ISSN : 2355-9365 e-Proceeding of Engineering : Vol.12, No.2 April 2025 | Page 3210

Analysis Of The Service System In The General Poly RS Husada Utama With Discrete Simulation

1st Pinkkan Alisia Audria Fadillah
Teknik Industri
Universitas Telkom
Surabaya, Indonesia
pinkkanalisiaaf@student.telkomuniversity.ac.id

2nd Abduh Sayid Albana
Teknik Industri
Universitas Telkom
Surabaya, Indonesia
abduhalbana@telkomuniversity.ac.id

3rd Paramaditya Arismawati
Teknik Industri
Universitas Telkom
Surabaya, Indonesia
paramadityaars@telkomuniversity.ac.id

***Abstrak* — Hospitals require high efficiency, with one major challenge being the management of patient queues. At Husada Utama Hospital, long queues lead to waiting times of up to 90 minutes due to an imbalance between patient arrivals and service capacity. This study aims to reduce waiting times and improve service levels by modeling the queuing system using discrete simulation. Observation data from 08.00 to 17.00 on busy days (excluding special holidays) were used, processed, and simulated using Arena Software. Model verification and validation were conducted by comparing simulation results with actual data through T-tests. Under current conditions, the average waiting time at the Nurse Station is 47.86 minutes (72% utility), at the General Poly 144.86 minutes (89%), and at the Specialist Poly 163.97 minutes (89%). After applying improvement scenario 1, which adds one APKM unit, waiting times dropped to 26.80 minutes (68% utility) at the Nurse Station, 94.03 minutes (83%) at the General Poly, and 105.23 minutes (84%) at the Specialist Poly. This represents a reduction in waiting time of 60.82%, 35.08%, and 35.83% respectively. Scenario 1 is proven to be the most effective in reducing average waiting times with optimal utility.**

***Kata kunci*— Queue, Arena, Hospital, Discrete Simulation**

I. INTRODUCTION

Hospital is one of the system in the medical service environment that requires a high level of efficiency and effectiveness [1]. Hospitals are required to always provide excellent service, which is effective and efficient throughout the process, from patient arrival at the hospital, hospitalization, to discharge home or outpatient care. Because the hospital system is very complex, the efficiency and effectiveness of hospital services are often challenged [2].

One of the challenges faced by hospitals is the management of patient queues to get services. The cause of queues in the health services of Husada Utama Surabaya Hospital is the long waiting time to get medical services from doctors, with the average patient waiting time reaching 90 minutes. Meanwhile, according to the Decree of the Minister of Health number 129/Menkes/SK/II/2008 that the waiting time for outpatients is set at 60 minutes or less than 60 minutes. However, many patients wait longer than the minimum waiting time set by the government [3].

This can be evidenced by the number of patients waiting in the waiting room because the number of patiens who come to the Nurse Station at Husada Utama Surabaya Hospital reaches an average of 110 patients per day, while the nurse service capacity is only able to handle 60 patients in the operational time range from 08.00 to 17.00 WIB per day. This condition indicates that the number of patients served far exceeds capacity, potentially leading to increased waiting time and decreased service efficiency. If this problem is not addressed immediately, the hospital service system will face greater challenges. The impact of the long waiting time problem on the health service system at Husada Utama Surabaya Hospital can affect the performance of hospital performance because it can reduce the level of satisfaction with hospital service.

Previous research provides various approaches in analyzing and solving queuing system problems in various health services. One approach that has proven effective in improving performance is the simulation method. Simulation is a tool to solve problems in a system by creating a mock or imitation of the system and improving the simulation model without affecting the actual system. With simulation, problems are seen more comprehensively, because these problems affect various components in the system, rather than only being seen unilaterally or partially [2].

Therefore, this research is important to analyze the queuing service system at the General Poly of Husada Surabaya Hospital using the Discrete Simulation method by involving the simulation of the queuing model with the help of Arena Software as a follow-up research with the focus of the research is the placement of the Independent Health Examination Platform (APKM) unit in the hospital. This is due to the shorter service time of APKM, which is 15 minutes faster than the service time at the Nurse Station. The main objective is to reduce patient waiting time and improve service level through proposed improvement scenarios based on the simulation analysis conducted so that service efficiency in the hospital can be improved.

