INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 15, Issue 5, (2025) E-ISSN: 2222-6990

An Analysis of Performance, Focusing on Waiting and Service Times Using Simulation Modelling

[1]Mohd Rahimie Bin Md Noor, [2]Mohd Azry Abdul Malek, [3]Ahmad Bukhari Bin Mohd Yasin, [4]Mohd Zainuri Bin Muhamad, [5]Hassanul Firman Bin Md Apandi, [6]Mohd Noor Azam Bin Nafi, [7]Omar Kairan, [8]Amri Bin Abdul Rahman

[1]Mathematics department, Faculty of Computer & Mathematical Sciences Universiti Teknologi MARA (UiTM) Cawangan Kelantan, Bukit Ilmu, 18500 Machang, Kelantan Darul Naim, Malaysia, [2,6,7]Statistic Department, Faculty of Computer & Mathematical Sciences Universiti Teknologi MARA (UiTM) Cawangan Kelantan, Bukit Ilmu, 18500 Machang, Kelantan Darul Naim, Malaysia, [3,4,5]Business Department, Faculty of Business And Management Universiti Teknologi MARA(UiTM) Cawangan Kelantan Kampus Kota Bharu Lembah Sireh, 15050 Kota Bharu, Kelantan Darul Naim, [8]Computer Sciences, Faculty of Computer & Mathematical Sciences Universiti Teknologi MARA (UiTM) Cawangan Kelantan, Bukit Ilmu, 18500 Machang, Kelantan Darul Naim, Malaysia

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v15-i5/25358 DOI:10.6007/IJARBSS/v15-i5/25358

Published Date: 24 May 2025

Abstract

The objective of this study is to develop and simulate the waiting time process at Kopi Saigon, a coffee café located in the Kota Bharu branch, Kelantan, utilizing a Discrete Event Simulation (DES) approach. Upon arrival, customers join a queue for various services, including meal ordering, waiting for preparation, and making payments. Observations reveal that the queuing process is time-consuming, prompting the creation of a simulation model to evaluate the system's performance based on key metrics such as average waiting time, total time spent in the system, resource utilization, and queue length. The simulation model, developed using Arena software, aims to identify bottlenecks within the current process. Several alternative solutions were tested to enhance system performance. The findings indicate that the most effective alternative led to significant reductions in both the average waiting time and the total time spent in the system, ultimately improving customer satisfaction with Kopi Saigon's services

Keywords: Discrete Event Simulation, Queuing, Waiting Time, Arena, Service Time

Introduction

For this project, Kopi Saigon has been chosen as the location for the simulation. To older Vietnamese citizens, Saigon is now known as Ho Chi Minh City. The early 19th century saw the introduction of coffee plantations in Vietnam by French colonists, who also pioneered

the creation of Vietnamese coffee (Albuquerque, n.d.). The name “Kopi Saigon” was selected to introduce Kopi Vietnam to the Malaysian public. Kopi Saigon is located at Jalan Jambatan Sultan Yahya, Kg. Sireh. It is situated only 150 meters from Lotus Kota Bharu, Kelantan. This café operates as a coffee shop offering a variety of coffee beverages, making it an ideal spot for coffee lovers to experience premium Vietnamese coffee, renowned for its exceptional quality.

The café provides a range of coffee options and several amenities, such as power outlets, highchairs, free Wi-Fi, air conditioning, takeaway services, outdoor seating, comfortable seating, and a game center. Customers can use the power outlets to charge their phones or laptops, while highchairs are available for babies during meals. Guests can enjoy free Wi-Fi and the comfort of air conditioning while dining or waiting for their orders. The café offers both dine-in and takeaway options. Additionally, Grab services are available, allowing customers to conveniently order drinks online. For those who enjoy the outdoors, outdoor seating is offered. The café also features a game center where customers can play board games, congkak, UNO, and carrom.

