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Modeling Analysis and Queuing System at Mie Gacoan Restaurant

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Abstract

Mie Gacoan Restaurant faces long queues especially during rush hour, which leads to long waiting times and decreased customer satisfaction. The purpose of this study is to evaluate the existing queue system and create an overall service process model. The system receives input in the form of data on the number of customers and service duration, while the output is in the form of a queue model and performance analysis. This topic is significant because the speed of service is a key factor in customer satisfaction in fast food restaurants. Currently, there is no model that describes in detail the queuing system at Mie Gacoan, so there is no analytical basis for operational improvements. The solution is carried out through discrete simulation modeling based on the results of field observations. The system was analyzed using a single queue–multiple server model that depicts the real conditions of the restaurant. Simulation of multiple scenarios was used to examine the effect of changes in the number of servers on queue performance. The addition of one waiter during peak hours has been proven to reduce waiting times by up to 35% and queue lengths by up to 40%. This research contributes as a quantitative basis for operational decision-making.

Keywords : discrete simulation; queue system; gacoan noodles; customer service; wait time; system modeling

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INTRODUCTION

Queue is a condition in which an entity, such as a customer, has to wait to receive services due to limited service capacity (Iqbal, 2018). In the context of the business world, queues that are not managed properly can have negative impacts, such as decreased customer satisfaction, loss of revenue potential, and a declining service image. Although long queues are often considered an indicator of high customer interest, if not handled systematically, they can hinder operational effectiveness and service efficiency (Suharto, 2010; Gross & Harris, 2008).

Mie Gacoan Restaurant is one of the fast-growing restaurant chains in Indonesia. Its popularity is influenced by an aggressive marketing strategy, relatively affordable prices, and an attractive menu variety. However, the significant growth in customer visits has not been accompanied by optimization of the service system (Purwanda & Indriati, 2019; Mulyadi & Wardhana, 2021).

Arrival and service completion times were recorded for 50 customers who visited the *Mie Gacoan* restaurant, Purwokerto branch, during the observation period from 20:23:58 to 22:30:05. The graph consists of three types of information: arrival time (green), service completion time (blue), and the number of customers in order of arrival (orange) (Rossetti, 2015).

Based on this data, the first customer arrived at 20:23:58, and the 50th customer at 22:15:02. This means that the average time between customer arrivals was approximately 80 seconds. Meanwhile, the average service time required to serve one customer was 152 seconds, or about 2.5 minutes. The total time spent by customers in the system—from arrival, waiting, to completion of service—was about 1,183 seconds, or almost 20 minutes per person. This implies that most customers had to wait in line before being served (Law & Kelton, 2014; Sari & Sugito, 2016).

As many as 98% of customers (49 out of 50) were recorded as having to wait before being served. This is indicated by the clear time gap between the green line (arrival) and the blue line (service completion) in the graph. The average customer waiting time in the queue was 593 seconds, or almost 10 minutes, and for those who had to wait, the average rose to 606 seconds. This data shows that the existing queue system is not efficient, particularly during peak hours (Che, Dong, & Namkoong, 2024).

Additionally, the orange area graph shows a steady increase in the number of customers from the 1st to the 50th. The consistently rising trend indicates that the customer arrival flow is stable and there are no significant time lags between arrivals. This further supports the analysis that the system needs to be improved to handle surges in demand—for example, by increasing the number of *cashiers* or reorganizing service flows (Qminder, n.d.).

Overall, the graph illustrates the high workload placed on the restaurant's queuing system. Given the long waiting times and the high proportion of customers required to wait, improvements are necessary in the service process to maintain customer satisfaction. The use of such data is critical to support precise, reality-based operational decisions (Chuah & Aziz, 2023).

The gap between customer arrival rates and available service capacity underscores the need to improve the queue system. The current system is conventional and has not yet adopted modeling technologies or dynamic regulatory systems that are adaptive to demand fluctuations. The fundamental issue lies in the lack of integration between operational data and workforce planning, resulting in bottlenecks at the ordering and food pickup stages (Gross & Harris, 2008; Iqbal, 2018).

To address this challenge, a data-driven and system-based solution is required. The novelty of this research lies in the application of a discrete-event simulation approach using *FlexSim* software, which is rarely employed in queue analysis for fast-food restaurants in Indonesia. While previous studies have mostly relied on analytical or manual queue models, this study advances the field by applying visual-based simulation integrated with empirical input distributions from *ExpertFit*. The simulation enables the evaluation of multiple real-time scenarios, such as adding cashiers or redesigning service flows, without disrupting actual operations (FlexSim Software Inc., 2020; Law & Kelton, 2015).