II. THEORITICAL STUDIES

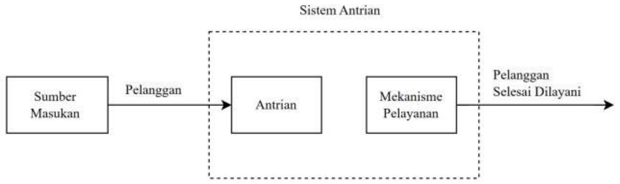
A. Queueing Theory

Queuing theory is a mathematical study of systems where people or goods wait for service, first introduced by Danish mathematician Agner Krarup Erlang in 1917 [4]. It is used to analyze system performance and service quality, from simple service chains to complex networked queues [5].

Queuing models represent real-world queuing systems to evaluate queue length, average waiting time, maximum queue size, and overall system waiting time [6].

Queuing models help optimize system operations by addressing insufficient service capacity. Queuing theory aims to design efficient systems that balance service quality and cost to maximize organizational performance [7].

The input process relates to customer arrival patterns, while queuing rules govern how customers wait, categorized into loss-based, waiting-based, and mixed-based rules [8].



B. Model

A model is a realistic representation of a system in real life that is the focus of attention and the subject matter. Modeling can be interpreted as the process of forming a model of a system by using a certain formal language [7].

C. Descrete Simulation

Discrete event simulation is one of the system modeling approaches that is suitable for analyzing discrete processes, such as manufacturing systems, transportation, service queues, and others. In discrete event simulation, changes in the state of the simulation model occur at discrete times caused by events. In discrete event simulation, measurements of system performance criteria can be made such as the number of queues, waiting time in the queue, time of process completion, and several other necessary criteria [7].

III. METHOD

The data processing process begins with identifying queuing problems at the Husada Utama hospital in Surabaya. Data collection in this study was carried out through direct observation at the main husada hospital in Surabaya, including structural, operational, and numerical data. The next step, calculating the average processing time for each data that has been collected and conducting distribution tests on processing time data to determine the appropriate distribution.

Data that has been processed and tested for distribution becomes the basis for building simulation models using Arena Software. The simulation model is made based on the actual conditions that occur in the fiels, where the data that has been collected will be input in Arena Software, then the simulation will be run and produce the output as needed. Meanwhile, the improvement scenario simulation model will be created after the simulation model passes the validation test and it can be stated that the simulation is valid.

After creating a queuing system simulation model using Arena Software, the next step is to conduct a validation test of the simulation model that has been created. The method used in this test is divided into three, namely the replication test, verification test, and model validity test.

After the model has been validated, further analysis can be carried out, where the analysis process is carred out by reading the results issued by Arena Software, then several improvement scenarios will be made.

Analysis is carried out to interpret the results of data processing that has been carried out. Interpretation in this case to interpret the resuts of data processing in the form of numbers into a form that is in accordance with the research context. The results of this processing can later be used as a theoretical basis in overcoming queues in future generations.

The last stage is drawing conclusions from the research carried out based on the results of data processing and also the analysis carried out.

IV. RESULT AND DISCUSSION

Data collection in this study was carried out through direct observation at Husada Utama Hospitl in the nurse station, general poly, and specialist poly including processing time. Processing time involves eight data, ranging from patien arrival time to the length of time the patient is in the system.

A. Structural Data

The following is the structural data used in this research through observation techniques:

Table 1

(Structural Data)

Category	Data	Data Collection Technique/Method
Entity	*Patient*	*Observation*
Resource	1. Operational Data 2. Staff and Medical Personel 3. Waiting Room 4. Software Arena	*Observation*
Location	1. *Nurse Station* 2. Waiting Room 3. General Poly 4. Specialist Poly	*Observation*

B. Operational Data

The operational data used in this study consists of several types of categories, namely:

a. Entity Flow Diagram

The following is an entity flow diagram on the service system at the General Poly and Specialist Poly of Husada Utama Surabaya Hospital.

