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Application of Registration Queue System Simulation with Multi Chanel-Multi Phase Method at Royal Prima General Hospital with Promodel

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Abstract

Royal Prima General Hospital often faces the problem of patient accumulation, especially at the initial registration stage, which results in increased waiting time and decreased service quality. To overcome this problem, this study implemented a multi-channel multi-phase queuing system using Promodel simulation software. This method allows the distribution of patients into multiple lanes and service stages, thereby reducing congestion and shortening waiting times. The research data was taken from a simulation that included 500 patients in the first phase (registration) and 100 patients each in the second phase (internal medicine polyclinic) and third phase (neurology polyclinic). The simulation results show that the multi-channel multi-phase queuing system is able to handle the flow of patients effectively with an average waiting time of 1.75 minutes before receiving service. Facility utilisation rates show that the internal medicine and neurology polyclinic areas operate almost at full capacity (above 90%), while the admission area has an underutilised capacity (31.8%).

Keywords: Simulation, Queuing, Hospital, Multi-Channel, Multi-Phase, ProModel

1. Introduction

Hospitals as healthcare providers often face challenges in handling patient backlogs, especially during initial registration. In conventional systems, patients often have to wait in long queues, which not only hampers service but also affects the overall patient experience (van Ginneken, 2022). This situation is exacerbated by the lack of an efficient system to share the burden of patient arrivals, leading to inconvenience and increased waiting time (Safdar, 2020).

One of the solutions developed to overcome this problem is the implementation of a Multi-Channel Multi-Phase queuing system (Zaporozhets, 2024). This model allows for more than one entry point and multiple service phases, which is designed to reduce congestion by distributing patients into multiple channels and service phases. In this study, the Multi-Channel Multi-Phase queuing system is applied to RSU Royal Prima to optimize the patient registration process. This system is expected to have a positive impact by shortening waiting times and improving overall service quality.

The problems identified in this study include. The accumulation of patients during registration at RSU Royal Prima. The inefficient queuing system causes the patient's waiting time to be longer. The lack of flexible entry points and service stages causes services to be hampered.

This research aims to:

1. Implement a Multi Channel-Phase queuing system in the registration process at RSU Royal Prima.
2. Analyze the effect of implementing the system on the efficiency of patient waiting time.

2. Literature Review

2.1. Definition of Queuing

Queuing theory is a mathematical discipline that studies queuing systems with the aim of analyzing and optimizing service flow in situations where incoming service requests can generate waiting times. This theory includes various queuing models that describe customer arrival patterns, the number of available servers, system capacity and service rules, such as the basic M / M / 1 model which shows a queue with one server and arrivals following a Poisson distribution (Mor & Sharma, 2021).

2.2. Queuing Discipline

Queuing discipline refers to the rules or mechanisms used to determine the order of service for individuals or entities in a queuing system. Some common queuing disciplines include First-Come, First-Served (FCFS), Last-Come, First-Served (LCFS), Shortest Processing Time (SPT), and Priority Queue. These disciplines are important because they affect the efficiency of the queuing system and customer or service user satisfaction (Mor & Sharma, 2021).

2.3. Queuing Model

A queuing model is a mathematical representation that describes the process of arrival, service, and departure of customers or entities in a system. Queuing models help in measuring system efficiency, optimising waiting times, the number of customers in the queue, and resource usage (Mor & Sharma, 2021). Queuing models are used in various fields such as healthcare, transport, manufacturing, and banking. Here are the types of model types.

a) Single-Channel, Single-Phase (M/M/1)
This queuing model has one arrival path and one service (single-server). The M/M/1 notation indicates that arrivals and services follow a Poisson or Markovian distribution, with one server serving customers one by one. Research by Wang et al. (2020) showed that the M/M/1 model is effective for analysing simple queues with a moderate number of customers, but can cause backlogs when the service load increases.

b) Single-Channel, Multi-Phase (M/M/s)
In this model, there is one arrival path but several service stages (multi-phase). The M/M/s model is often used in systems with multiple sequential processing stages such as in healthcare or call centres. Research from Sahin and Kucukyazici (2019) revealed that this model can optimise waiting times at each service stage, especially when each stage requires different service times.

c) Multi-Channel, Single-Phase (M/M/s)
This model is used when there are multiple servers serving one phase of the process. This system is suitable for service centres with many staff, such as in banking or airports. The study by Moustafa et al. (2020) shows that the M/M/s model effectively reduces customer waiting time in multi-server systems, especially in environments with high arrival rates.

d) Multi-Channel, Multi-Phase (M/M/s/k)
This model is a combination of multi-channel with multi-phase, usually used in complex systems such as hospitals or distribution centres. In the study of Deshmukh et al. (2021), the M/M/s/k model was implemented in an emergency department system to speed up patient waiting times at each critical service stage, thereby improving overall efficiency.