Kopi Saigon operates for 12 hours, from 11 a.m. to 11 p.m. Staff members work in shifts, with a female worker serving customers alongside the boss from 11 a.m. to 5 p.m. After 5 p.m., a male worker takes over, continuing to assist customers until closing. The café has only two counters, staffed by one male and one female worker. Kopi Saigon was selected as the location due to its close proximity to the rental house, situated only 20-50 meters away. This convenience allows the project to be carried out efficiently without the need for long-distance travel, saving time and simplifying the entire process. Regarding the current queuing system, the café tends to experience delays in service due to the limited number of staff, as only two workers are available.

Problem Statement

Effective management of service systems is vital in various industries, such as customer service, healthcare, telecommunications, and transportation. The challenge lies in reducing wait times, making the best use of available resources, and meeting high customer satisfaction expectations. Providing excellent customer service is essential for retaining clients and maintaining a positive company reputation. Customer satisfaction is key to business success. However, many companies struggle to uphold customer satisfaction due to inefficient processes, like lengthy queues.

Kopi Saigon is a café known for its wide range of coffee options, attracting a large clientele, particularly coffee aficionados. However, some challenges have been identified that contribute to customer wait times. In this project, the main issue is long queues during peak periods, especially around lunch time. Additionally, a shortage of staff adds to this issue, as the café operates with only two counters to handle all customers. As such, this project intends to create a simulation-based model to optimize the queuing system at Kopi Saigon, Lembah Sireh, Kota Bharu.

This project aims to create a simulation-based model of the queuing system at Kopi Saigon, Lembah Sireh, Kota Bharu. The café serves coffee enthusiasts seeking a variety of Vietnamese coffee flavors. Since there are only two counters available at Kopi Saigon, this

project will focus on the counters that manage both customer orders and payments. The primary focus will be on aspects like waiting time, pickup time, and dine-in time. Customer arrival times and the duration of order processing will be tracked until they leave the counter. The simulation will be conducted during the café's operating hours on Tuesday, 8 June 2024, from 12 p.m. to 7 p.m. A total of 7 hours was spent observing and recording the system during the study. 53 customers were logged in the system, excluding those who used Grab services.

The objectives of this project are to develop a simulation model of the queuing process and to recommend strategies to improve the efficiency and performance of the queuing system.

Literature Review

Numerous studies in the literature have explored the performance of customer service systems. Common methods employed to evaluate system performance and enhance customer service include system dynamics (Sapiri, Rahim, & Mohamad, 2017; Rahim, Sapiri, & Mohamad, 2017), linear programming (Madankumar & Rajendran, 2019), service quality (Özkan, Süer, & Kılıç, 2019), and discrete-event simulation (Gumus, Guneri, & Ilk, 2017; He & Hu, 2018; Jalal, Zulkefli, Hashim, & Hussain, 2018). A significant amount of past research has focused on using discrete-event simulation to identify bottlenecks and recommend potential improvements. Computer simulation modeling has been a useful and effective tool since the 1950s, particularly in supporting decision-making. Its wide range of applications has led to a substantial increase in popularity (Tahar, 2006). Simulation can be applied for performance evaluation, system design, decision-making, and planning (Panayiotou, Metsiou, & Chatzikokolakis, 2000). Simulation is the process of mimicking real-world operations or systems over time, aiming to analyze the behavior of a system, explore “what-if” scenarios, and aid in system design (Tahar, 2006).

Simulation techniques are applied in a variety of settings. In 2015, Alhaag, Al-Ashaikh, and Alzahrani (2015) conducted a study on the queuing system at the outpatient department of King Khalid Hospital in Riyadh, Saudi Arabia. Patients were classified into three categories: Type 1, Type 2, and Type 3. Arena software was used to evaluate three potential alternatives for the system, focusing on performance measures such as average waiting time, the number of customers in the queue, and total service time. In 2016, Xian, Yusof, and Rasmani (2016) examined the queuing challenges at UniMall, where a single payment counter operated under a first-come, first-served (FCFS) policy, resulting in long queues and customer dissatisfaction. Arena software was used to model the queuing system, and various alternatives were assessed to improve the system and boost customer satisfaction. Prior to this, in 2011, Eskandari, Sadi, and Amini (2011) focused on improving the performance of emergency departments. Their study introduced a new framework to enhance patient flow in a government hospital’s emergency department. Among fourteen proposed scenarios, the most effective solution prioritized emergency patients in MRI and CT scan wards and recommended adding mobile beds and a financial department to improve hospital operations.