Based on this background, a data-driven quantitative approach through discrete modeling and simulation is essential to evaluate and improve the existing queue system. In this study, *FlexSim* software is used as a simulation tool to construct a visual model of the system, while *ExpertFit* determines the appropriate input probability distribution based on empirical data (Che et al., 2024; Rossetti, 2015).

Terms such as *queuing* have been standardized to *queue*, and the term *server* has been used consistently, except when referring to technical simulation contexts. The purpose of this study is to analyze and model the queue system at *Mie Gacoan* Restaurant to identify service issues and develop data-based solutions. To achieve this, the research follows several key steps. First, a probability distribution analysis is conducted for each service process using *ExpertFit* software to obtain a suitable statistical model as simulation input. Second, a simulation model of the existing queue system is constructed using *FlexSim*, reflecting the actual conditions of the restaurant, and several improvement scenarios are developed to assess the impact of proposed changes on system performance. Lastly, the results of these simulations are analyzed to generate strategic recommendations that can effectively reduce customer waiting times and enhance overall service efficiency at the restaurant.

RESEARCH METHOD

This study uses a quantitative approach based on discrete simulation to understand and analyze the queue system at the *Mie Gacoan* Restaurant, Purwokerto branch. This method was chosen because it can represent the service process in detail and dynamically, especially under crowded conditions. The purpose of using simulations is to test various potential system improvements without disrupting real-world operations. According to Law and Kelton (2015), the discrete simulation approach is highly suitable for analyzing complex and stochastic service systems, such as the queue system in a fast-food restaurant.

Data collection was conducted through direct field observation, which was then analyzed using *ExpertFit* software to determine the probability distributions of arrival and service times. In addition, the use of software such as *FlexSim* and *ExpertFit* allows for the visual construction of system models based on empirical data, resulting in more accurate and reliable analysis (Rossetti, 2015; Nasution and Fahmi (2021). This processed data was then input into *FlexSim*, a visual-based simulation software, to build a queue system model that reflects actual conditions. Through this process, several scenarios were tested to examine how changes—such as adding cashiers—could impact overall system performance.

The raw time data was statistically analyzed using *ExpertFit* software to determine the most appropriate probability distributions for both arrival and service times. *ExpertFit* helped match empirical data to theoretical distributions, ensuring accuracy in the simulation model (Santoso & Lestari, 2022). These distributions served as input parameters for the simulation conducted in *FlexSim*, a discrete-event simulation software.

To ensure realism, the *FlexSim* model mirrored the actual conditions observed at the restaurant, including a single service point (cashier) and a First-In-First-Out (FIFO) queue discipline. Several improvement scenarios were tested, such as adding an extra cashier, and the outcomes were evaluated based on average waiting time, queue length, and server utilization (Sutanto et al., 2023). The entire process involved model verification (ensuring the logic flow matched field conditions) and validation (comparing simulation results with actual data) to ensure the robustness and reliability of the findings.

Systematics of Problem Solving

The systematics of problem solving in this study are structured based on a discrete simulation approach. The first step began with identifying the queue system problem at the *Mie Gacoan* Restaurant, Purwokerto branch, which exhibited service inefficiencies during peak hours. This issue was then formulated into specific objectives and a research problem statement. Subsequently, data collection was carried out, consisting of primary data (direct observations of arrival time, service time, and completion time) and secondary data (literature and previous research references). Primary data served as the main basis for building the queue system model. The collected data was processed to calculate parameters such as inter-arrival time, waiting time, service time, and total time spent in the system. This processing was followed by distribution testing using *ExpertFit* software to determine the best probability distribution that accurately represented service patterns and customer arrivals. These distributions were then used as input in the simulation process using *FlexSim*.

An actual system model was developed in *FlexSim* and expanded into multiple scenario models that represented various improvement alternatives, such as adding servers or redesigning queue lines. Each model was subjected to repeated simulations to measure scenario performance. The verification process ensured that the simulation model conformed to the real system by comparing the modeled service logic to actual field operations. Validation was conducted by comparing the simulation results with real-world data to assess accuracy. Once verification and validation were complete, the results from each scenario were analyzed and compared.