2.4. Application of Queuing Systems in Hospitals

The solution to the problem of handling the buildup of prospective patients at RSU Royal Prima is to implement a multi-channel - multi-phase queuing system, where there will be more than one entry point to register at RSU Royal Prima so that the patient's arrival pattern is divided into several times and paths tailored to the patient's desired time needs and there is more than one stage of service at RSU Royal Prima (Jamaludin, 2022).

2.5. Parameters and Formulas of Multi Channel - Multi Phase Queuing System

a. Average Patient Arrival Rate (λp)

$$\lambda p = \frac{Number\ of\ patients\ during\ observation}{Observation\ time} \tag{1}$$

b. Speed of patient arrivals to the server ($\lambda server$)

$$\lambda server = \frac{Average\ patient\ arrival}{Number\ of\ server} \tag{2}$$

c. Average patient service time (μ)

$$\mu = \frac{Total\ \ length\ of\ service}{Number\ of\ patients} \tag{3}$$

d. Speed of patient service ($1/\mu$)

$$\frac{1}{\mu} = \frac{1}{Average\ service\ time} \tag{4}$$

e. Average number of patients in the system (L)

$$L = \frac{\lambda}{\mu - \lambda} \tag{5}$$

f. The average number of patients in the queue (Lq)

$$Lq = \frac{\lambda^2}{\mu(\mu - \lambda)} \tag{6}$$

g. Average time spent in the system (W)

$$W = \frac{L}{\lambda} \tag{7}$$

h. Expected time for each arrival to wait in the queuing system (Wq)

$$Wq = \frac{Lq}{\lambda} \tag{8}$$

i. Service Facility Busyness Level (ρ)

$$\rho = \frac{\lambda}{\mu} \tag{9}$$

The following are the criteria or notations used in the queue simulation. Can be seen in Table 1 below:

Table 1: Queue Notation

Notation	Explanation
$\lambda pasien$	Average Patient Arrival Rate
$\lambda server$	Patient arrival speed to the server
μ	Average patient service time
$1/\mu$	Speed of patient care
L	Average number of patients in the system
Lq	Average number of patients in queue
W	Average time spent in the system
Wq	Expected time for each arrival to wait in the queue system
ρ	Utilisation or Busyness Level of Service Facilities

2.6. ProModel

ProModel is a windows-based simulation software used to simulate and analyze systems. Promodel provides a good combination of usage, flexibility, and modelling a real system to make it look more realistic. In Promodel, during the simulation, animation of the ongoing activities can be observed and the results will be displayed in the form of tables and graphs that make it easier to analyze. To build a model of a desired system, Promodel provides several elements that are precisely tailored to model a production system. Some of the basic elements include location, entities, processing, arrival, resources, path network and running simulations (Tjusila, 2022).

Here are the advantages and disadvantages of ProModel:

a. Advantages
   1) Ease of Use, ProModel is designed to make it easy to create simulation models with an intuitive interface and elements such as locations, entities, resources, and well-structured path networks (Toffaha, 2021).
   2) High Flexibility, Able to model various types of systems such as manufacturing, logistics, and services with high flexibility in designing experiments.

3) Visual and Real-Time Analysis, equipped with realistic animation capabilities, helps users understand the process visually.
4) Save Cost and Time, Helps identify the best solution before real system implementation, thus reducing the need for costly and time-consuming live testing.
5) Compatibility with Real Data, Able to use actual data for accurate simulation and validation of results (Winnie et al. 2018).

b. Disadvantages
1) Complexity for Beginners, despite having an intuitive interface, new users still need time to learn the features in-depth.
2) Limitations on Specific Types of Simulation, not all types of systems can be modelled with a certain level of detail, depending on the case and need (Haryadi, 2023).
3) Licensing Fee, this software has a licensing fee that may be expensive for small organizations or individuals.
4) Data Dependency, Simulation results are highly dependent on the quality and completeness of the data used. Inaccurate data can produce inappropriate models (Winnie et al. 2018).

3. Materials and Methods

This Registration Queue System simulation was designed and built using the methodology shown in Figure 1.

