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Case Study on Performance of Post Office– Panadura

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***Abstract*—The postal service organization is among the most important service organizations in any country that providing customers with proper services leads to their satisfaction. As a service-providing organization, considering the customers' needs is an important factor in the success of the postal service. This study aims to analyze the customers' waiting time through computerized simulation and suggest ways to increase organizational efficiency to increase customers' satisfaction. The simulation of this single server queuing system was performed using Rockwell ARENA. Primary data collection was done taking into account customer arrival time, waiting time, and service time. Secondary data were collected through journal articles, books, and other written sources to develop a literature review and conceptual model. The ARENA model for, the existing system was developed using the identified statistical probability distribution. The sample was selected from the customers who were served at each service counter from 8 a.m. to 3.00 p.m. on weekdays. In the existing system, higher waiting times were identified especially at the public allowances counter. The results explain the average waiting time in the public allowances queue to be 48.6 minutes. The number waiting at the counter was 14.8 customers. The existing system needs to be improved to minimize the waiting time of the customer while reducing the cost. The most efficient proposed model was to add an extra resource to the public allowances counter and increase the efficiency of the service providers of the remaining counters to increase the service performance. The study further revealed the possibility of reducing waiting time at the allowances counter to 0.5 minutes by doubling the resources at the counter. Performance was increased by 97% of the proposed model.**

Keywords—ARENA, post office, simulation, single server, waiting time

I. INTRODUCTION

In Sri Lanka, the postal service is a common service that most of the general public use in their daily lives. Mail products, mail services, philatelic products, money transfer services, banking services, insurance services, social and obligatory services, utility payment services, examination services, booking services, and postal facilities are the main functions of postal service. Since the number of services offered by a Post office is high, the number of customers who expect to receive postal services is also high (Soni & Saxena, 2011). In most post offices, there are considerably large queues. Further study of these waiting lines at the post offices revealed that there was a considerably high waiting time. This research was prompted by the fact that previous researchers' solutions to the long queues at post offices counters in Sri Lanka through the ARENA software were minimal, and that prior researchers had not paid attention to solving long and irregular queues in the postal service, which has become a major problem.

The objective of this study is to provide cost-effective solutions to the problems identified in the post offices, such as long queues, long waits, and unnecessary waiting times while enhancing the efficiency of the post office. The significance of this study is to provide theoretical solutions to the long queues and waiting periods that can be seen in post offices in Sri Lanka and increase the performance and efficiency of post offices through practical and cost-effective solutions.

Mainly, there were four service counters available at the post office, namely;

- Local and foreign parcel/stamp counter
- Register post counter
- Public allowances counter
- Money order/ bill payment counter

Counter 01: The first counter is designated for accepting local and foreign parcels and issuing stamps. This counter is very crowded because the above two services are offered at the same time.

Counter 02: The second counter is for registering posts. This counter is normally busy, and especially in the evening, this counter becomes busier. This is due to the government offices that are located nearby bringing their mail to post in the evening.

Counter 03: The third counter is for issuing public allowances such as pensions, elderly allowances, and farmer's pensions. Since these allowances are issued on selected days of each month, this counter is crowded only for a particular period of each month.

Counter 04: The fourth counter is designated for placing money orders and paying bills, including water bills, electricity bills, and phone bills. This counter is crowded most of the time. The customer who wants to place a money order first arrives at the counter and collects the form to fill it out, then fills out the form and enters the queue to place the money order. Customers who want to pay their bills directly enter the queue.

II. Literature Review

The higher the number of services offered the number of customers who require those services get higher. Then the concept of a waiting line or queue occurs. The queuing theory was developed to analyze the telephone traffic density (Soni & Saxena, 2011) and is currently used to study queuing phenomena in (Gross and Harris, 1985) transportation, business industrial service systems, variable reservoirs, (Soni & Saxena, 2011) ATM, bank, petrol pump and retail shops.