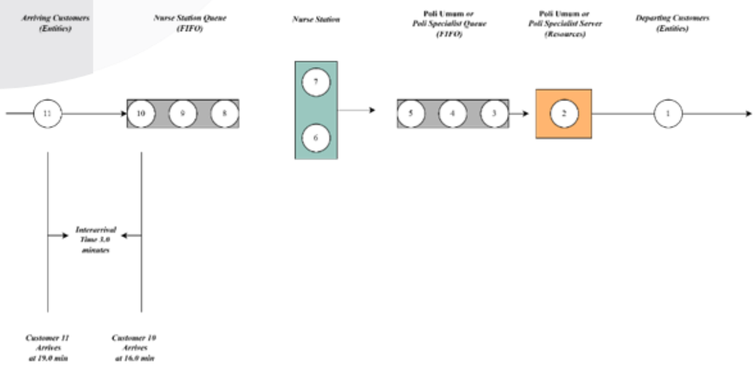


Figure 1

(Entity Flow Diagram)

The Figure 1 shows the flow of entities in the service system at the General Poly and Specialist Poly of Husada Utama Surabaya Hospital which is described using a flow diagram. The flow of the system operational process starts from the arrival location, which is the starting point of the patient's arrival. Next, the patient goes to the Nurse Station Queue location to wait for an initial health check. After that, the patient will be directed to the Nurse Station location to undergo an initial health check. Then, the patient goes to the General Poly or Specialist Poly Queue location to wait for medical services from the doctor. After waiting, the patient receives medical services at the General Poly or Specialist Poly location. The service process is completed when the patient reaches the exit location, which is the end point of the medical service.

b. Schedule

The schedule of practice and operational hours in General and Specialist Policies lasts for 8 hours a day, starting from 08.00 to 17.00 WIB, with a break at 12.00 to 13.00. In one week, the practice and operational days of the General Poly and Specialist Poly are from Monday to Friday. The following is a table that describes a detailed description of the practice and operational schedules at the General and Specialist Poly at Husada Utama Surabaya Hospital.

Table 2

(Schedule)

Operating Hours		
Working Day	Working Hours	Break Time
Monday - Friday	08.00 – 17.00	12.00 – 13.00

c. Arrival

Arrival describes the time, frequency, and location of an entity when it enters the system. Data is recorded on the patient's arrival time to the Nurse Station, which is then converted into time between arrivals. Arrivals will appear at the arrival location in the Arena Software.

d. Entity and Resource Movement

Entity and resource movement is a rule of moving from one location to another in a process experienced by an entity or resource. In the picture below, you can see an overview of the patient's movement flow.

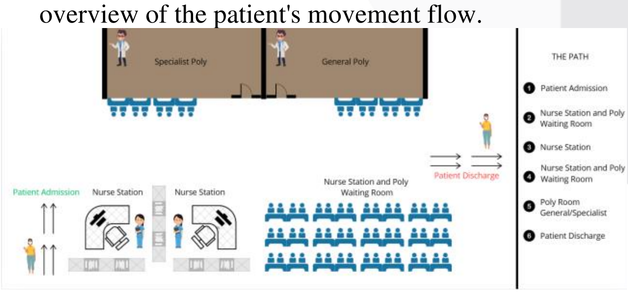


Figure 2

(Entity and Resource Movement)

The figure 2 explains the flow of patient movement at each location in the service process. The patient starts the flow by entering at the initial arrival lane. Next, the patient moves from the initial arrival location to the Nurse Station waiting room to wait for the initial health check. After that, the patient moves from the Nurse Station waiting room to the Nurse Station to undergo an initial health check. After completion, the patient moves from the Nurse Station to the waiting room of the General Poly or Specialist Poly to wait for medical treatment by the doctor. Then, the patient moves from the poly waiting room to the intended poly to get medical treatment. Finally, the patient moves from the clinic to the exit lane as a sign that the medical service has been completed.

C. Numerical Data

The numerical data used to solve the case in this study consists of:

a. Site Capacity

Each location contained in this research object has its own capacity. The following is a detailed explanation of the capacity of each location.