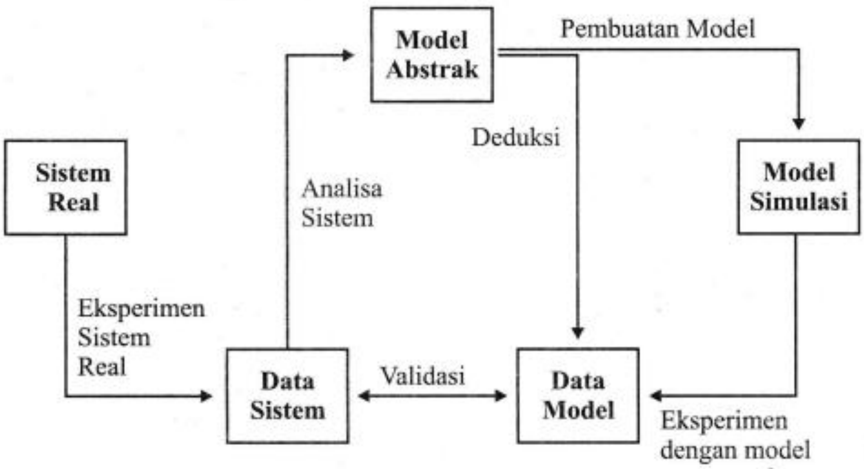

Figure 1: Research method.

3.1. Real System

This stage begins with direct observation of the patient queuing system at Royal Prima to understand the workflow and service process. The observation starts from the registration phase (Phase I), where patients come to the Customer Service (CS) to register their initial data. In this phase, the number of CS officers serving in parallel, the average time taken to serve one patient, as well as the patient arrival pattern were observed. After completing registration, patients proceed to Phase II or Phase III, depending on their medical needs.

The process includes various phases within each pathway, allowing analysis of different points in the system simultaneously. The applied research path can be seen in Figure 2.

a) Phase I (Registration)
In the first stage, patient service data starts with the registration process to the Customer Service (CS). Here, the patient provides the initial information required before proceeding to the next stage.
b) Phase II and Phase III (Polyclinic Services).

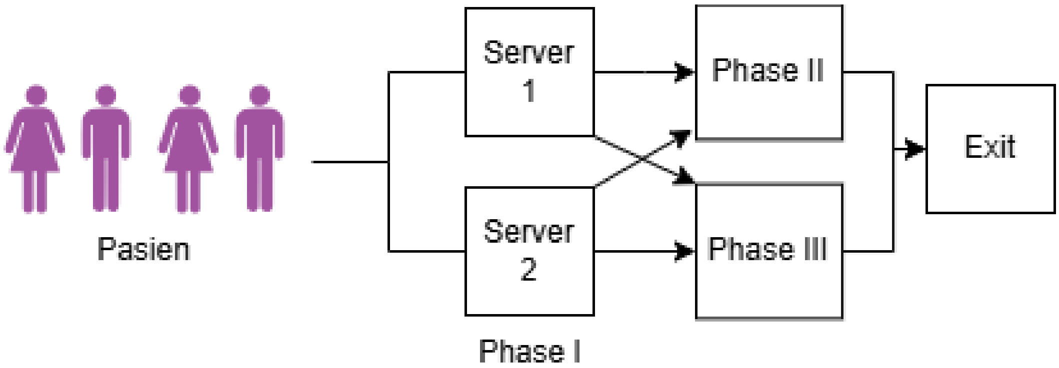

Figure 2: Real System

After completing registration, patients can proceed to Phase II which includes services at the polyclinic according to their medical needs. There are two service options in this phase:

1) Internal Medicine Polyclinic (Patients who need internal medicine examination will be directed to this polyclinic).
2) Neurological Disease Polyclinic (Patients who need services related to neurological diseases will be served at this polyclinic).

c) After completing all the necessary steps, the patient exits the system at the exit stage.

3.2. System Data

At this stage, the data required to build the simulation model is comprehensively collected. The main data is obtained from a journal entitled "Application of Registration Queuing System with Multi Channel-Multi Phase Method". In this journal, there are 20 original data per phase. For research purposes, the data was then reproduced in a distributed manner to reach 500 data for Phase I and 100 data each for Phase II and Phase III. This data addition process aims to create a larger data set, so that it can be used in simulation and more in-depth analysis of multi-channel and multi-phase queuing systems.

3.3. Abstract Model

At this stage, the queuing system is designed in the form of a conceptual model to represent the flow of the service process at RSU Royal Prima. This abstract model describes a multi-channel system, where each service phase has several parallel lines, as well as multi-phase, where each patient goes through several stages of the process sequentially.

3.4. Simulation Model

The abstract model was implemented into ProModel simulation software. This process begins by building a registration phase (Phase I) involving several parallel channels, where patients arrive with a certain arrival time distribution pattern.

The simulation model is built using ProModel software based on the abstract model:

a) Registration Phase (Phase I)
   - A 2-server parallel channel is created with a service time distribution based on the collected data.
   - Patients arrive at the registration with a certain arrival time distribution pattern.

b) Polyclinic Phase (Phase II and III)
   - Patients from Phase I are directed to one of the two polyclinic lines (internal medicine or neurology).
   - Each line has a different service time and capacity.

c) Exit, After finishing at the polyclinic, the patient exits the system, and the total processing time is calculated.

d) Visualisation, The model is visualised to illustrate the patient flow, queues in each phase, and the service process in each channel.

