International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Modeling and Analysis of Customer Service in Banking System Using Arena Software

Naji S. Abdelwanis[1], Magdi Ahmed El Hadiri[2], Abdelaziz.EL.Abdelsalam[3]
[1]Industrial and Manufacturing Systems Engineering, University of Benghazi, Benghazi, Libya
[2]College of Mechanical Engineering Technology-Benghazi, Benghazi, Libya
[3]College of Mechanical Engineering Technology-Benghazi, Benghazi, Libya
Email: naji.abdwlwanis@uob.edu.ly, magdielhadiri@ceb.edu.ly, abdelaziz_elsharif@ceb.edu.ly

***Abstract*—** *Discrete event simulation (DES) has been an effective tool used widely to model and analyze various types of manufacturing and service systems. Multiple software's are available to imitate real manufacturing or service systems without interrupting it. This paper presents the use of Event Based simulation to analyze and enhance services provided by banking sector. ARENA simulation software was utilized to build a simulation model that represents the current situation. After validating the model, the current performance was recorded and different scenarios were evaluated by utilizing the "OPTQUEST for ARENA" optimization tool, according to which recommendations and suggestions were provided. The suggested configuration would reduce the queue length and cut the utilization of counters by more than half.*

***Keywords*—** *Banking System, Event based simulation, Arena software.*

I. INTRODUCTION

It is real challenging to make a decision to enhance the performance of a service providing systems where arrival and service times are under uncertainty [1, 2]. Systems simulation modeling is widely implemented in many service systems including banking systems, health care, transportation, and other manufacturing and service areas [4][5][6]. For decades, simulation modeling has played an important role in helping decision makers to achieve the desired levels of productivity and efficiency in manufacturing. Nowadays, simulation has proved its significant capability as sophisticated decision support tool in service systems [3].

Because of its ability to mimic, analyze, and design complex processes and systems, simulation modeling has become an important tool that engineers, designers and managers rely on to make decisions [4].

Discrete event simulation (DES) is an important tool that is used for analyzing the service performance which drives to customer satisfaction [8].

Banks and financial institutions provide services to a large number of customers. Due to increased types of activities to a wide range of people requiring services, these institutions face some difficulties that affect customer satisfaction. One of the important elements of customer satisfaction is to get the needed attention and receive the required service without delay. This will result in spending shorter times in queues and service counters.

The banking system in Libya is facing difficulties regarding the provision of services to customers. Many types of activities and procedures are added in recent years without proper changes in the way of provision of services. Several problems have floated in the surface such as overcrowding, long waiting times, limitation of service space and uneven distribution of work load between employees.

Despite the fact that banks are in a high competition in directing their customers towards the use of new technologies such as ATMs and electronic services, a large percentage of customers would rather choose to be served traditionally by physical appearance in front of the counter for their own reasons [11].

To improve some aspect of the current situation, it is important to study certain services in detail, collect needed data, analyze to help improve customer satisfaction by reducing the waiting time and reduce overcrowding in the service area.

Customer dissatisfaction is a growing concern of the society that affects many individuals. There is a need to provide some solutions to reduce problems that lead to such situation.

For all what have been mentioned, the authors of this work decided to dig under the ground to explore the problems facing banking sector in Benghazi-Libya by conducting their research in one of the busiest banks in the country to evaluate the current situation and provide some suggestions to improve their performance. The National Commercial Bank, main office in Benghazi is selected as a location for the current study.

The aim of this work is to evaluate a number of the current processes in a local bank through observation, data collection and analysis through simulation. Based upon the analysis, suggestions for improvement will be made.

II. PROBLEM STATEMENT AND OBJECTIVES

In a local bank, due to an increased demand for different services and increased number of customers within limited space of service area, problems are created regarding long waiting times and delays that resulted in a customers' dissatisfaction.

2.1. Problem Statement

This study begins with visiting the local bank and identifying the services to be studies and collect the needed data. This data include waiting times, service times and queue lengths at different number of periods. Analysis will be made

Naji S. Abdelwanis, Magdi Ahmed El Hadiri, and Abdelaziz.EL.Abdelsalam, "Modeling and Analysis of Customer Service in Banking System Using Arena Software," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 5, Issue 9, pp. 184-187, 2023.

through simulation. Discrete event system simulation is an effective analysis and decision tool that can be used to optimize service provision and study different configuration to improve customer satisfaction. ARENA software version 14.5 will be utilized.

