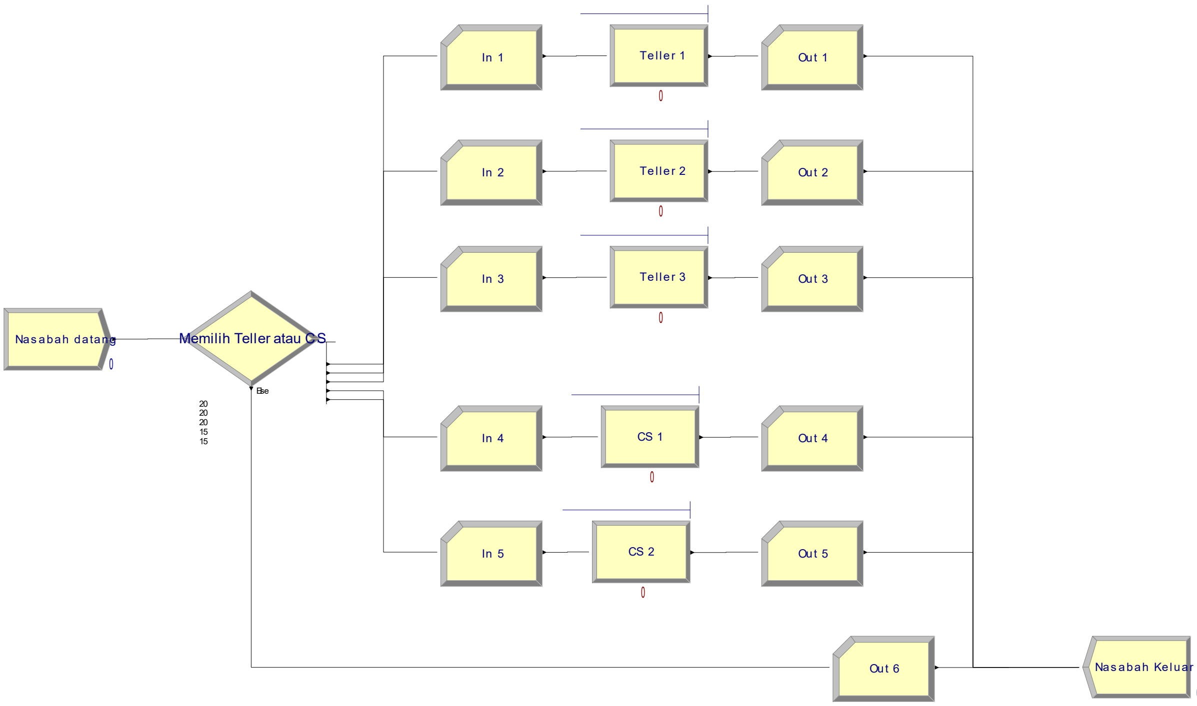

Figure 2. Actual System Model in this Bank

In the supermarket cashier queue system, several events occur in the queue, including:

a. The customer arrival process is described using the "Create" module.
b. The decision to choose a teller or customer service is explained using the "Decide" module.
c. The customer service process at the teller or customer service is explained using the "Process" module.
d. The process of leaving the supermarket queue system is described using the "Discard" module.
e. To more easily find out how many entities are in and out of the system, the "Record" module is used before and after entering the teller service or customer service and also after the service is complete to leave the system.

4.2 Verification and Validation

Model verification is a way to prove whether the simulation model created is correct and can run or not. The model that has been created is considered correct and can be executed if it has gone through the check model function on the run menu and after that, a notification appears as below.

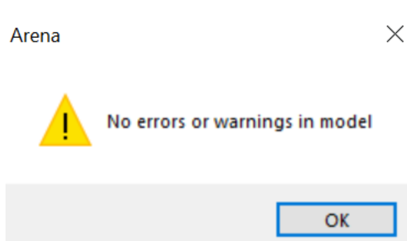

Figure 3. Verify the Actual System Model of Bank

Model validation aims to determine the suitability of simulation results with emulated symptoms or processes. The model can be said to be valid when it does not have significant differences with the real system observed both from its characteristics as well as from its behavior. The simulation is run by providing 1 replication in one shift for 8 hours with a replication time of 8 hours. After the simulation is complete, the report is obtained from the system model that has been run.

