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An Organised Literature Review of Queueing Modeling in Different Sectors

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Abstract: *Queue scheduling involves determining the sequence in which tasks or entities in a queue are processed or served. It requires making decisions about resource allocation and task sequencing to enhance system efficiency and performance. Queue scheduling is widely used in operating systems, computer networks, telecommunications, and service-oriented industries. The primary objectives of queue scheduling are to minimize waiting time, maximize throughput, and ensure equitable distribution of resources. To achieve these goals, different scheduling algorithms and policies are employed based on specific system requirements and constraints. Although previous studies on queue management systems have been inadequate in providing satisfactory solutions, recent research has incorporated advanced technologies such as machine learning techniques and diverse queuing models. In this paper research conducted from 2015 to 2022, various strategies for optimizing queues were identified by examining research perspectives on queue management systems. The findings indicate that machine learning approaches have been extensively used, employing tools like ARENA and SIMIO, and adapting different queuing algorithms to address this issue.*

Keywords: Queuing models, capacity management, arrival process, queue length, performance measures, waiting time..

I. INTRODUCTION

Queueing theory was developed by A. K. Erlang(A.K. Erlang 1904) to help determine the capacity requirements of the Danish telephone system (Brockmeyer 1948). It has since been applied to a large range of service industries including banks, airlines, and telephone call centers (Brewton 1989, Stern and Hersh 1980, Holloran and Byrne 1986, Brusco 1995, and Brigandi 1994) as well as emergency systems such as police patrol, fire and ambulances (e.g. Larson 1972, Kolesar 1975, Chelst and Barlach 1981, Green and Kolesar 1984, Taylor and Huxley 1989).

Unlike simulation methodologies, queuing models require very little data and result in relativelysimple formulae for predicting various performance measures such as mean delay or probability of waiting more than a given amount of time before being served. This means that they are easier and cheaper to develop and use. In addition, since they are extremely fast to run, they provide a simple way to perform "what-if" analyses, identify tradeoffs and find attractive solutions rather than just estimating performance for a given scenario.

A queue, also known as a waiting line, is a common social phenomenon in today's communities, especially in cases where there are insufficient facilities or none at all to meet the needs of consumers for a given commodity or service. Customers waiting for service are referred to as arriving units in a queue. These individuals need a specific service at a service delivery center and must wait patiently in a line or wait if the services are not delivered promptly. However, waiting in a line can be uncomfortable and exhausting for customers, leading to lower customer satisfaction. Queuing theory has been extensively used to evaluate customer waiting times, optimize staff schedules, and improve the robustness of a queuing system in the face of changing demand (Gabriele Obermeier, 2020; Vile, 2016; Bandi, 2019). When a large number of people require access to a resource, and the service is unable to keep up with the demand, queuing issues arise. However, long queues may also result in extended periods of inactivity for clients, and customers are often in a hurry to get the service they need. As a result, long wait times can lead to customer dissatisfaction, and businesses should strive for more effective resource allocation to reduce wait times (Yaduvanshi, 2019). Queues can be found in a variety of settings, such as paying for groceries, ordering food at a restaurant, or scheduling an appointment

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with a doctor. Most queuing scenarios could benefit from queue management to reduce the cost of resources used, in terms of both staff costs and customer waiting times, even though research has shown that longer waiting times may occasionally lead to increased consumption in some cases. Many businesses utilize queue optimization methods to improve customer service. Queue scheduling approaches can be used to manage long queues, and they are employed in various sectors.