2.2 Research Objectives

- Provide a simulation model for describing service in a local bank.
- Provide an evaluation of the current situation and suggestions for improvement.
- Evaluate the suggested solutions for improvement through simulation to improve service and reduce waiting times.

The bank's building is of two floors. The first floor contains the treasury department, credit department, electronic clearing department, current accounts department and Islamic Murabaha department. There are eight counters provide different services. This study is applied on five of these counters, as will be explained later. Situated on the second floor are administrative affairs department, credits department, remittances department and the processes control department.

The diagram in figure1 shows the movement of the customer inside the building of the National Commercial Bank, when the customer enters the National Commercial Bank, arrival time, service time, departure time and waiting time of customers were recorded. The service is provided by five counters, two of them provide deposit and legal instruments, two to enquiry, and one counter provides electronic clearing

III. DATA COLLECTİON AND ANALYSİS

Data were collected during the working hours (8:30 am to 1:30 pm) of the period, Sunday the 25th of August to Thursday the 26th of September, 2019. The number of customers covered is 10381. In some instances, breakdowns in the Bank's computer system happen. This is due to severance of communication links from Tripoli; No data were collected during those periods.

The 'ata was collected through direct observation and was analyzed. Since the ARENA simulation software is selected for the current study, the collected data were fitted to the best distribution by using the input analyzer tool that is built in the software. The fitted distributions for time between arrivals and service times for the five counters are shown in table1and table 2 respectively.

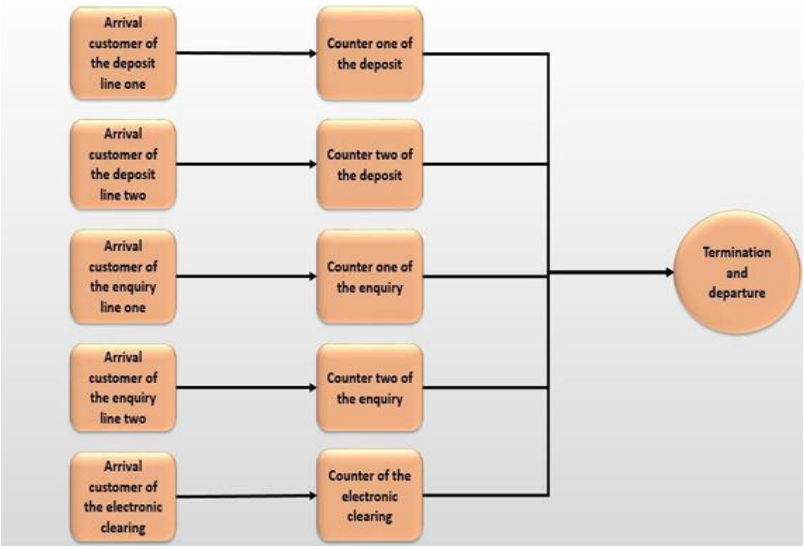

Fig. 1. The movement of the customer within the NCB

TABLE 1: Fitted distributions for time between arrivals

Counter	Fitted Distribution	Expression	Square Error
Deposit and legal instruments counter (1)	Lognormal	0.5+LOGN(2.61,3.47)	0.002559.
Deposit and legal instruments counter(2)	Weibull	-0.5+WEIB(3.23,0.958)	0.001285
Enquiry counter (1)	Exponential	-0.001+EXPO(2.02)	0.002214
Enquiry counter (2)	Lognormal	-0.5 + LOGN(1.61,1.65)	0.000749
Electronic clearing counter	Lognormal	-0.5 + LOGN(3.74,4.92)	0.001108

TABLE 2: Fitted Distributions for Service Times

Counter	Fitted Distribution	Expression	Square Error
Deposit and legal instruments counter (1)	Lognormal	LOGN(2.05,1.54)	0.058137
Deposit and legal instruments counter(2)	Gamma	GAMM(0.884,2.77)	0.007715
Enquiry counter (1)	Lognormal	LOGN(1.75,2.08)	0.003149
Enquiry counter (2)	lognormal	LOGN(0.883,0.901)	0.000582
Electronic clearing counter	Gamma	GAMM(1.27,1.23)	0.001266

Naji S. Abdelwanis, Magdi Ahmed El Hadiri, and Abdelaziz.EL.Abdelsalam, "Modeling and Analysis of Customer Service in Banking System Using Arena Software," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 5, Issue 9, pp. 184-187, 2023.