4.3 Experiment Results and Analysis

The simulation runs for 8 hours, basedon the report, the average system process result is 10.6398 minutes and the maximum system processing time is 23 minutes, the system wait time is 15.1576 minutes and the maximum system wait time is 174.05 minutes, and the number of system exits is 137 out of 156 entities entering the system.

Modeling the actual system of customer queues at banks on teller services and customer service, in the teller queue each has one operator who performs customer service. Based on the report, the average waiting time for teller service 1 is 2.5293 minutes with a maximum value of 9.4491 minutes, the average waiting time for teller service 2 is 3,036 minutes with a maximum value of 10. 5375 minutes, the average waiting time for teller service 3 is 2.3019 minutes with a maximum value of 11.8142 minutes, the average waiting time for customer service 1 is 48.5900 minutes with a maximum value of 120.39 minutes, the average waiting time for customer service 2 is 79.6591 minutes with a maximum value of 79.6591 minutes with a maximum value of 79.6591 minutes 184.91 minutes. The average operator utilization on teller service 1 is 42.88%, the average operator utility rate on teller service 2 is 90.49%, the average operator utility rate on teller service 3 is 94.27%, the average operator utility level on customer service 1 is 51.95%, the average operator utility level on customer service 2 is 55.51%.

4.4 Proposed Improvement Scenarios

Improvements are needed for the system to run optimally, as the result after running the simulation in a fairly high level of waiting time and utilization.

a. Improvement Scenario 1

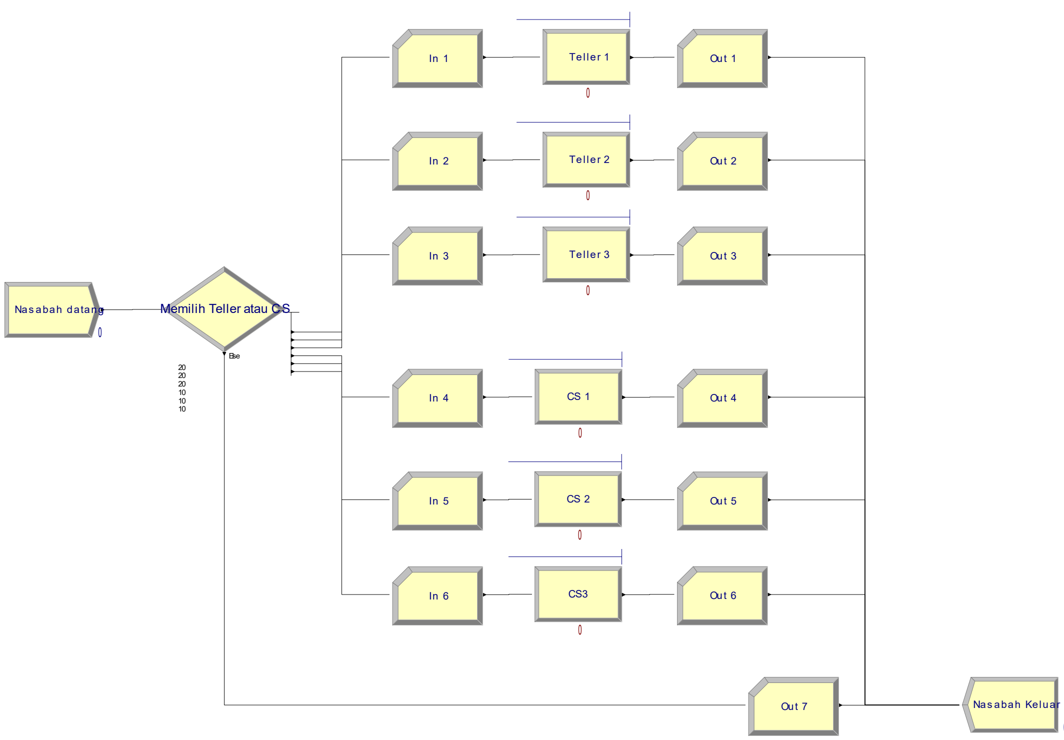

Figure4. Simulation of improved scenario model 1

The above is the first repair system modeling for service queues at this banks using Arena Simulation software. In this first fix scenario, there is the addition of one server in the customer service section and one operator. Based on the results of the report, after the simulation ran for 8 hours, the average system processing time was 12,7896 minutes and the maximum system processing time was 30,1235 minutes, the average system waiting time was 13,2392 minutes and the maximum system waiting time was 98.8378 minutes, and the average number of exits from the system was 153 out of 157 entities entered the system.

