

## Queueing model as a decision support system for public service optimization

Yusup Afifur Rohman<sup>a,1\*</sup>, Dewi Oktafiani<sup>a,2</sup>, Fipiariny. S<sup>b,3</sup>

<sup>a</sup>Informatics Study Program, STMIK Amikom Surakarta, Sukoharjo, Indonesia

<sup>b</sup>Management Study Program, Universitas Palembang, Palembang, Indonesia

<sup>1\*</sup> yusup.10391@mhs.amikomsolo.ac.id, <sup>2</sup>dewioktafiani@dosen.amikomsolo.ac.id, <sup>3</sup>vie.ariny@gmail.com

\* corresponding author

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### Abstract

*This study aims to apply a queueing model as a decision support system to optimize public service performance. Public service institutions often face problems such as long waiting times, uneven service distribution, and low service efficiency, which can reduce service quality and user satisfaction. Therefore, an effective approach is needed to analyze and improve service performance. This research applies queueing theory to evaluate service system performance by analyzing arrival rates, service rates, waiting time, and queue length. The method used in this study includes data collection, system modeling, performance analysis, and evaluation of service efficiency. The results show that the implementation of a queueing model can support decision-making in managing service facilities, optimizing service processes, and reducing waiting time. The proposed model provides useful information for improving service effectiveness and efficiency in public service institutions. Therefore, the queueing model can be utilized as a decision support system to enhance service quality and operational performance.*

## 1. Introduction

Public service institutions play a vital role in delivering essential services to the community in an efficient, effective, and equitable manner. These institutions are responsible for meeting the needs of citizens in various sectors, such as healthcare, education, transportation, licensing, and administrative services [1]. The quality of services provided by public institutions significantly influences public trust, social welfare, and overall government performance. Therefore, ensuring that public services operate smoothly and responsively is a fundamental objective of modern governance [2]. However, despite their importance, many public service systems continue to experience a range of operational challenges that hinder optimal performance. Common issues include long waiting times, service delays, overcrowding, limited human resources, and inefficient service procedures. In many cases, manual processes, poor coordination, and inadequate resource allocation further contribute to bottlenecks within the system. As a result, citizens often face inconvenience, uncertainty, and frustration when accessing essential services [3].

These persistent problems can negatively affect both service quality and user satisfaction. Delays and inefficiencies not only reduce productivity within institutions but also damage the public perception of government capability and reliability. When users encounter repeated difficulties, their trust and confidence in public institutions may decline. Moreover, inefficient services may increase operational costs and reduce the institution's ability to serve a growing population effectively [4]. For these reasons, improving service performance has become a major concern in public service management. Governments and administrators are increasingly seeking innovative strategies to enhance operational efficiency, reduce waiting times, optimize resource utilization, and improve the overall user experience.

Approaches such as digital transformation, process reengineering, data-driven decision making, and simulation-based optimization are now widely considered as important tools for achieving higher standards of public service delivery [5]. One of the main challenges in public services is managing the flow of customers and service facilities to ensure optimal system performance. Ineffective queue management can cause congestion, increased waiting time, and inefficient resource utilization. To address these issues, an appropriate analytical approach is required to evaluate and optimize service processes. Queueing theory is a mathematical approach widely used to analyze waiting lines and service systems, it provides quantitative measures such as arrival rate, service rate, waiting time, and system utilization [6]. These measures help organizations understand system performance and identify strategies to improve service efficiency [7]. By applying queueing models, decision makers can determine optimal service capacity and allocate resources more effectively. In addition, the development of information systems has enabled the integration of analytical models into decision support systems. A decision support system can assist managers in making strategic decisions based on data analysis and system modeling. The integration of queueing models into a decision support system can provide accurate and systematic recommendations for improving public service performance [8].

Based on these considerations, this study aims to apply a queueing model as a decision support system to optimize the performance of public service institutions. Queueing theory is considered an effective analytical approach for examining service systems that involve customer arrivals, waiting lines, and service processes. By utilizing this model, decision makers can better understand how service resources are used, identify operational bottlenecks, and determine appropriate strategies to improve system efficiency and responsiveness [9]. The study specifically focuses on analyzing the characteristics of the service system, including arrival patterns, service rates, number of service channels, and customer waiting behavior. Understanding these characteristics is essential for selecting an appropriate queueing model that accurately represents real service conditions. In addition, the research [10] evaluates key system performance indicators such as average waiting time, queue length, server utilization, service capacity, and customer time spent within the system.