In the banking sector, queue scheduling can be implemented at service counters and ATM machines (Gao 2015).. Bank management can focus on resource factors such as creating separate counters for specific purposes and increasing the number of ATM and deposit machines to divide long queues into several shorter queues, which are easier to manage. Simply increasing the number of bank servers and branch locations is not always beneficial for banks, as unwise location selection and routine bank operations can do more harm than good (Soorya 2021).In the healthcare sector, allocating a few doctor counters, a few pharmacy counters, and separating consulting doctors can help reduce long queues and manage them effectively. Queuing models are employed in the healthcare industry to maximize hospital resource utilization and manage trade-offs that will increase the effectiveness and quality of healthcare system services. Queuing models can also be used to evaluate service and wait times in pharmacies with heavy workloads or multiple points of service (Al-Aomar 2012) .Queue management is a crucial aspect of businesses and service providers, as long waiting times can lead to customer dissatisfaction and a loss of business. Various industries, such as banking, healthcare, and airports, have implemented queue scheduling and management techniques to improve customer service and optimize resource utilization. In banking, queue scheduling can involve dividing long queues into shorter ones by allocating separate counters for specific purposes or adding more ATM machines and deposit machines. In healthcare, queuing models can be used to evaluate service and wait times in pharmacies with heavy workloads or multiple points of service. In airports, wait time estimation and personnel changes are key factors to consider when developing queue scheduling technologies, which can use image processing, artificial neural networks (ANN), and machine learning. Automated queue management technologies are widely used but often fail to consider consumer wait times (Hermanto 2018). Queuing theory can be used to forecast line length and duration, while queue management is the practice of enhancing customer experiences by managing waiting times (Soorya 2021).In various industries, queuing theory is applied to optimize revenue and enhance customer satisfaction. There are different queuing approaches available such as shortest job first, longest job first, most lucrative work first or different priority classes (Cowdrey, 2018). The integration of mobile applications can also aid in the improvement of the queuing system, taking advantage of frequently used cell phones.

The aim of this study is to provide a comprehensive account of the artificial neural network approach for queue management and scheduling, in order to reduce waiting time. Additionally, a systematic literature review of various research papers conducted by different researchers has been utilized.

II. STIMULATION OF THE SURVEY

The management of queuing in the banking sector is crucial to ensure customer satisfaction. In India, customers are experiencing longer wait times due to increasing customer numbers. Queuing can be categorized into two types: structured and unstructured. Structured queues refer to queues where customers are positioned in a known location, such as at grocery store checkout desks or in retail locations like banks and post offices. These types of queues are frequently used to manage ticket ranking for services that require identification, allowing for a stress-free waiting experience.In practice, implementing an effective queue management method can be challenging due to the unpredictability of human behavior. Previous research on queue management principles has taken various forms, including Shortest Processed First (SPF), First In First Consider (FIFC), Single Queue (SQ), Plural Queue (PQ), Diffuse Queue (DQ), and Head of Queue (HQ). SPF is a scheduling policy that prioritizes processing jobs that require the least amount of time. In contrast, FIFC processes the oldest entries first and customers leave the line in the order that they entered. SQ, or single queue, uses a snake format where each customer is attended to, eliminating crowding and increasing customer confidence in fair treatment. When dealing with large groups, it is important to use multiple queues or PQ, as it is an improvement over the single queue and prevents long waiting times, as seen in grocery store lines.A queuing system has benefits for both the customers and the service providers. These benefits can be either direct or indirect.

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III. APPROACHES

We have employed a systematic mapping approach to examine queue scheduling in the banking sector, Airport, Health Care Centre and Public facilities. Main approaches used in this study are based on Artificial Neural Networks, queuing theory, and time scheduling. We followed the process used by Kai Petersen(2008) such that

- Identify research questions and define the scope of the review
- Conduct a comprehensive search for relevant papers
- Screen the papers to identify those that are most relevant
- Conduct an abstract search to further narrow down the selection of papers
- Perform the mapping process using a systematic approach.

IV. QUESTIONAIRE

Q1	What types of queuing systems are utilized in the banking sector?
RQ2	What are the reasons for implementing an effective queue management system?
RQ3	What strategies are used by banks to handle lengthy queues?
RQ4	How are priorities established in the scheduling algorithm for queue management?