Table 3

(Site Capacity)

No	Location	Process	Many Units
1	Nurse Station	Initial Health Check	1
2	Waiting Room	Where patients wait to be treated	30
3	General Poly	Where patients receive medical treatment	1
4	Specialist Poly	Where patients receive medical treatment	1

b. Processing Time Distribution

Processing time distribution includes various time elements that occur while the entity is processed in the system. These elements include data on arrival time, initial health check-up time, waiting time before getting service, service time in general and specialist clinics, time the entity leaves the system, and the total time the entity spends in the system.

Data from these elements are processed using the Input Analyzer feature in Arena Software to determine the distribution that best fits the processing time at each stage. The initial process starts by collecting observation data from each time element, where each element reflects a specific activity in the system. The following are the results of the distribution calculation for the processing time data.

Table 4

(Processing Time Distribution)

Data Type	Preferred Distribution
Arrival Time	UNIF (10, 279)
Difference in Arrival Time	1 + EXPO(7.95)
Initial Health Check	1 + LOGN (8.39, 9.09)
Waiting Time	1 + LOGN (2.62, 2.05)
General Clinic Service Time	LOGN (40, 2.73)
Specialist Clinic Service Time	LOGN (40, 2.56)
Exit Time	UNIF (84, 367)
Time in system	UNIF (74, 123)

D. Existing System Simulation Model

From the data collected above, the next step is to create a simulation model of the existing system using Arena Software. The following is a model layout used in this study:

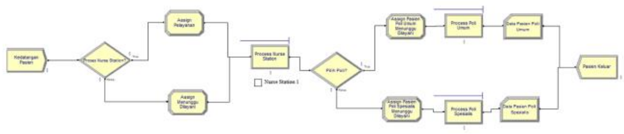


Figure 3

(Existing System Simulation Model)

Based on the Figure 3, it can be seen that in building a simulation model, several model components are needed. The following are details on each model component with representation in Arena Software. After making the existing model with the input that has been adjusted, the next step is to run the simulation model which is run for 8 hours or for 480 minutes. The model is run for 8 hours or 480 minutes because the observation time carried out is for 8 hours or 480 minutes.

The following are the running results of the existing system simulation model:

Table 5

(Output Existing System Simulation Model)

Average Nurse Station waiting time	47,86 Minutes
Nurse Station Utility	72%
Average waiting time for General Surgery	144,86 Minutes
General clinic utility	89%
Average Specialist Clinic waiting time	163,97 Minutes
Specialist Poly Utility	89%

E. Simulation Model Validation Test

a. Replication Test

The replication test is carried out to determine the number of replications (sample data) needed whether it is sufficient for the minimum replication required. The replication test is carried out using a formula to determine the value of the confidence interval, standard deviation, and the number of replications determined. The results of the calculation for the replication test of each processing time that has been collected, with the alpha determined at 0.05, are as follows:

Table 6

(Replication Test)

Data Type	Output Statistic	Value
Difference in Arrival Time	Average	8.95
	Standard Deviation	6,91
	Half Width	2,58
	Number of Replications	27,55
Initial Health Check Time	Average	3,59
	Standard Deviation	1,9
	Half Width	0,71
	Number of Replications	27,55
General Clinic Service Time	Average	5,79
	Standard Deviation	4,51
	Half Width	1,68
	Number of Replications	27,55
Specialist Clinic Service Time	Average	6,83

Data Type	Output Statistic	Value
	Standard Deviation	3,74
	Half Width	1,4
	Number of Replications	27,55

From the Table 6, based on 30 data on patient arrival time, initial health examination time, patient service time in General Poly and Specialist Poly, the average, standard deviation, and (half width) are obtained. Then the number of replications needed for all these data is 27.55 or 28 data replications.

b. Verification Test

The model verification test was carried out using the help of Arena Software, where when the simulation was run, no information appeared that there was an error or problematic simulation either when the simulation started or until the end of the simulation. Therefore, the simulation model can be said to run as desired or has fulfilled the verification test. Figure 6 shows when the simulation is successfully run and no errors occur as follows:

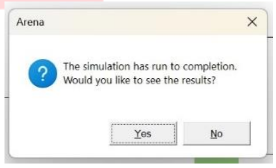


Figure 4

(Verification Test Success)

c. Validation Test

In the validity test it takes real system data of 95.47 minutes resulting from the average waiting time in the system of 30 patients for 4 weeks at the General Poly and Specialist Poly of Husada Utama Surabaya Hospital, while the simulation system time is generated from 30 replications through the output when running the simulation model, the average time in the system matches the data in the real system. The following are the results of hypothesis testing based on time in the real system and simulation using Microsoft Excel:

Table 7

(Validation Test)

Replication	Real System Time (Minutes)	Simulated System Time (Minutes)
1	95,47	102,31
2	95,47	110,35
3	95,47	82,87
4	95,47	103,55
5	95,47	83,69
6	95,47	91,80
7	95,47	103,66
8	95,47	114,43
9	95,47	84,05
10	95,47	110,04
11	95,47	114,30

Replication	Real System Time (Minutes)	Simulated System Time (Minutes)
12	95,47	85,65
13	95,47	112,19
14	95,47	91,08
15	95,47	106,26
16	95,47	102,69
17	95,47	101,38
18	95,47	115,72
19	95,47	91,29
20	95,47	105,92
21	95,47	103,67
22	95,47	114,35
23	95,47	102,40
24	95,47	110,42
25	95,47	104,00
26	95,47	97,69
27	95,47	90,09
28	95,47	105,72
29	95,47	97,17
30	95,47	91,12

Furthermore, from the data in the table above, the processing time samples that have been collected both the time in the real system and the simulation system time, then the validation process is carried out using the T-test: Paired Two Sample For Means. This test is used to determine the effectiveness of the treatment which is characterized by a difference in the average before and average after treatment. The first step is to draw a hypothesis, where the hypotheses to be tested are as follows:

a) H_0 : The process time data in the real system is the same as the simulation system.
b) H_1 : Process time data in the real system is not the same as the simulation system.

After the hypothesis is determined, then the T test can be done: Paired two Sample For Means, where testing is done with the help of Microsoft Excel, namely with the Data Analysis feature. The output shows the mean, variance, observations, t-stat, up to the t critical two tail, where these two values have the following meanings:

a) If the t stat value (t count) is greater than the t critical two tail (t table), it can be stated that H0 is rejected and H1 is accepted.
b) Conversely, if the t stat value (t count) is smaller than the t critical two tail (t table), it can be stated that H0 is accepted and H1 is rejected.

Table 8

(T-Test: Paired Two Sample For Mean)

t-Test: Paired Two Sample for Means		
	Variable 1	Variable 2
Mean	95,47	100,9953333
Variance	1,88021E-27	301,8270585
Observations	30	30
Pearson Correlation	1,34962E-15	
Hypothesized Mean Difference	0	
Df	29	
t Stat	-1,489226601	
P(T<=t) one-tail	0,073611775	
t Critical one-tail	1,699127027	
P(T<=t) two-tail	0,147223551	
t Critical two-tail	2,045229642	

Table 8 shows that the t stat value is smaller than the critical two tail t value and the P-value is more than alpha or 0.05, which means H0 is accepted. So the process time data in the real system can be said to be the same as the simulation time or the existing system simulation model has passed the validity test and can be said to be valid.

F. Analysis of Results

Based on the results of building a simulation model, the next step that must be taken in conducting simulations is to analyze the actual simulation model both in terms of queue time that occurs. The following are the results of the analysis related to the actual simulation model that has been built in this study.

Table 9

(Analysis of Results Existing System Simulation Model)

Object	Average Queuing Time
Nurse Station	47,86
General Poly	144,86
Specialist Poly	163,97

Table 9 shows the queue time for each location. At the Nurse Station queue location has an average queue time of 47.86 minutes. At the General Poly location has an average queue time of 144.86 minutes. Then at the Specialist Poly location has an average queue time of 163.97. This can happen because the location has a long process. Meanwhile, the smallest queue time occurs at the Nurse Station because the initial health examination process will be carried out directly and by the nurse if there are patients who finish first which indicates that there will be no long waiting process.