Frame of Mind

This research stems from real problems observed in the field—namely, long customer wait times and queues during peak hours. Observations revealed that the current queue system operates with only one service line and one cashier, which is insufficient to efficiently manage customer surges. To gain deeper insights into this situation, a data-driven analysis was conducted, starting with the collection of arrival and service time data. This data was then subjected to distribution testing using *ExpertFit* to derive a statistical model that reflects field conditions.

Subsequently, a simulation model was developed using *FlexSim*, covering both the existing system and potential improvement scenarios. Through simulation, the researchers assessed the effects of changes, such as increasing the number of servers or reorganizing service flow. The simulation outcomes were then compared to determine the most effective scenario in reducing wait times and enhancing service efficiency.

To clarify the research logic, the flow of thought was organized systematically into interrelated stages. The process begins with the "Start" stage, marking the formal initiation of the research. Following that, the problem is identified based on field observations and formulated clearly as a research problem and objective.

The next stage involves data collection, including primary data from direct observation and secondary data from relevant literature or prior studies. The collected data is then processed to compute inter-arrival time, waiting time, service time, and total system time. These results form the basis for developing the queue system model. Initial models were constructed using *FlexSim* to mirror field conditions. Time distributions were then determined using *ExpertFit* to ensure that simulation inputs matched actual patterns.

With these inputs, researchers developed various improvement scenarios—such as increasing the number of servers—to evaluate impacts on system performance. All scenarios were executed and analyzed in terms of waiting time, queue length, and server utilization. The results were used to identify the optimal scenario, which then informed the formulation of strategic recommendations for restaurant management. The research concluded with the compilation of a final report that presented all findings and proposed solutions based on the simulations.

RESULTS AND DISCUSSION

Verify Results

Table 1. Verification of Processing Data Results

Metric	Formula	Result	Unit
Average Waiting Time	= 29670 / 50	593	seconds
Probability of Customer Needing to Wait	= 49 / 50	0.98	-
Average Time in System per Customer	= 59138 / 50	1,183	seconds
Average Service Time	= 7577 / 50	152	seconds
Average Interarrival Time	= 3931 / 49	80	seconds
Cashier Idle Percentage	= 0 / 7577 × 100	0.0	%
Avg. Waiting Time for Waiting Customers Only	= 29670 / 49	606	seconds

Source: Processed Data

Based on the table above, it can be seen that the average waiting time is 593 seconds. This indicator describes the average time a customer spends before getting a service. The process of obtaining the data results uses the formula of total waiting time ÷ Total customers so that the result is 29670 seconds ÷ 50 customers = 593 seconds. Then the chance of customers waiting to be served is 98%. This calculation measures the likelihood that a customer who comes will face a queue because the cashier is serving other customers. The process of calculating this result uses the formula: Total customers Queue ÷ total number of customers and results: 49 ÷ 50 = 0.98 or 98%. Based on the results of further calculations, it is known that the average time spent by customers in the system, from arrival to completion of service, is 741 seconds or about 12 minutes 21 seconds. This value is obtained from the total time in the system of 37,043 seconds divided by the number of customers as many as 50 people. Meanwhile, the average time needed for a cashier to serve one customer is 152 seconds, which is obtained from a total service time of 7,577 seconds divided by 50 customers. Furthermore, if the percentage of time the cashier was unemployed during the observation period is calculated, the result is 0%. This means that the cashier continues to serve customers without interruption during the period. This indicates that the cashier's workload is very high, and the system does not give the cashier any free time. The average time between customer arrivals is around 80 seconds. This figure is obtained from the total time between arrivals of 3,931 seconds divided by 49 differences in arrivals between 50 customers. This gives the impression that customers come quite often and continuously. If you look at it more specifically, the average waiting time is only calculated for customers who are actually in a queue, which is as many as 49 out of 50 people. Their average waiting time reaches 606 seconds or about 10 minutes and 6 seconds. This means that almost all customers have to wait quite a long time before being served. This condition further confirms that the current service system is experiencing high loads and very inefficient waiting times.