Otilia and Jaradat (2010) state that, the waiting line model plays a major role in operational effectiveness. The waiting line is a primary source of customer dissatisfaction and the cost of dissatisfaction is non-negligible (Fink and Gillett, 2006). To enhance the effectiveness, (Otilia and Jaradat., 2011) suggested increasing the average service rate or to add new service channels. Reducing the average service time can perform by redesigning the waiting line or using new technology.

Characteristics of a queue consist of the calling population, arrival pattern, distribution of customer arrival, service pattern, service time distribution, queue discipline, length of the queue, queue behavior, and exit from the queue. The customer's perception of service quality depends on the efficiency of waiting time. To get customer satisfaction, the waiting model should be managed properly and sufficient capacity should be provided. The cost of waiting is different from one person to another and so the study of the waiting model is crucial (Friedman and Friedman, 1997). When waiting is examined as a psychological experience, identified that the people who wait in a single queue feel more predictable and arousal than those waiting in multiple queue lines (Rafaeli, Barron & Haber, 2002). When there are multiple queues, before joining a specific queue, the customer will inspect the queue or join the queue balk. This inspection is associated with a cost (Hassin & Green, 2017).

The aim of developing a waiting line model graphically is to identify the issues and describe the waiting system without implementation. That is important in reducing costs which is related to the waiting line.

Sri Lanka post was established in 1798 with five offices. Currently, there are 4692 post offices around the country with more than 19000 employees. They offer various types of services to the general public and post offices are considered one of the most commonly used formal communication methods in the country. Mainly Sri Lanka postal service offers mail products, mail services, philatelic products, money transfer services, banking services, insurance services, social & obligatory services, utility payment services, examination services, booking services, and postal facilities (Source - Sri Lanka post website).

According to Kendall's classification, a post office queue classifies as a system with an infinite queue with exponentially distribution of arrival and service times and waiting for the discipline of FIFO (first in first out) (Dutkova, Achimsky & Drozdziel, 2020).

Dutkova, Achimskya, and Hostakova (2019) stated that in a queue of a post office, many random variables cannot be captured in the analytical solution of the optimization problem. The simulation model which is closer to the actual model should be used in analyzing the model.

III. Methodology

In this study, computer simulation by ARENA software was chosen as the methodology to determine a solution to the identified problem.

3.1 Data Collection

Primary data collection was done taking into account customer arrival time, waiting time, and service time. 150 data for each service counter were observed in minutes using a stopwatch. Secondary data were collected through journal articles, books, and other written sources to develop a literature review and conceptual model.

3.2 Sampling Procedure and Population

The sample was selected from the customers who were served at each service counter from 8.00 a.m. to 3.00 p.m. on weekdays. The tenth day of the month in which the pension allowances were paid, was selected to collect data because it was discovered that there was a long and irregular queue at the public allowances counter. Data were also collected the next day to avoid bias in data collection.

3.3 Data Analysis

With the observed data, the arrival distribution and the service distribution were analyzed using the Input Analyzer of the ARENA software. Inter-arrival times and service times were entered into the ARENA Input Analyzer and identified statistical probability distributions. Then the identified probability distributions were considered for designing the ARENA model.

3.4 Model Development

The ARENA model for the existing system was developed using the identified statistical probability distributions. A few assumptions were followed up to analyze the model namely;

- Customers are served on a First-In-First-Out (FIFO) basis.
- Continuous service was provided by the server.
- A single customer only gets the service once.
- Customer arrival is independent and infinite.
- The system has an infinite waiting room.

IV. Results and Discussion

The input analyzer of the ARENA was used to obtain the probability distributions of the arrival and service rates. Obtained values are shown in Tab. 1 and Tab. 2.