G. Simulation Model of Repair System

From the results of the simulation model validation test, it is stated that the existing simulation model is valid because it was successfully run, so the next step is to analyze the location of the high waiting time and then make improvement scenarios. Improvement scenarios to reduce waiting time can be done by adding capacity and location units that have high waiting times. The following are the improvement scenarios that will be made.

Table 10

(Simulation Model of Repair System)

No	Alternative	Description	Objective
1	Alternative 1	Addition of 1 APKM Unit	Reduced waiting time at Nurse Station, General Clinic, and Specialist Clinic.
2	Alternative 2	Nurse Station Replacement with APKM	

Based on table 10, it can be seen that there are two alternative models that will be used in this study, namely alternative 1 by adding 1 unit of APKM and alternative 2 by replacing the Nurse Station with APKM. Both alternatives have the same goal which is to reduce the waiting time at the Nurse Station, General Poly, and Specialist Poly. Each alternative will be modeled and analyzed until the best alternative is obtained which will be offered to stakeholders at Husada Utama Surabaya Hospital as an alternative solution to overcome the problems that occur at Husada Utama Surabaya Hospital.

H. Analysis of Alternative Solutions

The next step in this research is to analyze alternative solutions that have been determined based on the problems that occur. The alternative solutions used to solve problems in the case in this study consist of two alternatives.

a) Alternative 1: Addition of One APKM Unit

The first alternative solution is the addition of one APKM unit with the aim of reducing the queue time that occurs at the Nurse Station, General Poly, and Specialist Poly.

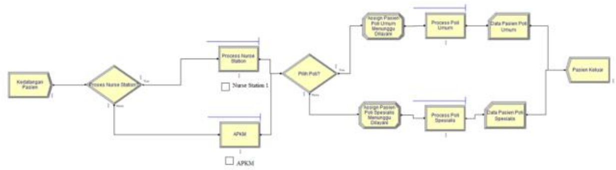


Figure 5

(Alternative 1: Addition of One APKM)

Based on the Arena Software output for the existing system simulation model, it can be seen that the average percentage of waiting time and utility at the Nurse Station, General Poly, and Specialist Poly is high. This is due to the long service time and the patient arrival rate is greater than the service capacity. Therefore, it is necessary to add a unit at the Nurse Station location to become one Nurse Station unit and one APKM unit. Then the simulation is carried out again using Arena Software with the hope that after the improvement of scenario 1, the utilization and average waiting time will be more ideal. Based on the first improvement scenario model carried out, the results obtained are as follows:

Table 11

(Output Alternative 1)

Average Nurse Station waiting time	26,80 Minutes
Nurse Station Utility	68%
Average waiting time for General Surgery	94,03 Minutes
General clinic utility	83%
Average Specialist Clinic waiting time	103,23 Minutes
Specialist Poly Utility	84%
Average APKM waiting time	10,70 Minutes
APKM Utility	44%

Based on Table 11, it can be seen that with the addition of one APKM unit, the waiting time at the three locations of Nurse Station, General Poly, and Specialist Poly has decreased significantly. This is evidenced that previously the queue time at the Nurse Station had an average queue of 47.86 minutes, the queue time at the General Poly had an average queue of 144.86 minutes, and the queue time at the Specialist Poly had an average queue of 163.97 minutes. However, with the addition of one APKM unit, the queue time at the three locations at the Nurse Station, General Poly, Specialist Poly decreased with an average queue time of 26.80, 94.03, and 103.23 minutes respectively. Thus, the average queue time for patients to do an initial health check is 18.75 minutes with a utility at the Nurse Station of 68% and a utility for APKM of 44%.

b) Alternative 2: Nurse Station Replacement with Two APKM Units

The second alternative solution is the replacement of the Nurse Station with APKM which aims to reduce the queue time that occurs at the Nurse Station, General Poly, and Specialist Poly.