Conceptual Models

The queue system at Mie Gacoan consists of *Single Channel-Single Phase*. Customers only interact with one service line and one phase as shown in the following figure:

Figure 1. Conceptual Model
Source: Processed Data

The picture above is an illustration of the concept model at the Mie Gacoan restaurant in the Purwokerto branch which consists of 3 processes, namely:

1) Customer arrival
The arrival of customers themselves includes the process of customers coming to the restaurant as the main entity which includes all processes in the Mie Gacoan restaurant. Customer arrival patterns are irregular or random, depending on the time and operational conditions. Every customer who arrives will be directly directed to the service point, but if the cashier is serving other customers, then the customer will have to wait in line.
2) Most recent booking
Upon arrival at the service point, customers will be served by an officer or cashier who is available. If the cashier is still busy when the cashier arrives, then customers are required to wait in the queue until their turn arrives. This process follows the principle *of First-In First-Out (FIFO),* where customers who come first will be served first. This stage is the core of the queue system because it affects waiting time, officer workload, and overall operational efficiency.
3) Outgoing Customers
After the order is completed and submitted to the customer, the customer exits the system. This stage marks the end of the entire series of service processes. The information from this phase is important for measuring the total time in the system and calculating the efficiency of the service as a whole.

This conceptual model is an important basis for the development of system simulations, to quantitatively analyze queue performance. With this modeling, various service improvement scenarios can be tested systematically. Although the model is simple, this multi-phase structure represents the customer's real flow fairly accurately, making it a solid foundation for advanced analysis and operational decision-making.

Simulation Model

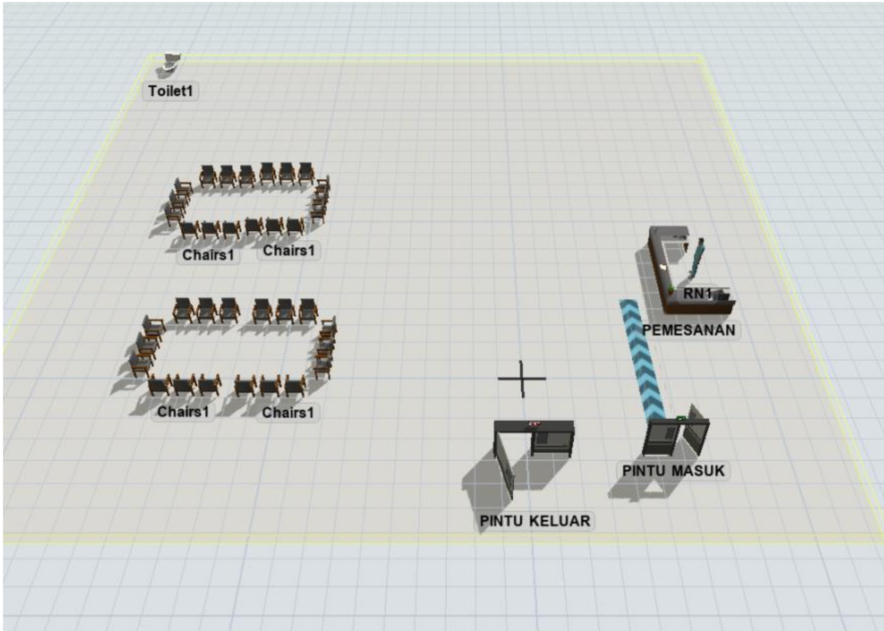

Figure 2. Flexsim Simulation Model
Source: Processed Data

The simulation flow starts when the customer enters the system through the Gateway. After that, they head straight to the Booking point, where customers will be served by a cashier. If the cashier is busy serving other customers, then the customer must wait in line according to the order of arrival. This process follows the *First-In First-Out* (FIFO) system, where customers who arrive early will get service first.

After completing the ordering and payment process, the next final stage in this process is the customer exits the system through the Exit. This point marks the completion of the entire service cycle for a single customer.

This flow structure represents a *Single-Phase-Single Channel* queue system, which is a system with one queue line and one service phase. This model is designed to capture real dynamics in the field.

Distribution Data Input

Table 2. Distribution Data Input

Arrival Time	Hours of service
0	191
42	87
119	96
41	207
99	179
80	185

Arrival Time	Hours of service
86	166
114	159
186	130
108	89
135	204
143	150
60	117
117	229
133	265
135	204
301	141
176	209
82	132
358	186
182	192
97	183
170	122
180	72
100	161
112	200
87	96
131	179
122	144
60	222
140	87
180	100
147	83
214	153
119	97
190	147
198	203
443	161
96	89
153	103
23	115
148	110
98	155
109	110
59	98
71	114
261	195
109	162
50	207
61	61