TABLE I. Arrival Distributions of the Existing System

Counter	Distribution	Expression
Parcel and stamps counter	Weibull	0.999 + WEIB (0.247, 0.278)
Register post counter	Gamma	-0.5 + GAMM (2.17, 1.67)
Public allowances counter	Lognormal	-0.5 + LOGN (4.41, 4.58)
Money-order and bill counter	Lognormal	-0.5 + LOGN (5.16, 6.04)

TABLE II. Service Rate Distribution of the Existing System

Counter	Distribution	Expression
Parcel and stamps counter	Beta	1.5 + 7 BETA (0.585, 3.54)
Register post counter	Lognormal	1.5 + LOGN (1.53, 1.32)
Public allowances counter	Poisson	POIS (4.29)
Money-order and bill counter	Gamma	1.5 + GAMM (1.34, 1.69)

The developed ARENA model for the existing system is shown in Fig. 1. The model was developed using the basic process panels such as create, process and dispose and advanced process panels such as routes and stations.

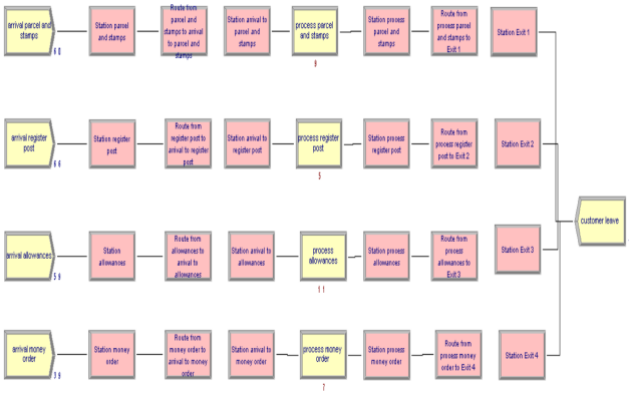

Fig. 1. ARENA simulation model of the existing system

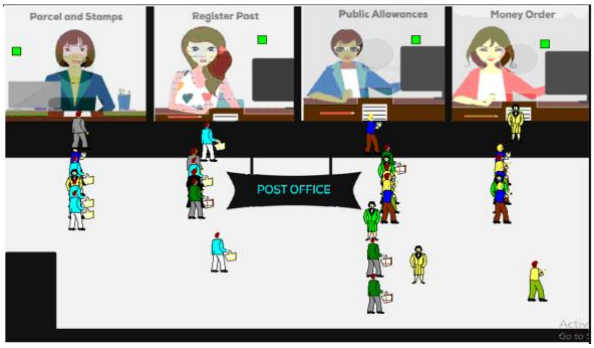

Fig. 2. The animated model of the existing system

4.1 Proposed Model

The existing model shows considerably high waiting times for all the service counters while only the public allowances counter shows a higher waiting number of customers to receive the service. The proposed model aims to minimize the waiting time of the customer while reducing the cost. To identify the most optimal method, 15 proposed models were analyzed. By adding an extra resource to each counter, a theoretically optimal solution can be generated which reduces the waiting time of the customer. But considering the cost of adding extra resources and the cost of operations, the most efficient proposed model is identified as the model which added an extra resource to the public allowance counter. To increase the service performances of the remaining counters, increasing the efficiency of the service providers is suggested.

TABLE III. Output Data of Proposed Models

		Existing model	Proposed model
Number in		408	353
Number out		364	342
Customer served %		89.22	96.884
Waiting time (minutes)	Stamp and parcel	10.6635	8.143
	Register post	6.2968	6.4584
	Allowances	48.5781	0.4735
	Money order	11.7081	8.152
Number waiting	Stamp and parcel	2.3993	0.9772
	Register post	1.8131	1.8406
	Allowances	14.7657	0.1255
	Money order	2.3043	1.7323