In the banking sector, Madadi (2013) used the FITNESS simulation software to develop a model of the queuing system at a bank in Johor Bahru, Malaysia. Initially, the bank had four counters and two customer service tables. The simulation results, which focused on server idle time and busy time, suggested the addition of a new counter, removal of the service table,

and standardization of the shift schedules. Another study by Sharifi, Sadeghi, and Abolhassani (2014), titled Simulation Process of Isfahan Post Office Using ARENA, developed a simulation model to identify inefficient or underutilized counters, resulting in improved service quality. In 2016, a study by Lim, Azriani, and Nor (2016) focused on the queuing system at the Department of Immigration in Johor Bahru, Malaysia. The department had long queues for passport renewals and new applications. A more recent study by Kim, Jie, and Choi (2018) looked into the queuing problem at airport check-in systems, where passengers could either use self-check-in kiosks or go to manual counters. The simulation model developed with Arena software showed that using self-check-in kiosks and automatic immigration screening significantly reduced waiting times. From these studies, it is evident that discrete-event simulation is a highly effective method for analyzing queuing systems in the service industry, particularly in improving customer satisfaction.

Methodologi

This research provide the data survey which recognize as primer data. The data also will be transfer into probability distribution by using ARENA..

Data Collection

The data was collected on 11 June 2024 at Kopi Saigon in Lembah Sireh, Kelantan. Primary data was used, as it was convenient for us to simulate the model. The data was recorded over 7 hours, from 12 p.m. to 7 p.m. on a single day. The input variables include arrival time, order time, waiting time, pickup order, and dine-in process. The output variables include the average, minimum, and maximum processing time, waiting time, average total time in minutes for each input, and the number of customers checking in and checking out. The input analyzer was used to identify the distribution for each input variable. Table 1 below shows the expressions for each input variable.

Table 1
Expression for each input variable

Input	Expression
Arrival Time	1 + WEIB (1.08, 3.79)
Order Time	-0.5 + GAMM (2.69, 2.02)
Waiting Time	0.5 + WEIB (1.72, 6.13)
Pickup Order	1.5 + GAMM (1.7, 6.68)
Dine in Process	-0.5 + 41* BETA (1.26, 0.158)

Simulation is a specific method for studying models that is essentially experiential or experimental. The concept behind simulation is similar to that of field testing, except that a computational or physical model is used in place of the system of interest. The simulation process involves building a model that mimics the desired behaviors, experimenting with the model to produce observations of these behaviors, and making an effort to understand, gather, and expand these behaviors. In many applications, simulation includes validating, describing, and supporting simulation results and study recommendations, as well as testing and comparing alternative designs (White & Ingalls, 2009).

Conceptual Model of System

A theory can guide the development of one or more conceptual models to address a particular community health behavior or outcome. Conceptual models describe the

associations among variables in order to explain or predict outcomes. A theory is deliberately broad in its application (Brady et al., 2020). According to Swaen & George (2024), in addition to defining the appropriate research process objectives and outlining how those objectives come together to form coherent conclusions, a conceptual model demonstrates the probable connections between the selected variables. The figure 1 below shows the layout of Kopi Saigon.