V. FINDINGS OF PRIMARY STUDIES

Scientific databases were searched using relevant search strings and keywords. The search terms were structured based on the population, intervention, comparison, and outcome, as guided by the research topics. The search strings included phrases such as "queue scheduling" and "queuing scheduling" for the area of queue scheduling, "queue scheduling tactics" and "queue scheduling approach" for the method of queue scheduling, and "artificial neural network" for the area of artificial neural networks. The search was conducted using the Boolean operators "OR" and "AND" to combine the relevant search terms.

The databases used to conduct the search were different. The search strings, keywords, and query combinations were used to locate relevant resources. In this process, all works related to queue management with artificial neural networks were found and categorized by examining previous research publications.

INCLUSION CRITERIA

Books, papers, journals, and technical reports related to queuing theory and queue management were carefully selected based on the following inclusion criteria:

The papers have a standard structure and reference format.

The papers have clearly defined the discussion and conclusion of the research.

The studies have contained Artificial Neural Networks and queue scheduling.

If multiple papers reported the same study, only the most recent one was considered.

EXCLUSION CRITERIA

Exclusion criteria were applied during the selection process to ensure that only relevant studies were included. These exclusion criteria are presented in Table IV and included studies that were not written in English, did not have an abstract, or were outside the artificial neural network and queue scheduling domain. Additionally, only the most recent paper reporting on the same study was considered, and papers with a standard structure and reference format that clearly defined the discussion and conclusion of the research were included.

ANALYSIS OF KEYWORDING OF ABSTRACTS

Keywording is a process that helps in creating a classification system while considering the prior research in a shorter time. This process has two steps; the first one involves the reviewers reading the abstracts and identifying keywords and themes that represent the paper's contribution while also determining the research's context. The second step includes integrating the set of keywords from many papers to generate an overall understanding of the research's nature and contribution. This helps reviewers to create a collection of categories that reflects the entire population. In cases where

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the abstracts do not contain useful keywords, reviewers can also refer to the paper's introduction or conclusion. After finalizing the set of keywords, they can be clustered and utilized to create categories for the map.

SYSTEMATIC CLASSIFICATION

This process can be understood as a sequence of different steps involved in data mining.

Data Collection

To gather data for this study in the banking sector, it is important to collaborate with a bank. It is essential to clearly specify the reasons for each person's visit to the bank and whether their needs were fulfilled or not.

Evaluation

Evaluation is an essential step in sentiment analysis, where the performance of the classifier is measured using various metrics such as accuracy, precision, recall, and F1 score. The evaluation metrics are used to compare the performance of different classifiers and to fine-tune the parameters of the selected classifier.

Deployment

The final step in the sentiment analysis process is deploying the classifier into a real-world application. This step involves integrating the classifier with the application and ensuring that it performs accurately in real-world scenarios. It is also necessary to monitor the performance of the classifier over time and make necessary changes to maintain its accuracy.

VI. LITERATURE REVIEW

Many researchers and academicians worldwide have contributed to the reduction of queue waiting time through various data. This section provides a brief overview of their work.

Amir Elalouf et. al. (2022).This paper aims to present a comprehensive review of studies focusing on queueing-related challenges specifically related to emergency departments. The authors further explore managerial strategies implemented to improve efficiency in emergency departments. These strategies encompass bed management, fast-track procedures, dynamic resource allocation, patient grouping and prioritization, and triage approaches. Additionally, the authors discuss the scientific methodologies employed to analyze and optimize these strategies, which include algorithms, priority models, queueing models, simulation techniques, and statistical approaches.

Mohammad Forozandeh(2022).This paper aimed to enhance and optimize the overall performance of the banking service system by applying queuing theory to various activities with the objective of maximizing profits. The study examined and improved the performance of the banking system through the utilization of queuing theory. A sensitivity analysis approach was employed to propose novel solutions for optimizing bank queuing, which can be implemented to achieve improved banking performance. The findings of the study indicated that the recommended method resulted in the highest level of customer satisfaction and maximized profits. These results provide decision-makers with valuable insights and a deeper understanding of the system's behavior.