3.5. Experiments with the Model

At this stage, experiments are conducted using the simulation model to evaluate the performance of the queuing system. Various scenarios are tested to analyse the impact of changes in certain parameters, such as the number of channels, polyclinic capacity, or variations in service time.

3.6. Validation Process

Model validation is carried out to ensure that the simulation built is in accordance with the real conditions at RSU Royal Prima. The validation process begins by comparing the simulation results to the original data obtained from the journal.

4. Results and Discussion

4.1. System Data

The following data for Phase I, II, and III are presented in Tables 2, 3, and 4 respectively

Table 2: Data on Patient Services to CS (PHASE I)

No	Arrival Difference	Arrival Time	Call Time	Waiting Time	Exit Time	Length of Service	Server	Total Time
1	12:00:00	8:01:29	8:05:04	00:04:11	8:09:08	00.03:28	1	07:39
2	0:01:37	8:03:06	8:09:17	00:06:11	8:11:57	00.02:40	2	08:51
3	0:02:14	8:05:20	8:09:08	00:03:48	8:10:34	00.01:26	1	05:14
4	0:00:45	8:06:05	8:11:57	00:05:52	8:13:42	00.01:45	2	07:37
5	0:00:50	8:06:55	8:10:34	00:03:39	8:13:23	00.02:49	1	06:28
…	…	…	…	…	…	….	…	…
497	0:02:28	16:33:13	17:05:22	0:32:09	17:07:26	0:02:04	1	12:34:13 AM
498	0:00:06	16:33:19	17:10:42	0:37:23	17:13:13	0:02:31	2	12:39:54 AM
499	0:00:30	16:33:49	17:07:26	0:33:37	17:09:44	0:02:18	1	12:35:55 AM

Table 3: Data on Patient Services to Internal Medicine Polyclinic (PHASE II)

No	Arrival Difference	Arrival Time	Call Time	Waiting Time	Exit Time	Length of Service	Total Time
1	12:00:00	8:11:57	8:16:56	0:04:59	8:25:22	0:08:26	0:13:25
2	0:09:14	8:21:11	8:25:22	0:04:11	8:27:41	0:02:19	0:06:30
3	0:01:39	8:22:50	8:27:41	0:04:51	8:30:07	0:02:26	0:07:17
4	0:02:30	8:25:20	8:30:07	0:04:47	8:31:10	0:01:03	0:05:50
5	0:01:10	8:26:30	8:31:10	0:04:40	8:32:23	0:01:13	0:05:53
...	...	...	...	...	...	...	..
96	0:06:15	13:24:25	13:46:54	0:22:29	13:50:00	0:03:06	0:25:35
97	0:05:07	13:29:32	13:50:00	0:20:28	13:53:15	0:03:15	0:23:43
98	0:06:50	13:36:22	13:53:15	0:16:53	13:56:56	0:03:41	0:20:34
99	0:02:34	13:38:56	13:56:56	0:18:00	13:59:55	0:02:59	0:20:59

Table 4: Data on Patient Services to Neurology Polyclinic (PHASE III)

No	Arrival Difference	Arrival Time	Call Time	Waiting Time	Exit Time	Length of Service
1	12:00:00	8:05:20	8:10:07	0:04:47	8:11:30	0:01:23
2	0:01:35	8:06:55	8:11:30	0:04:35	8:12:45	0:01:15
3	0:01:05	8:08:00	8:12:45	0:04:45	8:13:34	0:00:49
4	0:01:01	8:09:01	8:13:34	0:04:33	8:16:11	0:02:37
5	0:02:54	8:11:55	8:16:11	0:04:16	8:19:10	0:02:59
…	…	…	…	…	…	…
96	0:03:36	15:08:23	15:24:54	0:16:31	15:28:46	0:03:52
97	0:10:12	15:18:35	15:28:46	0:10:11	15:33:49	0:05:03
98	0:02:10	15:20:45	15:33:49	0:13:04	15:39:15	0:05:26
99	0:06:52	15:27:37	15:39:15	0:11:38	15:43:43	0:04:28
100	0:04:16	15:31:53	15:43:43	0:11:50	15:46:52	0:03:09

4.2. Abstract Model

The following is the Abstract Model of the Royal Prima Hospital Registration Queue Simulation can be seen in Figure 3.