In the first repair scenario of customer queue at this bank, there are 3 tellers and 3 customer service that each have one operator who performs customer service. Based on the results of the report, the average waiting time for teller service 1 is 4.2881 minutes with a maximum value of 20.8502 minutes, for teller service 2 is 9.0382 minutes with a maximum value of 30.1774 minutes, for teller service 3 is 2.7339 minutes with a maximum value of 12.8119 minutes, for customer service 1 is 21.2071 minutes with a maximum value of 53.4619 minutes, for customer service 2 is 60.8198 minutes with a maximum value of 98.8378 minutes,and for customer service 3 is 17.2480 minutes with a maximum value of 53.4619 minutes. Average operator utilization on teller service 1 is 83.87%, average operator utility rate on teller service 2 is 90.46%, average operator utility level on teller service 3 is 70.23%, utility level The average operator on customer service 1 is 65.54%, the average operator utility level on customer service 2 is 62.56%, and the average operator utility level on customer service 3 is 38.17%.

b. Improvement Scenario 2

Above is a scenario modeling system to fix two customer service queues at XYZ bank using Arena Simulation software. In this second fix scenario, there is the addition of one additional operator on the teller that serves to calculate cash because it takes a long time. Based on the results of the report, after the simulation ran for 8 hours, the average system processing time was 8.3395 minutes and the maximum system processing time was 14.1748 minutes, the average system waiting time was 3.3675 minutes and the maximum system waiting time was 25.4837 minutes, and the number of exits from the system was 156 out of 162 entities entered the system.

In the second repair scenario of customer queue at XYZ bank, there are 3 tellers and 3 customer service that each have one operator who performs customer service. Based on the results of the report, the average waiting time for teller service 1 is 7.1819 minutes with a maximum value of 25.4837 minutes, for teller service 2 is 3.0089 minutes with a maximum value of 9.2182 minutes, for teller service 3 is 1.8116 minutes with a maximum value of 11.3015 minutes, for customer service 1 is 1.6729 minutes with a maximum value of 12.3716 minutes, for customer service 2 is 3.3487 minutes with a maximum value of 20.4230 minutes,and for customer service 3 is 6.7590 minutes with a value of maximum of 23.4228 minutes. Average operator utilization on teller service 1 is 36.41%, average operator utility rate on teller service 2 is 35.67%, average operator utility level on teller service 3 is 30.61%, operator utility rate average on customer service 1 is 64.09%, the average operator utility level on customer service 2 is 54.32%, and the average operator utility level on customer service 3 is 52.79%.

4.4 Comparison of Actual and Proposed Improvement Systems

After simulating the three models and the results have been released, a comparison of utilization rate, waiting time, and productivity is done.