Jupiter Ndiaye et. al. (2022) This paper introduces an electronic system developed with artificial intelligence for the management of queues in public facilities. The system is designed to personalize the user's ticket by automatically incorporating their name, facial image, age, and possible disability status. To eliminate the need for printing tickets on thermal paper, which has a significant carbon footprint, the system employs a name-calling mechanism, sound alerts, and screen displays at the counters to enable users to track their position in the queue. Additionally, the queue manager utilizes biometric authentication through facial recognition to verify the user's identity before registering them in the queue, thereby preventing fraud by individuals attempting to bypass the orderly arrival of users. This innovative approach has contributed to the enhancement of queue management by promoting fairness, inclusivity, solidarity, health, and environmental sustainability.

Jakub Szyguła (2021) The paper investigates the implementation of an Active Queue Management (AQM) mechanism using neural networks. The AQM allows packets to be dropped from the router's queue prior to buffer congestion. The objective is to develop a machine learning model that emulates the behavior of the AQM PIα mechanism. Training samples are created considering the self-similarity of network traffic, using fractional Gaussian noise as a source. Simulation-based quantitative analysis examines queue length, rejected packet count, and queue waiting times. The study demonstrates the effectiveness of the proposed AQM mechanism based on Neural Networks.

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Mengyu Ji et. al.(2021)This study presents an effective management policy aimed at reducing supply-demand gaps in taxi queues located in high-density areas where frequent demand surges occur. To tackle this issue, the authors propose a highly efficient passenger demand prediction system that utilizes real-time flight arrival information. By monitoring cumulative passenger arrivals and accounting for factors such as the departure cities of flights, they demonstrate that a simple linear regression model can accurately predict the number of passengers joining taxi queues. Through numerical studies based on real-world data, the authors observe that their proposed approach, which involves optimal control with demand predictions, outperforms the same control strategy assuming Poisson demand by 43%. Compared to the status quo, where no external control is implemented, the proposed methodology reduces the supply-demand gap by 23%. These results highlight the substantial real-world potential of the proposed methodology.

Kiplagat et al. (2020). A study was conducted on National Cement Company Ltd in Kenya to investigate the impact of automated Queue Management System Optimization on the company's performance. Data was collected from 105 company staff members using a questionnaire and interview guide. Both qualitative and quantitative methods were employed to analyze the data. The results indicated that the reliability and flexibility level, security level, and staff training associated with the automated Queue Management systems have a positive influence on the performance of the National Cement Company.

Limlawanet. al. (2020) This research paper introduces an advanced queue prediction system that enhances waiting time estimation accuracy. The system monitors queue length and service rate changes using EWMA control chart and uses them as inputs for an ANN. Comparing it to queue-theory-based, linear regression, and historical-based predictors, ANN with the proposed system performs better. The system's implementation can involve camera and computer vision technology, allowing customers to better manage their activities while waiting for services.

Sundari et al. (2020) In this study, an Artificial Neural Network (ANN) model was proposed to effectively manage queuing and waiting times at a busy airport. The research focused on treating airport runways as a single server with finite capacity queuing and employed Kendall's and Little's formulas to address runway queuing problems. The input layer of the ANN model was constructed using three data points: (i) flight arrival rate, (ii) takeoff or landing rate, and (iii) number of runways. Additionally, eight mathematical equations were utilized to process the queuing data related to arrivals. The ANN model was specifically designed to simulate runway scheduling, featuring three neurons in the input layer and sixteen neurons in the output layer. To enhance the accuracy of the solution, the number of hidden layers in the model was gradually increased. The implementation of the ANN model was carried out in MATLAB, and the model was trained, evaluated, and tested using appropriate tools and techniques.