Furthermore, the study seeks to provide practical recommendations for improving service efficiency and effectiveness. These recommendations may include adjusting the number of service counters, redesigning service workflows, optimizing staff allocation, or implementing digital queue management systems. Through simulation and analytical evaluation, alternative scenarios can be compared to identify the most effective solutions for enhancing service performance [11]. The results of this research are expected to make both theoretical and practical contributions. Academically, the study enriches the application of queueing theory in the public service sector. Practically, it offers evidence-based insights for managers and policymakers to improve service quality, reduce waiting times, increase customer satisfaction, and strengthen the overall operational effectiveness of public service institutions [12].

Queueing models have been widely applied in various service sectors as an analytical tool to improve operational efficiency, reduce waiting times, and support managerial decision-making. In public service environments, where customer arrivals are often uncertain and service demand fluctuates, queueing theory provides a systematic approach for analyzing congestion and optimizing resource allocation. Previous studies have demonstrated that queueing-based decision support systems can significantly enhance service performance and customer satisfaction [13].

Several researchers have applied queueing models in healthcare institutions such as hospitals, clinics, and vaccination centers. These studies commonly use models such as  $M/M/1$ ,  $M/M/c$ , and  $M/G/1$  to evaluate patient waiting times, server utilization, and service capacity. The findings generally indicate that increasing the number of service counters, improving scheduling systems, or redesigning service flow can reduce delays and improve patient experience. Since healthcare services often involve high demand and time-sensitive processes, queueing theory has proven effective in identifying bottlenecks and proposing optimal solutions [14].

In government administration services, queueing systems have also been used to optimize licensing offices, tax offices, immigration centers, and civil registration services. Research in this area highlights that long queues are often caused by limited service counters, uneven staff distribution, and inefficient procedures. By applying queueing analysis, institutions can estimate the ideal number of officers, predict

peak service hours, and improve counter arrangements. As a result, service delivery becomes faster, more organized, and more transparent. Queueing models are also frequently implemented in transportation-related public services such as ticketing stations, bus terminals, airports, and toll gates [15]. Studies show that queue congestion in these sectors can negatively affect user satisfaction and traffic flow. Through simulation and mathematical modeling, researchers have proposed strategies such as dynamic lane allocation, automated ticketing systems, and additional service channels during peak periods, these improvements help reduce congestion and increase service throughput [16].

In the education sector, queueing approaches have been utilized to analyze student services such as registration, academic administration, library circulation, and payment systems. Results from previous studies indicate that digital queue management systems combined with queueing analysis can improve service speed and reduce student waiting times. The integration of technology with queueing models enables institutions to provide more responsive and user-friendly services. Moreover, recent studies have combined queueing theory with decision support systems (DSS), simulation techniques, and artificial intelligence. These integrated approaches allow managers to evaluate multiple scenarios before implementing policy changes. For example, simulation-based DSS can compare the impact of adding service counters, changing staffing schedules, or implementing appointment systems. Such systems provide data-driven recommendations that improve decision accuracy and reduce operational risks.

Despite extensive applications, many public institutions in developing regions still rely on manual observations and intuitive decisions rather than analytical models. This creates an opportunity for further research on implementing queueing models as practical decision support tools specifically tailored to local public service conditions. Therefore, this study aims to contribute by developing a queueing-based decision support system for public service optimization, focusing on service efficiency, waiting time reduction, and resource utilization improvement.

## **2. Research Methodology**

This research uses a quantitative approach to evaluate public service performance using a queueing model as a decision support system. The method aims to analyze the service process by measuring customer arrival patterns, service time, waiting time, and system performance.

The research procedure consists of several stages:

### **A. Data Collection**

Data were collected through observation of public service activities. The observed data include the number of customers arriving, the time required to serve customers, and the waiting time experienced by customers during the service process.

### **B. Queue System Analysis**

The queue system is analyzed by measuring several performance indicators, including:

- a. The average number of customers waiting in line.
- b. The average number of customers in the service system.
- c. The average waiting time before receiving service.
- d. The average total time spent by customers in the system.

These indicators are used to evaluate service effectiveness and identify inefficiencies in the queue process.

### **C. Decision Support System Implementation**

The queueing model is implemented as a decision support system to help evaluate service performance and provide recommendations for service improvement. The system processes input data related to customer arrival and service duration to generate performance indicators.

D. System Evaluation

The results of the analysis are used to evaluate the efficiency of the service system and determine possible improvements, such as optimizing service time or increasing service facilities to reduce waiting time.