a. Utilization Rate Comparison

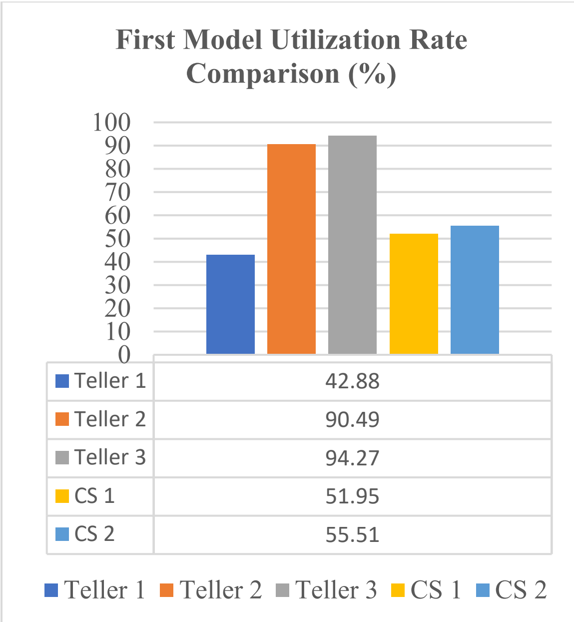

Figure5. First model utilization rate comparison chart

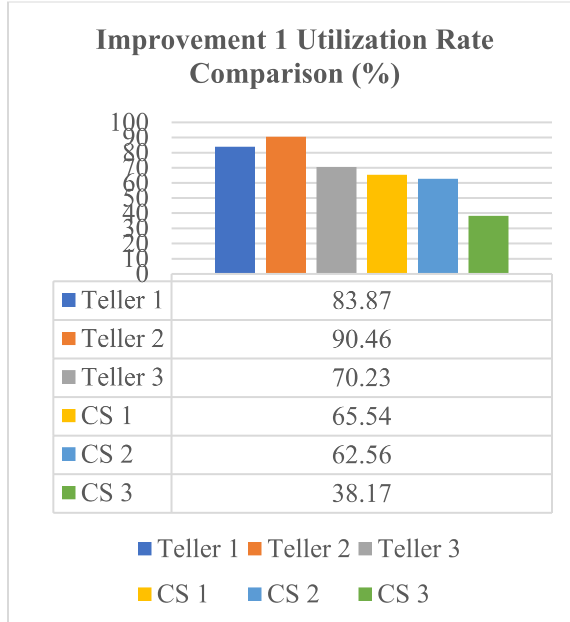

Figure6. Improvement 1 Utilization Rate Comparison Chart

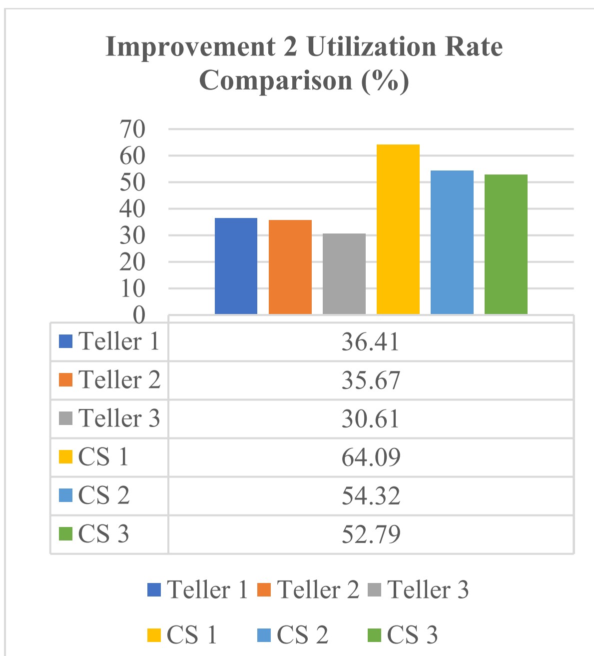

Figure7. Improved 2 Utilization Rate Comparison Chart

Based on the comparison graph of utilization rate above, shows that on the first improvement after the system is added to 3 servers in the customer service section, utilization in the customer service section decreases. However, there is still a queue on the teller section so the utilization can be said to be still high. In the second fix by not adding a server but by adding one operator on each teller that serves to calculate cash because this process takes a long time. The results obtained are distributed evenly on the part of tellers and customer service. In the second improvement, the utilization value on the teller and customer service also decreased compared to utilization in the initial model.