Sunday A. Afolalu (2019) This study examines the role of queuing theory in the banking sector, tracing its history and exploring its applications in telecommunications and engineering. The study reviews various approaches such as Artificial Neural Network (ANN), Business Process Reengineering (BPR), and M/M/1, M/G/1, Erlang B&C formulas to address queue management issues, including waiting times and economic costs. While these approaches have shown improvements, external factors and variations among banking systems present limitations. Further research is necessary to address the challenges faced by the banking sector.

Peter and Sivasamy (2019) c A study was conducted on the application of Queuing Theory Techniques in health care systems, specifically focusing on outpatient visits. The research aimed to address the issue of long waiting times for patients within the Outpatient Department (OPD) until their transfers to inner wards, as well as the allocation process to these wards. To address this, a randomized most idle routing algorithm was employed in the study. This algorithm was considered fair as it randomly selects an idle server without requiring information on arrival rates, pool sizes, or service rates at the time of decision-making. The findings of the study indicated that by employing a better understanding of Queuing Theory techniques and implementing various measures to manage patients' waiting times, hospitals can address the physical, psychological, and emotional factors that influence patients' perception of the waiting experience. This, in turn, can lead to decisions made by hospital managers that positively impact the satisfaction of all stakeholders involved. The study also confirmed that the proper application of this effective management tool can yield impressive results.

Cowdrey (2018) the researchers aimed to investigate waiting times at banking firms and develop a system to enhance the overall banking experience. The study employed queuing analysis and queuing theory to improve customer satisfaction and maximize profits. Various queuing strategies were implemented, with waiting time serving as the

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primary performance metric. The study explored several queuing methods, including FIFO, LIFO, SJF, most profitable job first, and priority queues, to identify the most efficient solution.The findings of the study indicated that the queuing system in a bank can be enhanced. The FIFO method proved to serve the highest number of customers, while the LIFO method resulted in the shortest waiting time for slow arrivals, albeit leading to customer dissatisfaction. The SJF method demonstrated the shortest waiting time and highest customer satisfaction. Additionally, the study suggested that implementing priority queuing and the most profitable job first scheme can further boost the bank's profits. The study concluded that the SJF method should be implemented during peak hours, while the most profitable job first scheme should be implemented during off-peak hours. Consequently, the utilization of these queuing methods effectively reduced waiting time, improved customer satisfaction, and enhanced profits for the banking firm.

Weiss, (2018). The research on Queue Management primarily focused on addressing, managing, and improving queues. The author identifies three key strategies for effective queue management: (1) eliminating or minimizing waiting through process improvement, (2) managing customer expectations through timely and relevant communication, and (3) enhancing the waiting experience. In this study, Weiss proposes specific approaches for each of these strategies. To manage customer expectations, the author suggests utilizing live highway signage as a technologically advanced solution to inform commuters about delays, thereby reducing their travel time and improving overall system performance. Innovative queue management techniques involving technology are also highlighted as effective means to reduce waiting times, presenting an opportunity for waste reduction efforts. Recognizing that waiting in line can be frustrating for customers, the study emphasizes the importance of integrating the waiting process seamlessly into the service experience, ultimately leading to a positive outcome for both customers and the company.

Seigha Gumus (2017)The study aimed to evaluate the queuing system at Blue Meadows restaurant, with the goal of determining its operating characteristics and enhancing customers' satisfaction during waiting times by employing queuing theory. The collected data was analyzed to assess whether it conformed to a Poisson distribution for arrival rate and an exponential distribution for service rate using the chi-square goodness-of-fit test. A 95% confidence interval was utilized to estimate the range of customers entering the system within a one-hour timeframe and the number of customers served during that period. By applying the M/M/s queuing model, several key parameters were derived, including the arrival rate, service rate, utilization rate, waiting time in the queue, and the probability of customers opting not to wait (balking) at the restaurant. The study found that the arrival rate (λ) at Blue Meadows restaurant was approximately 40 customers per hour, while the service rate was approximately 22 customers per hour per server.