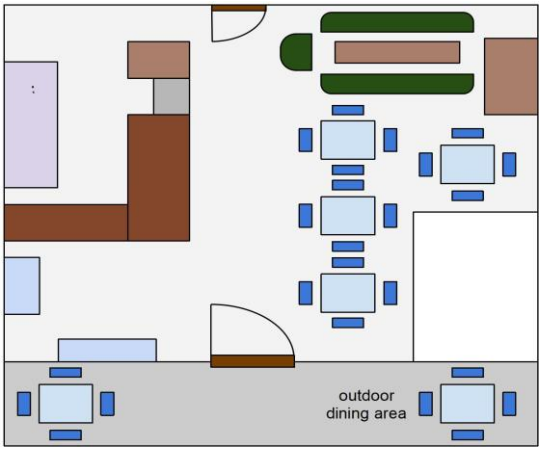

Figure 1: Layout of Kopi Saigon

Model of Simulation Process

Based on figure 2 below, the steps of simulation process begin. Kopi Saigon at Lembah Sireh, Kota Bharu operates from 11 a.m. to 11 p.m., providing 12 hours of service each day. Conceptually, each customer will enter the café and proceed directly to the counter to place an order and make a payment. Each customer will be served by one employee at the counter, who may be either a male or female employee. Customers will have to wait their turn to place an order and make a payment if the previous customer is still being served at the counter. The employee will repeat the order in front of the customer before proceeding with the payment to ensure the order is correct. The customer will inform the employee if they would like to dine in. If the customer chooses to dine in, the employee will prepare the order and serve it at the table. Otherwise, the customer will wait in the designated area after placing the order and pick up the completed order. Afterward, the customer will exit the café.

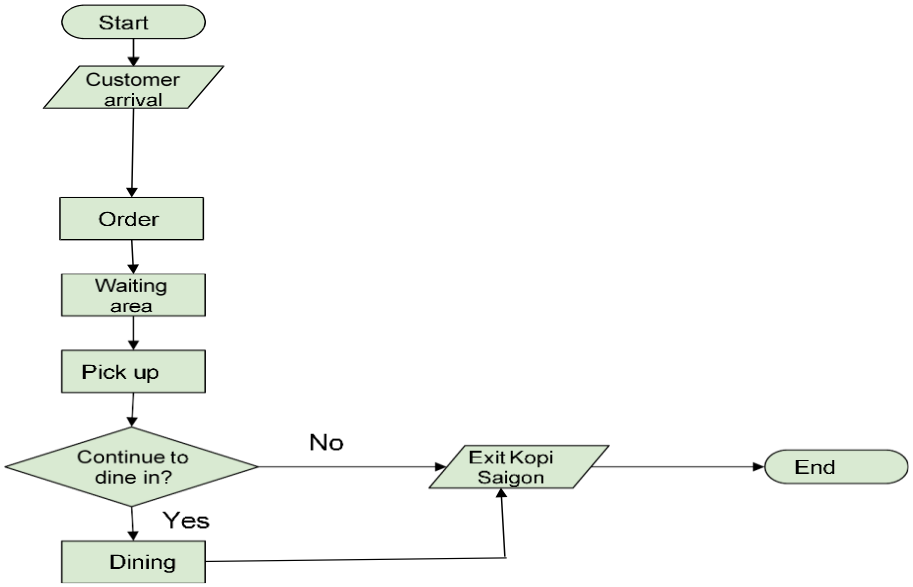

Figure 2: Flowchart Process of Kopi Saigon

Arena Simulation

Figure 3 below shows the service simulation at Kopi Saigon in Lembah Sireh, Kota Bharu, Kelantan, conducted using Arena software. Its application is highly beneficial in identifying areas of the café's current service that require improvement. Every process in this model was created using data gathered from direct observations, and it reflects the actual service provided by Kopi Saigon. Each process uses a specific expression through an input analyzer. The data analysis process was supported by the results obtained from the successful testing of the Arena model, which was based on the actual 7-hour operation period of the café. This study will consider both the number of customers queuing in a process and the length of time spent waiting as issues that Kopi Saigon can address. Addressing these issues could improve future customer satisfaction with the provided services and enhance the café's service effectiveness.