b. Waiting Time Comparison

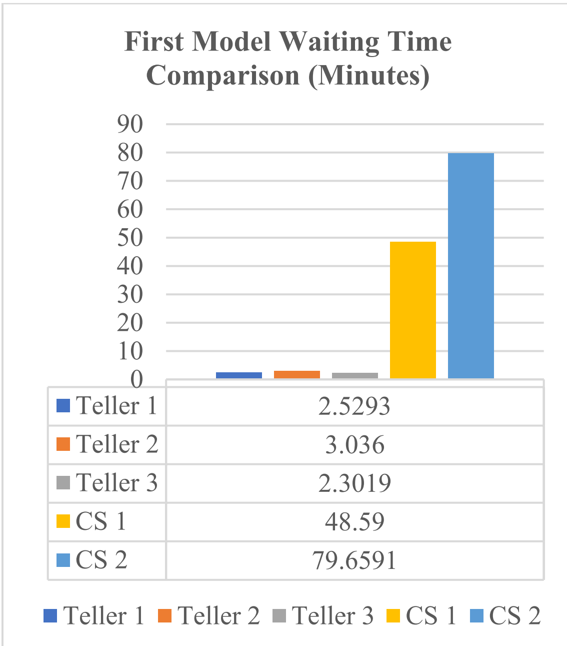

Figure8. First model timeout comparison chart

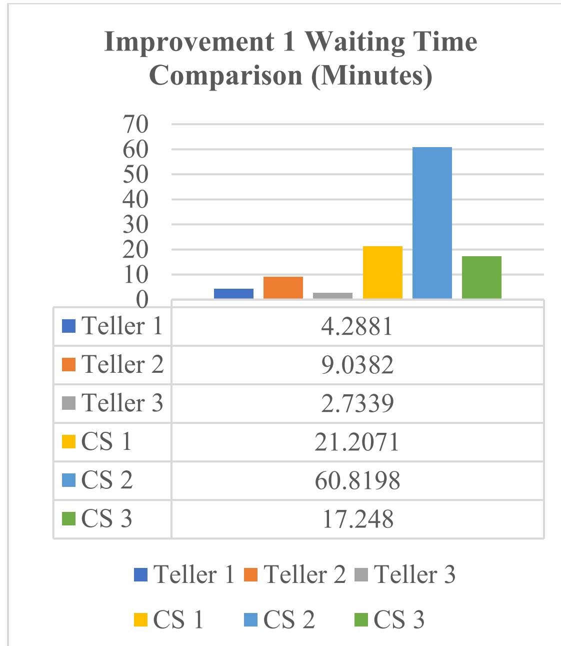

Figure9. Improvement 1 Waiting Time Comparison Chart

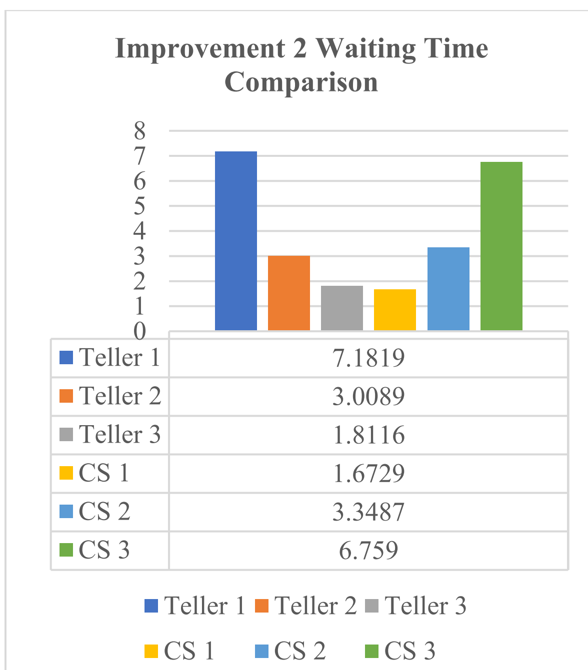

Figure10. Improvement 2 Waiting Time Comparison Chart

Based on the waiting time comparison graph above, it shows that in both scenarios the increase has reduced the average waiting time of the system compared to the initial model. The second fix scenario has a lower average system timeout than the first repair scenario, which is 0.05 minutes.