Ahmed (2016) A study was conducted on an Automated Queue Management System, with a specific focus on the queuing system in banks, various queuing algorithm approaches employed to serve customers, and the average waiting time. The study involved the implementation of two different queue control systems, which were regulated by an Intel Galileo Microcontroller that is compatible with the Arduino software development environment. The performance of these systems was evaluated through testing under diverse conditions. The findings of the study revealed that the utilization of an automated queuing system as a new approach resulted in a reduction in the average waiting time compared to traditional queuing systems. The study demonstrated the effectiveness of the automated system in managing queues and enhancing overall customer experience.

Mwangi and Ombuni (2015), An empirical analysis was conducted to examine the queuing model and queuing behavior in relation to customer satisfaction at Jkuat Students Finance Office. The study employed a questionnaire to gather data, with a total of 384 respondents participating. The findings of the study indicated that students had to wait for an average of 33.4 minutes in the queue before being served. This waiting time was considered lengthy and highlighted the inefficiency of the queuing system in place. The study revealed that this queuing problem led to some students resorting to queue-jumping as a means to address the issue. Additionally, it was observed that certain students, predominantly males, abandoned the queue temporarily and returned on the same day, while female students tended to completely abandon the queue, opting to return for the service on another day.These results underscored the need for improvements in the queuing system to enhance efficiency and customer satisfaction at the Jkuat Students Finance Office.

Agyei (2015) A study was conducted on the modeling and analysis of queuing systems in banks. The main objective of the study was to determine the optimal number of tellers that would minimize the total economic cost (including waiting cost and service cost) while providing satisfactory and reasonably short service times to customers. Data for the

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study was collected through various methods, including observations, interviews, and questionnaires. A multi-server single line queuing model was formulated based on the collected data. The data was analyzed using TORA optimization tools as well as descriptive analysis methods. The performance of different queuing systems was assessed in the study. The findings of the study indicated that the use of a five-teller system was more favorable compared to systems with four or six tellers, considering both the average waiting time and overall economic costs. The study provided valuable insights to assist bank management in making informed decisions regarding the optimal number of tellers required for efficient queuing system management.

There are various algorithms and tools available for queue scheduling. Many of the queue scheduling systems have been developed and tested using ARENA software, which is powered by Rockwell Automation. In the banking sector, researchers have used algorithms such as ANN, Stand Back propagation, Business Process Reengineering, Erlang B&C formulas, and Adam Optimization to achieve more than 90% accuracy (Bertsimas, D 1995). For the airport sector, researchers have utilized image processing, machine learning, Haar cascade, multiple linear regression, OpenCV, ANN, and Feed Forward Back Propagation algorithms to achieve more than 90% accuracy in queue scheduling systems (Sundari et. al.). Similarly, the petrol pump and ferry terminal sectors have used algorithms such as ANN, machine learning, computer vision, and image processing for their developments, achieving a considerable level of accuracy.

VI. RESULTS OF THE SELECTED STUDIES

Year	Author	Title	Research finding	Constraints of the research	Sector
2022	**Amir Elalouf**	Queueing Problems in Emergency Departments: A Review of Practical Approaches and Research Methodologies	This study focuses on improving efficiency in emergency departments and explores scientific methodologies such as algorithms, priority models, queueing models, simulation, and statistical approaches for analysis and optimization.	The study discussed the use of queuing theory in improving the waiting time however, it did not link the queuing theory to patient health condition..	Emergency Department
2022	**Mohammad Forozandeh**	Optimizing the Banking Service System Using Queue Theory	Through sensitive analysis, new solutions for optimizing bank queues can be implemented, resulting in improved banking performance. The recommended method enhances customer satisfaction and maximizes profits based on the obtained results.	This study linked automated queuing system to customer experience.	Banking Sector
2022	**Jupiter Ndiaye**	Electronic System Using Artificial Intelligence for Queue Management	The ticket design integrates user information like name, facial image, age, and disability status. A name calling and screen display system at the counters replaces printed tickets, while biometric authentication prevents fraud through facial recognition.	Adapt this model to improve passenger sevice level by predicting patterns	Public facilities