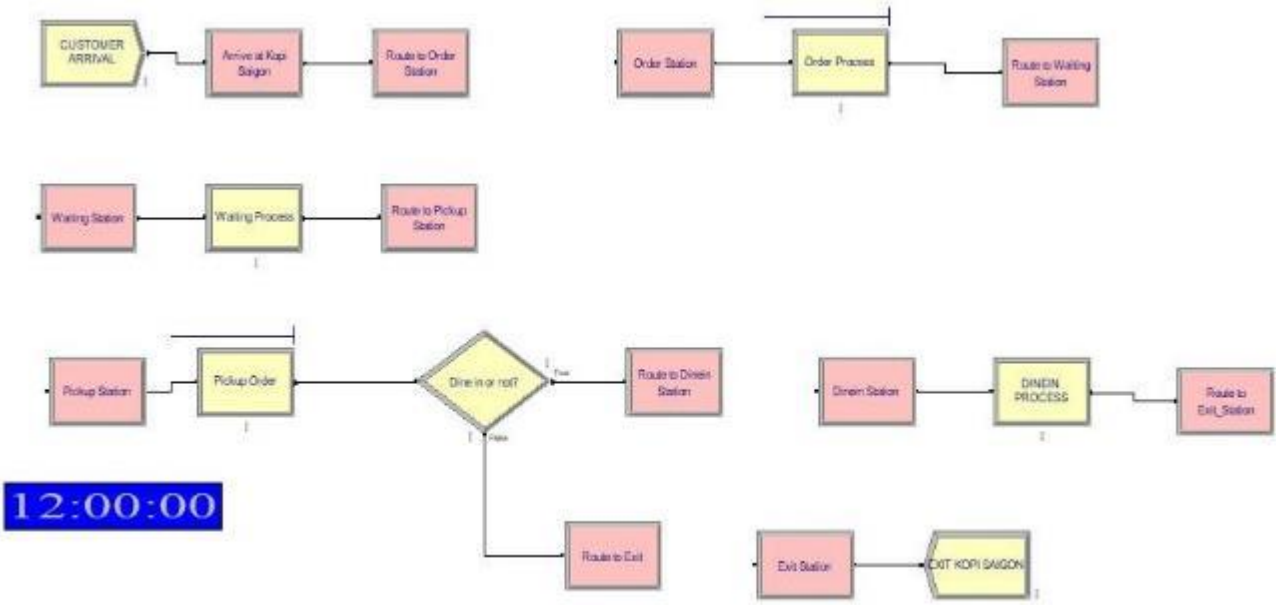

Figure 3: Kopi Saigon's Simulation Model

Validation and Verification

The developed simulation model is verified and validated before being used for analysis. Verification is performed to ensure that the developed model accurately mimics the real system. The validation process is defined as the procedure for reaching an acceptable level of confidence that the inferences drawn are current and applicable to the real-world system being represented. Model verification and validation must be carried out on the developed simulation model to ensure that the model is accurate and accurately mimics the real-world system. In this study, the accuracy between the simulation output and the actual output is evaluated. The simulation is run for 7 replications.

The method will be applied to validate the model by using the difference between the model's prediction and the actual observation. The difference is expected to be less than 10 percent to validate the model.

$$\text{Model validation} = \frac{\text{Simulation output} - \text{Actual output}}{\text{Actual output}} \times 100$$

Result and Discussion

The simulation model, which ran for 7 hours from 12 p.m. to 7 p.m., will be examined and discussed in this section. At Kopi Saigon, the system must account for several processes, including the order process, waiting process, pickup process, and dining process. All of these processes are crucial to the system. Throughout the order, pickup, and dining processes in this study, customers at Kopi Saigon were attended to, delayed, and released by employees. Meanwhile, during the waiting process, entities were delayed as they simply sat in the waiting area, queuing for a set period of time without any employees present. The employees were set as resources in this project. Therefore, summary statistics such as the average, minimum, and maximum values were used to analyze the queuing system's characteristics shown in table 2 below.