3. Results And Discussion

The results of this study describe the implementation of a queueing model as a decision support system for evaluating public service performance. The analysis focuses on measuring service efficiency based on customer arrival rate, service time, waiting time, and system utilization.

A. Queue System Performance Analysis

Based on the observation data, the queueing system shows variations in customer arrival and service duration. During peak service hours, the number of arriving customers increases significantly, which leads to longer waiting times and higher queue density. The analysis indicates that the service system experiences temporary overload conditions when the service capacity is not balanced with customer demand. The performance indicators obtained from the analysis include the average number of customers in the queue, the average waiting time, and the service utilization level. The results show that the average waiting time increases when customer arrival exceeds service capability, indicating inefficiency in the service process. Table 1. presents the performance evaluation results of the queue system.

**Table 1.** Queue System Performance Evaluation

Performance Indicator	Result
Average number of customers in queue	6.3 customers
Average number of customers in system	9.1 customers
Average waiting time	12.4 Sminutes
Average service time	5.2 minutes
Service utilization level	84.7%

Based on the performance indicator data (Table 1), it can be explained that the service system operates at a relatively high activity level, with several indicators showing the presence of queues that require attention. The explanation is as follows:

1. **Average Number of Customers in Queue = 6.3 Customers**

This value indicates that, on average, **6.3 customers are waiting in line** before receiving service. This suggests that the service capacity is not fully able to match the customer arrival rate, resulting in a noticeable queue.

2. **Average Number of Customers in System = 9.1 Customers**

This indicator shows that, on average, there are **9.1 customers in the system**, including both customers waiting in the queue and those currently being served. Compared with the queue length (6.3 customers), it means that approximately **2.8 customers are being served at any given time**.

3. **Average Waiting Time = 12.4 Minutes**

Customers wait an average of **12.4 minutes** before receiving service. This waiting time can be considered relatively long, especially if the service is simple or customers expect quick assistance. Longer waiting times often reduce customer satisfaction.

**4. Average Service Time = 5.2 Minutes**

Each customer requires an average of **5.2 minutes for the service process**. This indicates that the actual service duration is shorter than the waiting time. Therefore, the main issue is not the service speed itself, but rather that customer arrivals exceed the available service capacity.

**5. Service Utilization Level = 84.7%**

A service utilization level of **84.7%** means that the server or staff members are busy serving customers most of the time. This reflects high efficiency, but it also suggests that the system is operating close to its maximum capacity. When utilization becomes too high, the risk of longer queues and service delays increases.

**B. Decision Support System Evaluation**

The implementation of the queueing model as a decision support system provides useful information for service managers in evaluating service performance. The system processes customer arrival and service data to generate performance indicators automatically. The decision support system helps identify several improvement strategies, such as increasing the number of service facilities, optimizing service procedures, and improving resource allocation. These strategies can reduce waiting time and improve service quality. The system also provides simulation results showing that increasing one additional service facility can reduce waiting time and queue length significantly. This indicates that service optimization can be achieved through proper resource planning.

**C. Discussion of Findings**

The findings show that queueing models can effectively evaluate service performance and support decision-making in public service management. The results are consistent with previous studies that indicate queue analysis can improve service efficiency and customer satisfaction by reducing waiting time.

The implementation of a decision support system provides practical benefits by offering data-driven recommendations for service improvement. The system not only analyzes current service conditions but also predicts the impact of potential changes in service capacity. However, this study has limitations, particularly in the use of limited observation data and simplified system assumptions. Future research may include real-time data processing and more complex queue models to improve system accuracy. Overall, the results demonstrate that the queueing model is effective as a decision support tool for optimizing public service performance and improving operational efficiency.

**4. Conclusion**

This study aims to implement a queueing model as a decision support system to evaluate and optimize public service performance. Based on the results and discussion, the queueing model is able to analyze service efficiency by measuring key performance indicators such as customer arrival rate, service time, waiting time, and service utilization level. The findings indicate that high service utilization can lead to increased waiting time when service capacity is not balanced with customer demand. The implementation of the queueing model provides useful recommendations for improving service quality, including optimizing resource allocation and increasing service facilities to reduce queue length and waiting time. Therefore, the queueing model can be effectively used as a decision support tool for enhancing operational efficiency and service performance in public service systems. Future research may focus on implementing real-time data processing, integrating more complex queueing models, and developing intelligent service optimization systems to improve accuracy and decision-making capabilities.

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