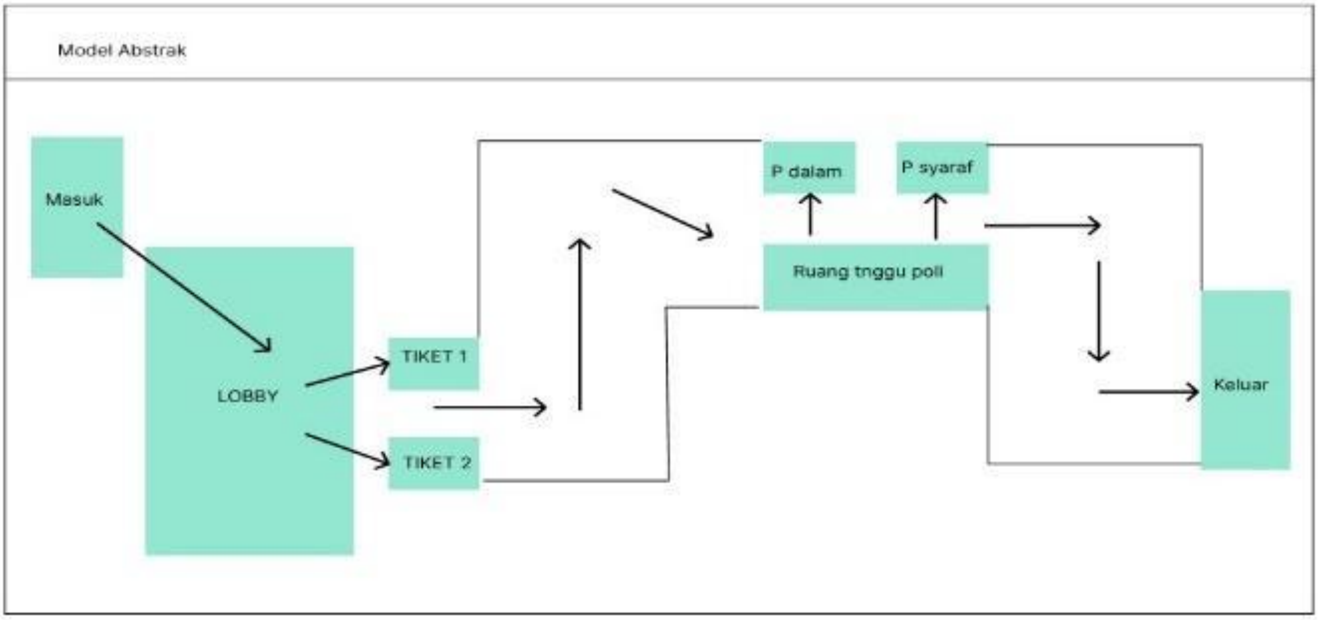

Figure 3: Abstract model.

a) Entrance
The patient starts the process by entering the healthcare facility through the entrance.

b) Lobby
After entering, the patient is directed to the lobby area. Here, the patient will do the initial process such as waiting or preparing the necessary documents.

c) Ticket Collection
In the lobby, patients will collect tickets based on their needs:
- Ticket 1 for patients with specific destinations.
- Ticket 2 for patients with different destinations.

This ticket determines the service path that will be travelled by the patient.

d) Poly Waiting Room
After getting the ticket, the patient goes to the poly waiting room. In this waiting room, patients wait for their turn to be called to the appropriate poly according to their illness.

e) Poly Service
Patients are served at the poly that matches their ticket and needs:
- Internal Medicine for patients with general or internal health problems.
- Neurological Clinic for patients with complaints related to the nervous system.

f) Exit
After completing the service at the intended clinic, the patient continues the process towards the exit.

4.3. Testing Results

a) Average arrival rate
From the data, it is known that there are 500 patients who arrive during the 17 hours of observation time. Then, the average patient arrival rate can be calculated as follows:

$$\lambda pasien = \frac{500}{17} = 29\ pasien\ perjam \tag{2.1}$$

So the average patient arrival is 29 patients per hour.

b) Patient arrival rate to server (λserver)
Since there are 2 servers serving patients, the patient arrival rate to each server is:

$$\lambda server = \frac{29}{2} = 14\ patients\ per\ hour \tag{2.2}$$

So the average patient arrival to the server is 14 patients/hour per server.

c) Average patient service time (μ)

The total service time provided is 1047 minutes for 500 patients. Therefore, the average service time per patient is:

$$\mu = \frac{1047}{500} = 2.094 \tag{2.3}$$

So, the average patient service time is 2 minutes per patient.

d) Speed of patient service (1/μ)
With an average service time of 2 minutes per patient, we can calculate the speed of patient service in units of patients per hour:

$$\frac{1}{\mu} = \frac{1}{2} = 0.5\ x\ 60 = 30 \tag{2.4}$$

So the average patient service speed is 30 patients/hour.
The average patient arrival rate is 29 patients per hour, the service provided to patients who come on average 2 minutes per patient and the number of registration sections open during peak hours is 2 servers. The following data has been obtained:

1) λ = 14 patients/hour
2) $\frac{1}{\mu}$ = 30 patients/hour

Since we have 2 servers serving at a rate of 30 patients per hour and the arrival rate to each server is 14 patients per hour (total 29 patients per hour), the steady state condition is fulfilled. This is because the arrival rate per server (λ server=14 patients/hour) is smaller than the service speed per server ($\frac{1}{\mu}$=30 patients/hour). Thus, the system is in a stable state and is able to handle incoming patients without excessive build-up in the queue.

e) Average number of patients in the system (L)

$$L = \frac{\lambda}{\mu - \lambda} = \frac{14}{30 - 14} = \frac{14}{16} = 0.875\, patients \tag{2.5}$$

The value of L=0.875 patients indicates that, on average, there are about 0.875 patients in the system, including both those being served and those waiting. In other words, at any time we can expect less than one patient to be active in the system. This indicates that the system is fairly smooth and there is no significant build-up in the number of patients.

f) Average number of patients in queue (Lq)

$$Lq = \frac{14^2}{30 \times (30 - 14)} = \frac{196}{30 \times 16} = \frac{196}{480} \approx 0.4083\, patients \tag{2.6}$$

The value of Lq=0.4083 patients indicates the average number of patients waiting in the queue before getting service. The average number of patients waiting is less than 1 patient, which means that queues are usually short or even non-existent. This indicates efficiency in service delivery and that patients do not have to wait long to be served.

g) Average time spent in the system (W)

$$W = \frac{L}{\lambda} = \frac{875}{140} \approx 0.0625\, hours = 3.75\, minutes \tag{2.7}$$

The value W=3.75 indicates that each patient spends an average of 3.75 minutes in the system, including waiting time and service time. This time is relatively short, which means that patients will not stay in the system for long, thus providing higher satisfaction for patients.

h) Average Time Spent in Queue (Wq)

$$Wq = \frac{Lq}{\lambda} = 140.4083 \approx 0.0292\, hours = 1.75\ \ minutes \tag{2.8}$$

The value of Wq=1.75 minutes indicates the average time a patient spends in the queue before receiving service. With a waiting time of only 1.75 minutes, this system is very effective in handling queues, so patients only need to wait a short time before being served.

i) Utilisation or Service Facility Busyness Rate (ρ)

$$\rho = \frac{\lambda}{\mu} = \frac{14}{30} = 0.4667 = 46.67\% \quad (2.9)$$

The service facility utilisation or busy rate (ρ) is 0.4667, or about 46.67%. This indicates that the server is busy for 46.67% of the time, and the remaining 53.33% of the time the server is idle or not serving patients. Busyness levels below 100% indicate that the system is stable, as the server can handle the level of patient arrivals without becoming too busy or experiencing excessive backlogs.

4.4. Promodel Implementation

Below is a picture of the layout of the research site that will be analyzed for data and simulated using Promodel. This layout includes 9 locations, namely: Entrance (hospital entrance), Lobby (main waiting area), Queue_1 (queue to take a ticket number), Ticket 1 and Ticket 2 (server for registration), Queue_2 (queue to wait for a call from the Internal or Neurological Polyclinic), P Dalam (Internal Medicine Polyclinic), P Syaraf (Neurological Disease Polyclinic), and Exit (hospital exit). This layout can be seen in Figure 4.

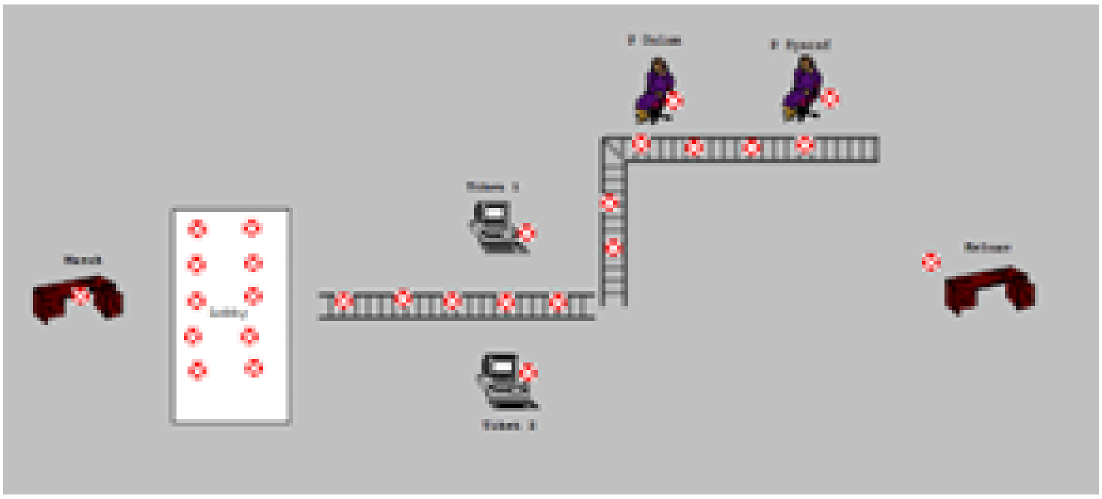

Figure 4: Royal Prima Hospital Queue Layout

The following is the Queue Simulation of Royal Prima Hospital during peak hours in Figure 5.