Table 2
Expression for each input variable

	Process Time (minutes)			Waiting Time (minutes)			Avg Total
	Ave	Min	Max	Avg	Min	Max	
Order	1.42	0.037	4.26	0.12	0	3.5	1.54
Waiting	6.66	0.71	16.3	0	0	0	6.66
Pickup	8.32	2.32	25.1	111.8	0	197.68	120.13
Dine In	5.86	0	40.1	0	0	0	5.86

The average, minimum, and maximum times for each process are shown in the table 2 above, along with the average total time spent by each customer at each process. The average process time for the order process is 1.42 minutes, while the average waiting time is 0.12 minutes. The order process time ranges from a minimum of 0.037 minutes to a maximum of 4.26 minutes, while the waiting process ranges from a minimum of 0.71 minutes to a maximum of 16.3 minutes. During the order process, customers may wait in line for up to 0.22078 minutes. The average time for customers to pick up their order is 8.32 minutes, ranging from a minimum of 2.32 minutes to a maximum of 25.19 minutes. Therefore, during the pickup process, customers may wait in line for up to 111.80 minutes. In addition, the

average dine-in process time is 5.86 minutes, with no waiting time during the dine-in process. Overall, a customer spends an average of 1.54 minutes at the order process, 6.66 minutes in the waiting area, 120.13 minutes picking up their order, and 5.86 minutes dining in.

Validation and Verification Result

Table 3

Differences between Simulation and Actual Data

Process	Simulation Output (minutes)	Actual Data (minutes)	Differences (%)
Order	1.3452	1.3396	0.4191
Waiting	6.1621	5.9623	3.3518
Pickup	7.6513	7.8113	2.0489
Dine in	4.3996	4.0755	7.9531

The Kopi Saigon simulation process needs to be validated and confirmed once it is completed. To generate output for this study, which consists of several statistics, we will conduct 7 replications. The average process time and customer check-in rates of the replications will then be compared to the real data. However, since the process of going to the waiting area is designated as a delay process, we will only consider the three processes order, pickup, and dine-in when validating our model. Given that there is less than a 10% difference between the simulation results and actual observations, the table 3 above indicates that the simulation model is valid with a 90% level of confidence.

Conclusion

The purpose of this research study is to understand the Kopi Saigon queuing system and how the simulation model can be used to evaluate it. A simulation replicates how real-world systems or processes work, and in this study, Arena Software was used to model the system at the café. The simulation model's results allowed for the identification of problems in the real system. To build the simulation model, data was collected over 7 hours during the study's operating period at Kopi Saigon, Kota Bharu. Information was gathered by recording customer activities from the time they entered the café until they left. The created model successfully replicated both the actual system and its key components. The pickup process wait time was identified as the main factor affecting the queuing system at Kopi Saigon, as there was only one crew member working at the pickup station during peak hours. To reduce customer wait times, we decided to add two more crew members and optimize the crew scheduling. As a result, customers now experience shorter waiting times during the pickup process.

Acknowledgements

The study was conducted without using any funds or research grants.

Conflict of Interest Statement

I am agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

References

Brady, S. S., Figueroa, M. E., Fagan, A. A., Earp, J. A., Gielen, A. C., Hovmand, P. S., & Zimmerman, M. A. (2020). Development of conceptual models to guide public health research, practice, and policy: Synthesizing traditional and contemporary paradigms. *Health Promotion Practice, 21*(4), 510–524. https://doi.org/10.1177/1524839919890869

Panayiotou, C. G., Cassandras, C. G., & Gong, W.-B. (2000). Model abstraction for discrete event systems using neural networks and sensitivity information. In *Proceedings of the 2000 Winter Simulation Conference* (Vol. 1, pp. 335–341). IEEE. https://doi.org/10.1109/WSC.2000.899736

Kim, D.-U., Jie, M.-S., & Choi, W.-H. (2018). Airport simulation based on queuing model using ARENA. *International Journal of Advanced Science and Technology, 115*, 125–134.