Source: Processed Data

Troubleshooting Analysis

Model Proposal

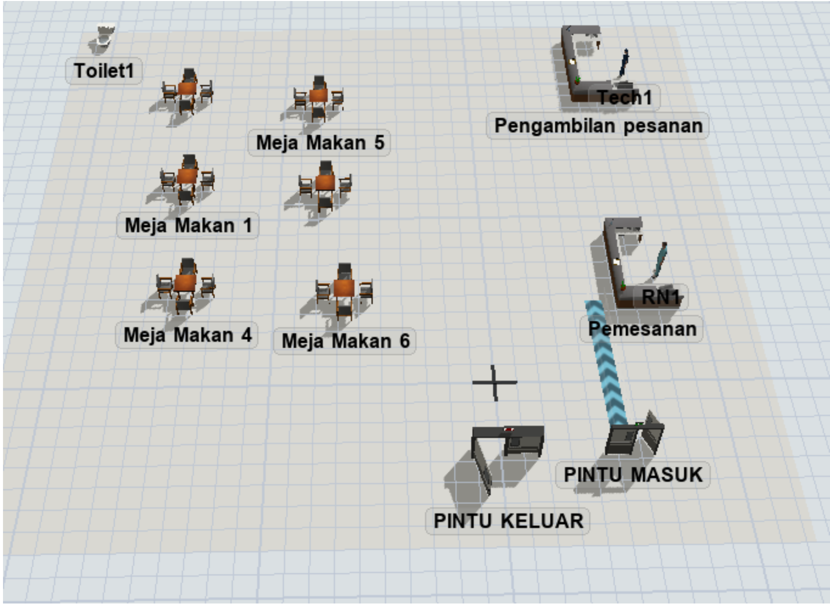

Figure 3. Proposed Model
Source: Processed Data

The design of this proposed system shows a more organized service structure, with a clear flow starting from the entrance, ordering area, order taking, to the exit. The addition of a cashier and the separation of the ordering and order picking areas into two separate service stations is one of the main strategies in this model. The customer route in the proposed model is more efficient because the customer is directed directly to the cashier to order and after that to a separate area to pick up food. This design helps reduce build-up at a single point and speeds up the flow of customers in the system. In addition, the arrangement of the dining room and clear entry/exit routes also adds to the comfort and regularity of the system. The addition of waiters in this simulation has been shown to significantly reduce waiting times. If previously the average waiting time reached almost 10 minutes, then with the proposed model and the scenario of adding cashiers, the waiting time dropped to about 6 minutes or even up to 3 minutes in the scenario of three cashiers. The utilization of the cashier also becomes more balanced without anything being too high or too low, reflecting the efficiency of human resource use.

With these results, the proposed simulation model can be used as a reference for the implementation of a new service system that is faster, more orderly, and more customer-friendly. A clearer separation of service functions and customer flows has proven to have a positive impact on overall system performance.

Statistical Comparison of Actual Models and Business Models

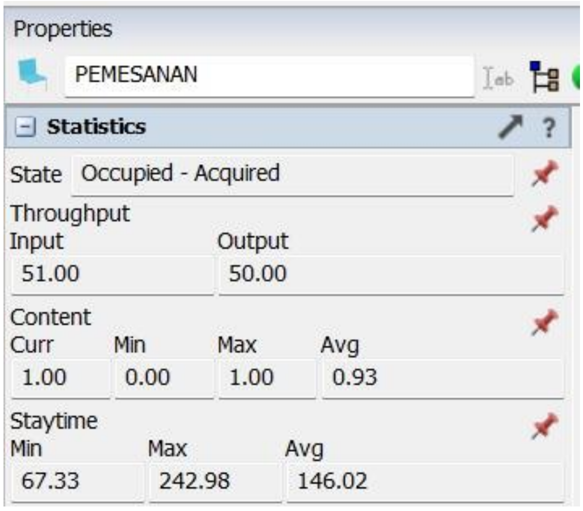

Figure 4. Actual Model Statistical Data on Bookings
Source: Processed Data

Based on the results of the scenario simulation and the calculation of queue parameters, it can be concluded that the main problem lies in the limitation of service capacity. With only one cashier and one ordering line, the system is not capable of handling customer volumes during peak hours. Simulations show that by adding one additional cashier, customer wait times can be significantly reduced. This shows that the strategy of adding service resources is very effective in handling the surge in demand.