c. Productivity Level Comparison

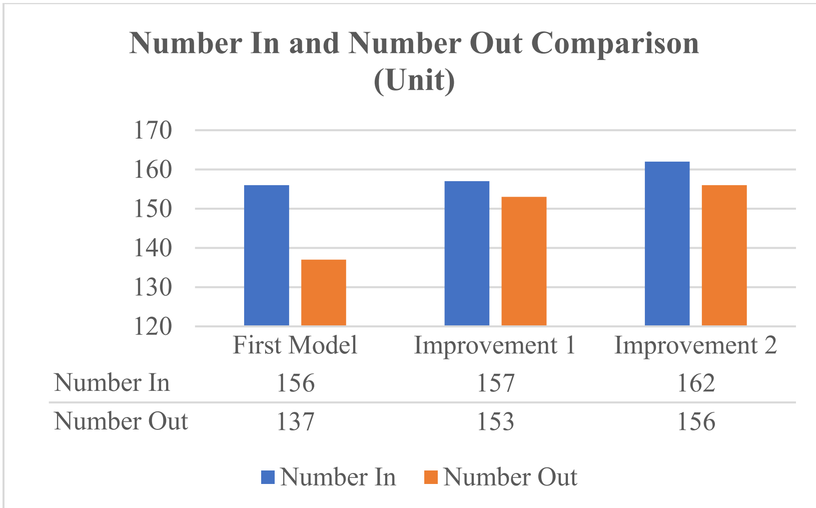

Figure11. Numer in and Number Out Comparison Chart

Based on the comparison graph of the amount in and the number above, shows that in the initial model the resulting amount is 137, in the first repair scenario the resulting amount is 153, and in the scenario the second exit repair number results in 156 which increases from the first and second repair scenarios.

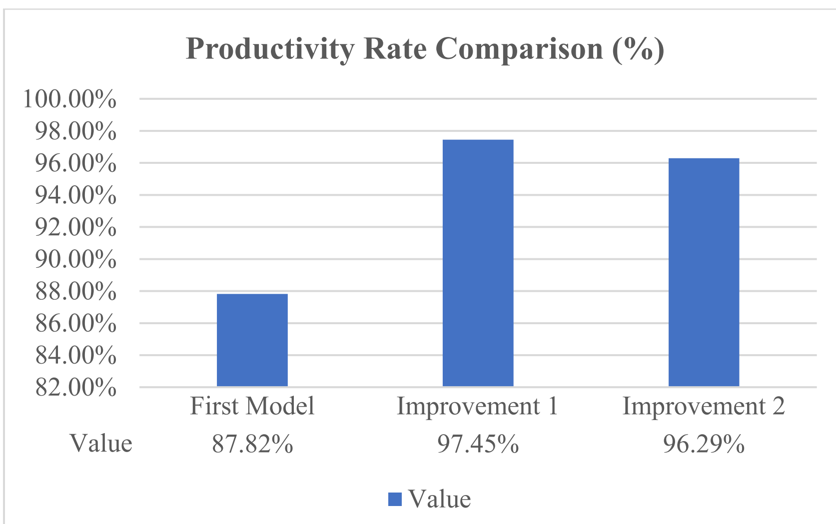

Figure12. Productivity Rate Comparison Chart

Based on the productivity level comparison chart above, shows that in the first improvement scenario, the lowest productivity rate is 87.82%. Meanwhile, the highest productivity level is in the first improvement scenario, which is 97.45.

5. Conclusions and Suggestions

After simulation using Arena software, it was found that the simulation of the second improvement scenario model had better results compared to the initial model simulation and the first improvement scenario simulation. Based on the utilization rate of the simulation system, the second repair scenario experienced a decrease in utility compared to the initial simulation model and the simulation of the first repair scenario, which means that in the second repair scenario, the cashier server experienced a decrease in queue density as it had completed the service faster. Based on the wait time, the second repair scenario also has a lower average system timeout compared to the initial model and the first repair scenario, since the second scenario wait time is only 0.05 minutes. Judging by the productivity level, the first improvement scenario has a value of 97.45% greater than the productivity of the initial model or the secondimprovementscenario.

Therefore, the second improvement scenario simulation is the most optimal simulation so that it can be chosen to be applied to the customer service queue system at this bank by adding one additional operator to each teller that serves to calculate cash because it takes a long time. Then our suggestions for more research can be observed more deeply related to the problems in this study and can also check whether the proposals selected in this study can be applied or not.

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