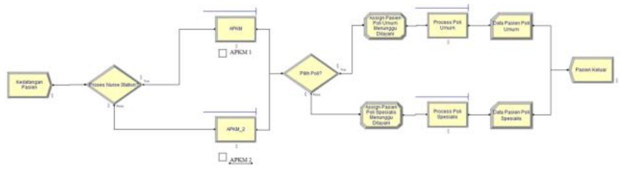


Figure 6

(Alternative 2: Nurse Station Replacement with Two APKM Units)

Based on the Arena Software output for the existing system simulation model, it can be seen that the average percentage of waiting time and utility at the Nurse Station, General Poly, and Specialist Poly is high. This is due to the long service time and the patient arrival rate is greater than the service capacity. Therefore, it is necessary to replace the unit at the Nurse Station location with two APKM units. Then the simulation was carried out again using Arena Software with the hope that after the improvement of scenario 2, the utilization and average waiting time would be more ideal. Based on the second improvement scenario model carried out, the results obtained are as follows:

Table 12

(Output Alternative 2)

Average waiting time for General Surgery	130,76 Minutes
General clinic utility	87%
Average waiting time for Specialist Poly	132,53 Minutes
Specialist Poly Utility	89%
Average waiting time APKM 1	27,62 Minutes
APKM 1 Utility	41%
Average waiting time APKM 2	13,22 Minutes
APKM 2 Utility	40%

Based on Table 12, it can be seen that with the replacement of the Nurse Station with two APKM units, the waiting time at the four locations of APKM 1, APKM 2, General Poly, and Specialist Poly has a difference. This is evidenced that previously the queue time at the Nurse Station had an average queue of 47.86 minutes, the queue time at the General Poly had an average queue of 144.86 minutes, and the queue time at the Specialist Poly had an average queue of 163.97 minutes. However, with the replacement of the Nurse Station with APKM, the queue time at the three locations in APKM, General Poly, Specialist Poly decreased with an average queue time of 20.42, 130.76, and 132.53 minutes respectively. So, the queue time for patients to do an initial health check is 20.42 minutes with APKM 1 utility of 41% and APKM 2 utility of 40%.

I. Comparison of Alternative Solution and Actual

Based on the determination of alternatives that have been carried out in the previous stage, at this stage is the stage to compare each alternative that has been determined with the actual model in the problem case to see which best alternative will be chosen to solve the problems in the case in this study. The following is a comparison table of each alternative with actual conditions.

Table 13

(Comparison of Alternative Solution and Actual)

Alternative	Location	Actual	Improvement Scenario
1	Nurse Station	47,86 Minutes	26,80 Minutes
	General Poly	144,86 Minutes	94,03 Minutes
	Specialist Poly	163,97 Minutes	103,23 Minutes
	APKM 1	-	10.70 Minutes
2	General Poly	144,86 Minutes	130,76 Minutes
	Specialist Poly	163,97 Minutes	132,53 Minutes
	APKM 1	-	27,62 Minutes
	APKM 2	-	13,22 Minutes

Based on Table 13, it can be seen that to reduce the queue time that occurs in the Nurse Station, general poly, and specialist poly processes, it can use the proposal in alternative Solution 1, namely the addition of one APKM unit. This is evidenced that previously the queue time at the Nurse Station had an average queue of 47.86 minutes, the queue time at the General Poly had an average queue of 144.86 minutes, and the queue time at the Specialist Poly had an average queue of 163.97 minutes. However, with the addition of one APKM unit, the queue time at the three locations at the Nurse Station, General Poly, Specialist Poly decreased with each average queue time of 26.80, 94.03, 105.23 with the queue time experienced by patients to do an initial health check is 18.75 minutes.

J. Analysis of the Preferred Alternative

Based on the observations, the following are the results of the representation of the existing model as outlined in Arena Software.