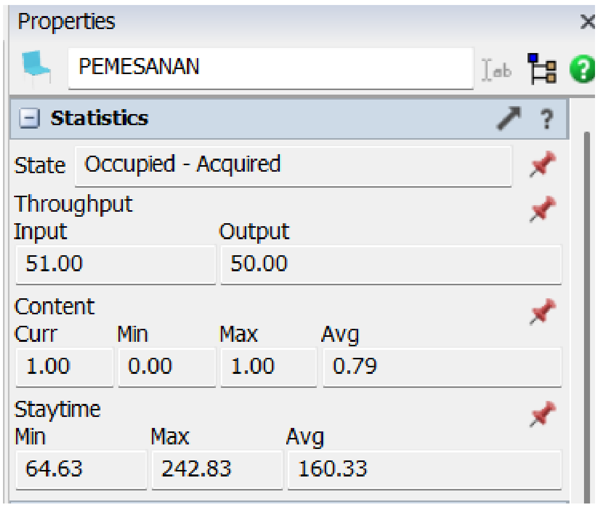

Figure 5. Statistical Data of Solution Proposal Model on Booking
Source: Processed Data

In addition, based on the statistical data on the "Booking" object in the simulation model, it can be seen that the total number of incoming customers (inputs) is 51 people, with 50 customers successfully completing the service process (output). The average value of the number of customers in the service process (content avg) is 0.79 customers, with a maximum of 1 customer at a time, indicating that the system rarely experiences a buildup of customers at the point of ordering. The average staytime of customers in the booking process is around 160.33 seconds, with the fastest time being 64.63 seconds and the longest time reaching 242.83 seconds. Despite the variation in service times, the system still showed stable performance and flowed without significant obstacles. These results indicate that the proposed service system design is effective in reducing waiting times and improving smooth operations in the booking area. This means that the service process is carried out in two stages or phases, namely ordering and order picking, but all customers still follow the same queue line. It is aimed at creating order, maintaining order, and reducing confusion among customers without breaking down service lines. This model was chosen because it was considered more suitable for congested restaurant conditions and required flow clarity without additional complexity in queue line setup.

Implementation Analysis

In order for the solution that has been formulated to be implemented properly, there are several things that need to be considered:

1) Human Resources
   The addition of one cashier requires adjustment of work schedules or additional recruitment. Management must ensure that the cashier's shift schedule can include peak hours without causing excessive work fatigue.
2) Operational Changes
   If the division of service lines will be determined, for example, a special *take-away cashier*, there needs to be a rearrangement of customer flow and modification of the restaurant layout to remain efficient and not confuse customers.
3) Advanced Simulation and Monitoring
   Simulations need to be done periodically to ensure that the system remains optimal over time. *Real-time* monitoring systems can also help in detecting spikes in visitors and making quick adjustments.
4) Training and Socialization
   The new cashier or officer added needs to be given training so that the service remains fast and consistent. Customers also need to be informed about changes in the service system.

Implications of a large task

The results of this study make a real contribution to improving operational efficiency in fast food restaurants, especially in the context of Mie Gacoan restaurants. The implications of the proposed solution include:

1) Increased Customer Satisfaction, with a shorter waiting time, customers will feel more comfortable and satisfied with the services provided.
2) Operational Efficiency, the addition of services has been proven to be able to reduce queues without adding a significant burden to restaurant operations.

3) The basis of decision-making, the model and approach used can be adapted by other branches of Mie Gacoan or other fast food restaurants with similar characteristics.

CONCLUSION

Based on the results of the research conducted on the queue system at the *Gacoan Noodle Restaurant*, Purwokerto branch, several important conclusions were drawn. The current system is classified as a *Multi-Phase–Single Channel* queue, in which the service flow includes ordering, waiting for food preparation, and food delivery— all managed through a single main service point, namely the cashier. This setup results in queue buildup, particularly during peak hours. Observations and calculations revealed that the average customer waiting time reached 593 seconds, with 98% of customers experiencing a delay before being served. Furthermore, the average time a customer spent in the system was 1,183 seconds, underscoring the system's high workload.

Using discrete-event simulation through *FlexSim*, with probability distribution inputs determined by *ExpertFit*, the research successfully modeled actual operational conditions. Verification and validation processes confirmed that the simulation closely mirrored real-world performance. Improvement simulations—particularly the addition of one extra service point—led to significant reductions in both waiting time and queue length, with efficiency improvements of up to 35–40%. Overall, the use of discrete simulation methods proved effective in analyzing dynamic service systems such as those in fast-food restaurants, enabling scenario testing and operational planning without disrupting actual business activities.

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