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2021	**Mengyu Ji**	**Automated Taxi Queue Management at High-Demand Venues**	Numerical studies demonstrate that the proposed optimal control approach with demand predictions outperforms the same strategy assuming Poisson demand, resulting in a 43% improvement. Compared to the status quo without external control, the approach reduces the gap by 23%.	Can apply for another sectors such as traffic in transportation systems and telecommunication	Airport
2020	**Sundari**	Intelligent Queue Management System at Airports using Image Processing and Machine Learning	The Artificial Neural Network (ANN) model was specifically developed to simulate runway scheduling. It consists of three neurons in the input layer and sixteen neurons in the output layer.	can be improved to identify overlapping faces of multiple people. -features for the airport security like unattended baggage tracking	Airport
2019	**Peter and Sivasamy**	Queuing Theory Techniques And Its Real Applications To Health Care Systems	The study demonstrated that by employing Queuing theory and implementing measures to reduce patients' waiting time, hospital managers can effectively address physical, psychological, and emotional aspects that influence patient satisfaction and make decisions benefiting all stakeholders involved.	ANN is more appropriate and can be adapted for advanced systems	Health Sectoer
2018	**Cowdrey**	Applying queueing theory for the optimization of a banking model	The study's conclusion suggests implementing the SJF method during peak hours and utilizing the most profitable job first scheme during off-peak hours to optimize operational efficiency.	The study focused on the application of queuing theory on customer waiting time.it did not show its relationship to employee performance.	Banking sector
2018	**Weiss**	Queue management: Elimination, expectation, and enhancement	The study recommends three approaches to manage queues: (1) improving processes to reduce waiting, (2) effectively communicating with customers to manage their expectations, and (3) enhancing the waiting experience to improve customer satisfaction.	Adapt this model to improve costumer service level by predicting presented issue.	Communi cation sector

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2017	**Seigha Gumus**	Application Of Queuing Theory To A Fast FoodOutfit: A Study Of Blue Meadows Restaurant	The study examined the arrival and service rates using chi-square goodness-of-fit test, confirming that they follow a Poisson and exponential distribution. A 95% confidence interval was used to determine the range of customers within a given time frame.	This study linked automated queuing system to customer experience.	Restaurant
2016	**Ahmed**	Automated Queue Management System	The study discovered that the utilization of automated queuing systems with different algorithms reduces the average waiting time compared to traditional queuing systems.	Can apply for another sectors such as traffic in transportation systems and telecommunication	Banking sector
2015	**Mwangi and Ombuni**	An Empirical Analysis Of Queuing Model And Queuing Behaviour In Relation To Customer Satisfaction At Jkuat Students Finance Office	The study revealed that students had to wait for an average of 33.4 minutes in the queue, indicating a prolonged waiting period. This suggests that the existing queuing system was inefficient and led to queuing problems.	ANN is more appropriate and can be adapted for advanced systems	Student finance office
2015	**Agyei**	Modeling and Analysis of Queuing Systems in Banks	The data was analyzed using TORA optimization tools and descriptive analysis methods, evaluating the performance of different queuing systems. The study concluded that, in terms of overall economic costs, the five-teller system outperformed the four or six-teller systems.		Banking sector

VII. CONCLUSION

This paper discusses the use of machine learning in queue scheduling and identifies various technologies used for this purpose. The authors conducted a systematic literature review and filtered out 12 relevant papers using inclusion and exclusion criteria and snowballing. Most of the selected studies reported achieving their target accuracy. Based on this review, the authors plan to focus on developing a queue scheduling process or model using Artificial Neural Network for the banking sector. This study provides a promising starting point for future research to enhance the accuracy of queuing models using hybrid approaches.

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