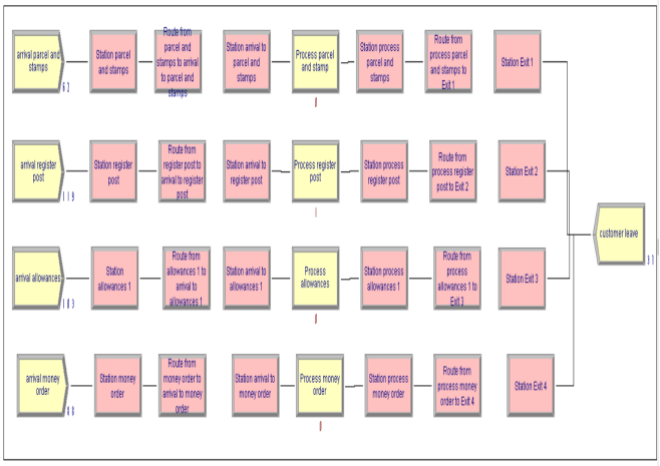

Fig. 3. ARENA simulation model for the proposed system

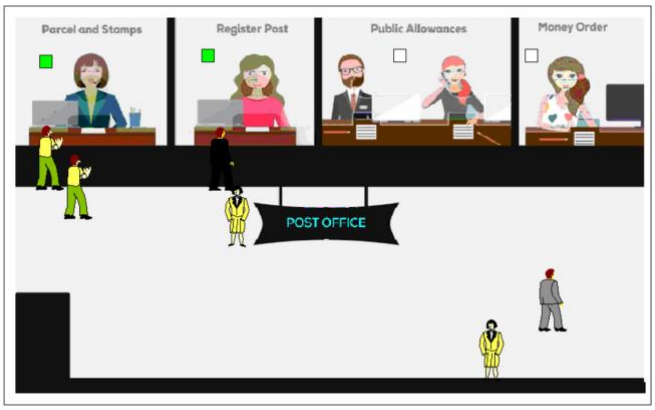

Fig. 4. The animated model for the proposed system

V. Conclusion and Recommendations

This study is aimed at stimulating and analyzing the performance measures of the existing four sections in the post office. By using ARENA, the average waiting time of the customers and the number of customers waiting in the queues were calculated. That analyzed performance was given that a large number of customers are waiting to receive services of the public allowances counter as compared to other counters. Thus, the existing system needs to be improved to minimize the waiting time of the customer while reducing the cost. According to the requirement, 15 models were modified and tested. The results revealed that if an extra resource is added to each counter, reduces the waiting time of the customer. But it was the only theoretically optimal solution. This is because when considering the cost of operations and the addition of additional resources, the most efficient proposed model was to add an extra resource to the public allowance counter and increase the efficiency of the service provider of remaining counters to increase the service performances.

Arena gives the solution only to reduce the long queue and waiting time for customers. But physically, there is another issue. The public allowances counter had an irregular queue. Because that counter provides several services, not just one. Therefore, that place was very crowded as the elderly people came to get all those services and someone else came with them to help them. Though there was allocated a person outside the counter to manage the customers, that person wasn't efficient. As a solution to that problem, it may be suggested to put chairs in place and rearrange the space, as there is ample space in the place. As another solution, it can be suggested to allocate time for each service separately.

Most of the waiting times of each of these counters occur due to the time spent serving the customer. Especially at the public allowances counter, the waiting time is considered very high. Further research can be conducted to identify the reasons for these waiting and implement proper solutions. Furthermore, the layout of the system also affects the service rate because multiple services are offered by the same counter. Future studies can conduct to identify an optimal layout for the post office.

References

[1] (n.d.). Retrieved from Department of post-Sri Lanka: https://slpost.gov.lk.

[2] Dutkova, S. A. (2019). Simulation of Queuing System of Post. Transportation Research Procedia, 40 (2019), 1037–1044.

[3] Dutkova, S. A. (2020). Simulation of a queuing system of a post office in analogic software. communications. 22 (2), 15-22.

[4] Friedman, H. &. (1997). Reducing the Wait in Waiting-Line Systems: Reducing the Wait in Waiting-Line Systems. Business horizon, 140, 54-58.

[5] Hassin, R. &. (2017). The impact of inspection cost on equilibrium, revenue, and social welfare in a single server queue. Operation Research, 65(3), 804-820.

[6] Otilia, S. &. (2002). The effect of queue structure on attitude. Journal of service research, 5(2), 125-139.

[7] Rafaeli, A. B. (2002). The effect of queue structure on attitude. . Journal of service research, 5(2), 125-139.

[8] Soni, K. &. (2011). Study of applicability of waiting line model in health care: a systematic review. IJMT, 19(1), 75-91.