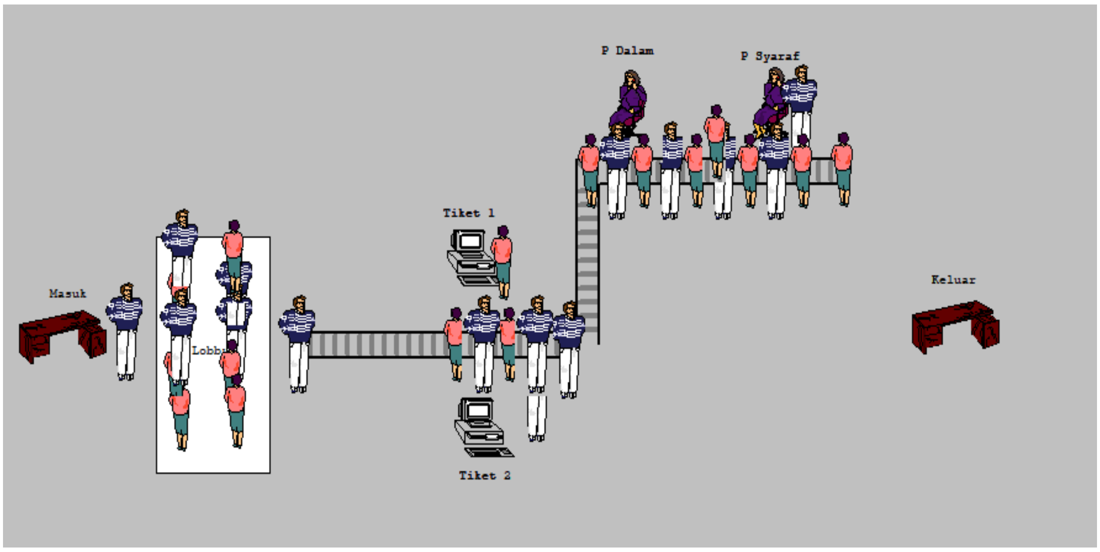

Figure 5: Queue Simulation during Busy Hours

Then the following are the results of the queue simulation at RSU Royal Prima with the Multi-Channel Multi-Phase model which runs for 17 hours. In Figure 6, the capacity for each service location is shown:

Figure 6: Simulated Capacity of Ticket 1, Ticket 2, Inner P and Nerve P Locations

1) Ticket 1 the system operates with a utilization rate of 55%, idle 7%, and blocked 37.7%. The high blocking rate indicates that this system often experiences obstacles in serving patients or service users.
2) Ticket 2 the operating rate is 54.9%, idle 7%, and blocked 38.5%. This condition is similar to Ticket 1, indicating a similar bottleneck that causes blocking in the system.
3) Internal Medicine Polyclinic, Operating with a utilization rate of 91.5% and idle time of 8.33%. This polyclinic is working almost at maximum capacity, with very minimal idle time, indicating high demand for services in this unit.
4) Neurology Polyclinic, has an operating rate of 93.3% and idle time of 6.5%, which also shows high utilization and low idle time. This indicates that the Neurological Disease Polyclinic operates almost continuously to meet the needs of patients.

The following are the results of the capacity simulation at several locations in RSU Royal Prima, which include the Lobby, Queue 1, and Queue 2, as shown in Figure 7.