Rahim, F. H. A., Hawari, N. N., & Abidin, N. Z. (2017). Supply & demand of rice in Malaysia: A system dynamics approach. *International Journal of Supply Chain Management, 6*(4), 1–7.

Sapiri, H., Zulkepli, J., Ahmad, N., Abidin, N. Z., & Hawari, N. N. (2017). *Introduction to system dynamics modelling and Vensim software*. UUM Press.

He, H., & Hu, Z. (2018). Analysis of fast food service capability based on Flexsim modeling and simulation. *IOP Conference Series: Materials Science and Engineering, 394*, 052005. https://doi.org/10.1088/1757-899X/394/5/052005

Eskandari, H., Riyahifard, M., Khosravi, S., & Geiger, C. D. (2011). Improving the emergency department performance using simulation and MCDM methods. In *Proceedings of the 2011 Winter Simulation Conference* (pp. 1211–1222). IEEE.

Lim, J., Azriani, N., & Nor, M. (2016). Simulation by queuing system at immigration department. *International Academic Research Journal of Social Science, 2*(1), 112–119.

Alhaag, M. H., Aziz, T., & Alharkan, I. M. (2015). A queuing model for health care pharmacy using software Arena. In *2015 International Conference on Industrial Engineering and Operations Management (IEOM)* (pp. 1–11). IEEE. https://doi.org/10.1109/IEOM.2015.7093849

Jalal, M. Z. H. A., Desa, W. L. H. M., Nawawi, M. K. M., Khalid, R., Ramli, R., & Abduljabbar, W. K. (2018). Road traffic congestion solution using discrete event simulation. *International Journal of Innovative Technology and Exploring Engineering, 8*(5S), 53–57.

Madadi, N., Roudsari, A. H., Wong, K. Y., & Galankashi, M. R. (2013). Modeling and simulation of a bank queuing system. In *2013 Fifth International Conference on Computational Intelligence, Modelling and Simulation* (pp. 209–215). IEEE.

Özkan, P., Süer, S., Keser, İ. K., & Kocakoç, İ. D. (2019). The effect of service quality and customer satisfaction on customer loyalty: The mediation of perceived value of services, corporate image, and corporate reputation. *International Journal of Bank Marketing, 38*(2), 384–405. https://doi.org/10.1108/IJBM-03-2019-0096

Tahar, R. M. (2006). *A practical approach to computer simulation modelling*. Universiti Putra Malaysia Press.

Swaen, B., & George, T. (2024, March 18). What is a conceptual framework? | Tips & examples. *Scribbr*. https://www.scribbr.com/methodology/conceptual-framework/

Gumus, S., Bubou, G. M., & Oladeinde, M. H. (2017). Application of queuing theory to a fast food outfit: A study of Blue Meadows Restaurant. *Independent Journal of Management & Production, 8*(2), 441–458. https://doi.org/10.14807/ijmp.v8i2.576

Madankumar, S., & Rajendran, C. (2019). A mixed integer linear programming model for the vehicle routing problem with simultaneous delivery and pickup by heterogeneous vehicles, and constrained by time windows. *Sādhanā, 44*(39). https://doi.org/10.1007/s12046-018-1048-y

Sharifi, S., Sajadi, S. M., & Tavakoli, M. M. (2014). Simulation process of Isfahan post office using Arena. *International Journal of Services and Operations Management, 17*(1), 50–66. https://doi.org/10.1504/IJSOM.2014.057995

Xian, T. C., Hong, C. W., & Hawari, N. N. (2016). Modeling and simulation of queuing system for customer service improvement: A case study. In *The 4th International Conference on Quantitative Sciences and Its Applications (ICOQSIA 2016)* (Vol. 1782, No. 1). https://doi.org/10.1063/1.4966087

White, K. P., & Ingalls, R. G. (2009). Introduction to simulation. In *Proceedings of the 2009 Winter Simulation Conference* (pp. 12–23). IEEE. https://doi.org/10.1109/WSC.2009.5429315