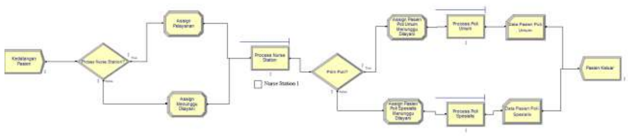


Figure 7

(Initial Model Simulation)

Based on the results of the improvement scenario simulation model, the alternative scenario chosen is the first scenario by adding one APKM unit at the Nurse Station location. The average queue time previously queued at the Nurse Station had an average queue of 47.86 minutes, the queue time at the General Poly had an average queue of 144.86 minutes, and the queue time at the Specialist Poly had an average queue of 163.97 minutes. However, with the addition of one APKM unit, the queue time at the three locations at the Nurse Station, General Poly, Specialist Poly decreased with an average queue time of 26.80, 94.03, and 103.23 minutes respectively. The average queuing time at the Nurse Station Location is obtained from the average queuing time that occurs at the Nurse Station Location and APKM Location 1, which is 26.80 minutes. So, the queue time for patients to do an initial health check if using an alternative scenario model 1 is 18.75 minutes. The following are the results of the simulation model of the selected alternative by adding one APKM unit at the Nurse Station Location.

V. CONCLUSION

This This study designed three simulation models, namely the existing simulation model, alternative scenario model 1 (addition of one APKM unit at the Nurse Station location), and alternative scenario model 2 (replacement of the Nurse Station with two APKM units). The proposed scenario model chosen is alternative 1, namely the addition of one APKM unit at the Nurse Station location. This alternative was chosen because it was able to significantly reduce queuing time. Previously, the average queue time at the Nurse Station was 47.86 minutes, at the General Poly 144.86 minutes, and at the Specialist Poly 163.97 minutes. With the addition of one APKM unit, the average queue time was reduced to 26.80 minutes at the Nurse Station, 94.03 minutes at the General Poly, and 103.23 minutes at the Specialist Poly.

REFERENCES

[1] F. Nabyla and R. C. Sigitta, “Desain Aplikasi Sistem Pendaftaran Online Menggunakan Smartphone Untuk Meningkatkan Mutu Pelayanan Pada Rumah Sakit,” *JOINS (Journal of Information System)*, vol. 4, no. 2, pp. 168–177, Nov. 2019, doi: 10.33633/joins.v4i2.3078.

[2] I. Berlianty, Y. D. Astanti, and I. Soejanto, “Application of Discrete-Event Simulation in Health Care : A Preliminary Studies,” *Conference SENATIK STT Adisutjipto Yogyakarta*, vol. 5, Nov. 2019, doi: 10.28989/senatik.v5i0.380.

[3] A. Hidayat, R. Firsandaya Malik, S. Nurmaini, M. Ilmu Komputer, and F. Ilmu Komputer Unsri, “Group Decision Support System (GDSS) Dengan Metode Entropy Untuk Menentukan Prioritas Antrian Layanan Rumah Sakit Menggunakan Multiple Channel Model (M/M/s),” 2020. [Online]. Available: http://jurnal.mdp.ac.idjatisi@mdp.ac.idReRevisedJune25th

[4] R. Listiyani, L. Linawati, and L. R. Sasongko, “Analisis Proses Produksi Menggunakan Teori Antrian Secara Analitik dan Simulasi,” *Jurnal Rekayasa Sistem Industri*, vol. 8, no. 1, pp. 9–18, Apr. 2019, doi: 10.26593/jrsi.v8i1.3154.9-18.

[5] R. A. Memon, J. P. Li, and J. Ahmed, “Simulation model for blockchain systems using queuing theory,”

Electronics (Switzerland), vol. 8, no. 2, Feb. 2019, doi: 10.3390/electronics8020234.

[6] S. Kakooei, “Application of queuing theory and simulation to reduce waiting time in dental hospitals,” *Journal of Oral Health and Oral Epidemiology*, vol. 11, no. 3, pp. 140–145, Oct. 2022, doi: 10.34172/johoe.2022.03.

[7] T. A. Purwanto, “Analisis Sistem Antrian Menggunakan Software Simulasi Arena Pada PT Indomobil Trada Nasional (Nissan Depok).,” *IKRA-ITH Informatika: Jurnal Komputer dan Informatika*, vol. 5, no. 2, pp. 54–66, 2021.

[8] L. Zhang, “Application of computer-based queuing theory in public hospital management,” in *Journal of Physics: Conference Series*, Institute of Physics Publishing, Jun. 2020. doi: 10.1088/1742-6596/1549/5/052009.