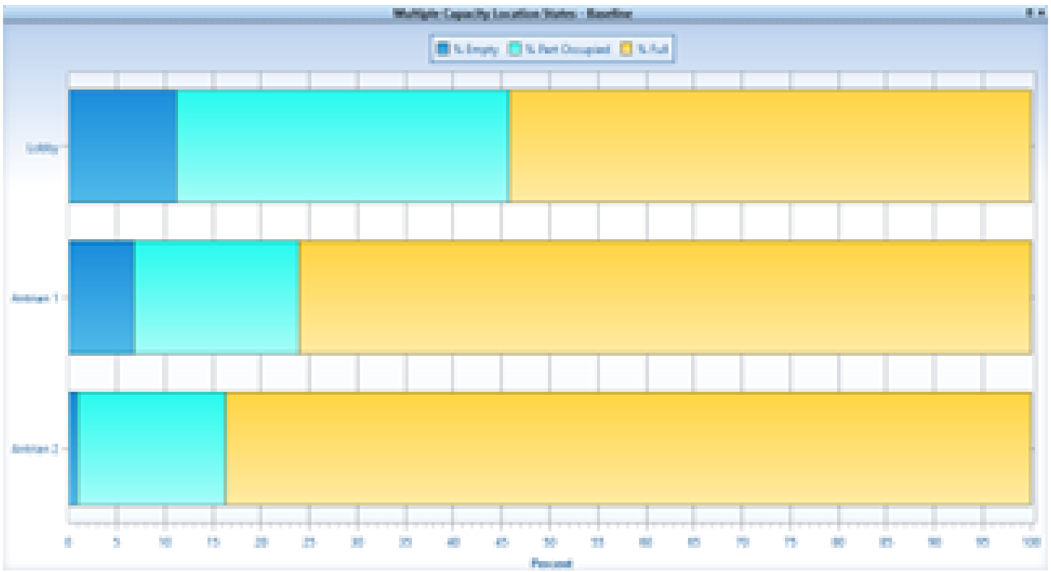

Figure 7: Simulation of Lobby, Queue 1 and Queue 2 Queue Capacity

1) The Lobby has an Empty capacity status of 11.23%, Part Occupied 34.56%, and Full 54.22%. This shows that most of the time, the Lobby is in full condition, with a small part of the time being empty or only partially occupied.
2) Queue 1 shows a status of Empty 6.74%, Part Occupied 17.2%, and Full 76%. The high percentage of Full indicates that Queue 1 is almost always fully occupied, indicating high demand or congestion in this area.

3) Queue 2 has a status of Empty 0.8%, Part Occupied 15.47%, and Full 83.64%. With a higher percentage of Full than other locations, Queue 2 is almost always at full capacity, indicating that this area has the highest density.

The following are the results of the utilization simulation at each location during the 17-hour operating time, as shown in Figure 8. This simulation uses Promodel software to monitor the utilization level of facilities at RSU Royal Prima:

Figure 8: Utilization Simulation Results for Each Location

The results of the promodel simulation utilization output can be seen in table 5.

Table 5: Promodel Simulation Utilization Data for each Location.

Location	Run Time	Utilization
Entrance	17	31.8%
Lobby	17	80.9%
Ticket 1	17	92.8%
Ticket 2	17	92.9%
P Inside	17	91.6%
P Nerve	17	93.4%

1) The Entry Area has a utilization rate of 31.8%, indicating that this area is not fully utilized and still has ample capacity to handle more activities or increased flow.
2) The Lobby has a utilization rate of 80.9%, indicating that this area is frequently used, although there is still idle time between activities.
3) Ticket 1 and Ticket 2 have very high utilization rates of 92.8% and 92.9% respectively. This indicates that these two areas are almost always occupied and functioning at a very high capacity, reflecting the high demand or volume of usage.
4) The Internal Medicine Polyclinic shows a utilization of 91.6%, reflecting the high usage of this facility with very limited idle time. This indicates a steady and considerable demand for services at this polyclinic.
5) The Neurology Polyclinic has the highest utilization rate of 93.4%, indicating that it operates almost fully for 17 hours, with very minimal idle time, indicating that the demand for services at this polyclinic is very high.

Overall, this data shows that most locations in Royal Prima, especially the Ticketing area and the Disease Polyclinic, are operating at very high capacity, while the admission area has greater capacity that is not fully utilized. These simulation results provide a good overview of facility utilization to assess operational efficiency and assist decision-making in future capacity planning.

5. Conclussion

Based on simulation results and data analysis at Royal Prima, it is found that the average patient arrival rate is 29 patients per hour, while the service speed of each server is 30 patients per hour with two servers operating for 17 hours. The system is in a steady state or stable condition, with the patient arrival rate per server (14 patients per hour) being smaller than the service speed per server. This shows that the system is able to handle the flow of patients without causing excessive build-up.

The average value of patients in the system (L) of 0.875 patients indicates that few patients are in the system at any given time, either waiting or being served, and the average patients in the queue (Lq) is 0.4083 patients. This indicates that queues are relatively short, with an average waiting time of only 1.75 minutes before patients receive service. The total time spent in the system by patients is 3.75 minutes, which is relatively short and provides more convenience for patients.

In terms of utilization, the Polyclinic (Internal Medicine and Neurology) location shows a very high utilization rate, with a rate above 90%, reflecting the large demand for services in that area. In contrast, the admission area has a lower utilization rate of 31.8%, indicating that there is still unutilized capacity in the area.

Explain what has been done, and draw conclusions in accordance with the objectives of the research that has been determined. The conclusions are delivered narratively, do not contain equations, tables, and figures.

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