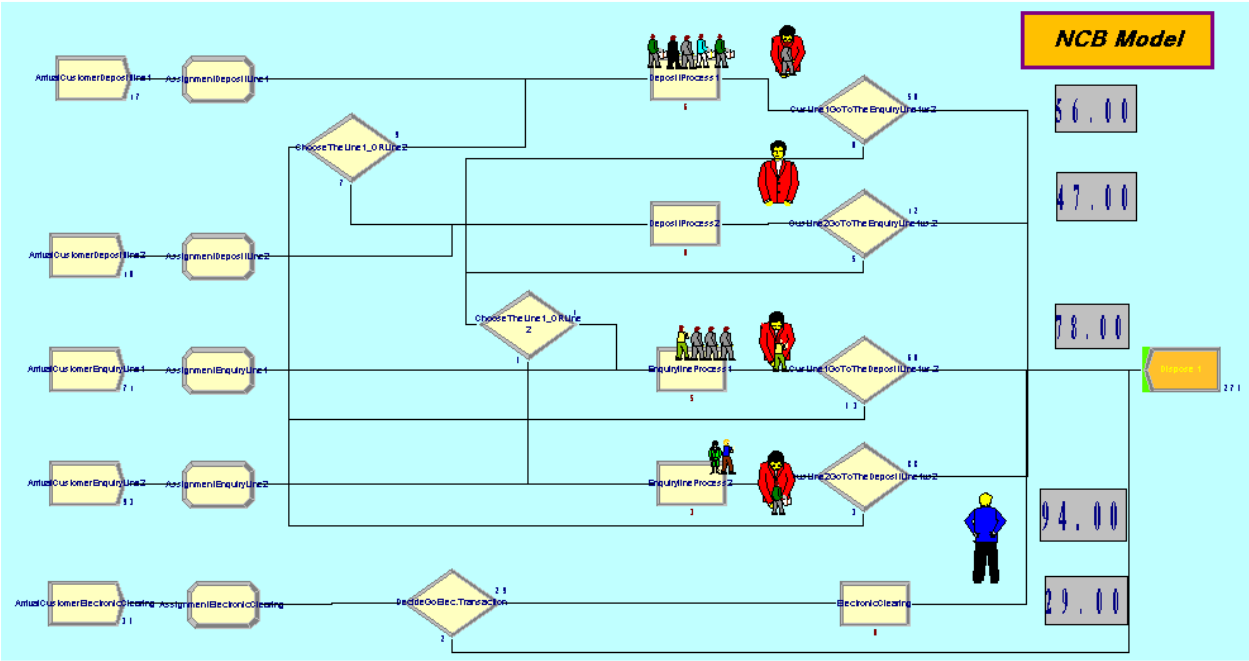

Fig. 2. The simulation model for the current system.

3.1 Simulation Model Development

Having studied the system configurations and behavior and collected and analyzed the relevant data, a simulation model was built, using ARENA software 14.5, to mimic the current situation and to examine different proposed scenarios among which to select the best. Figuer2 shows the logic view of the current model for the processes carried out in the bank under study.

3.2 Validating the Model

Before drawing any conclusion, the simulation model must be validated to make sure that it represents the actual system. This could be achieved by running the simulation model and comparing the performance measures to that of collected data [5,6]. For our model, this was done by comparing some variables, namely counters utilization and number of customers out, given by the software to collected data. Table 3 shows that our simulation system provides a good representation to the real system.

After collecting the data of interest and validating the model, the turn comes to conducting and analyzing experiments to document and present results. This experimentation is mainly carried out by adjusting the key variables of the system and watching the response represented by the dependent variables defined earlier [6]. After running the model for 10 replications the statistics of the system were collected and presented in table 4.

TABLE 3. Simulation Model Validation

Variable's name	Actual data	Simulation Data	Model Accuracy %
Utilization of Deposit and legal instruments counter (1)	85%	90%	94.4
Utilization of Deposit and legal instruments counter(2)	83%	88%	94.3
Utilization of Enquiry counter (1)	96%	92%	95.6
Utilization of Enquiry counter (2)	49%	54%	90.7
Utilization of Electronic clearing counter	43%	39%	89.7
Number of Customers out	10381	11716	87%

TABLE 4. Results from the simulation model

Service Location	Service Time (minute)	Number of Customers in	Number of Customers out	Waiting Time (minute)	Number of customers waiting	Utilization %
Deposit Line 1	2.11	2173	2165	19.48	9	90
deposit Line 2	2.62	1723	1713	14.11	5	88
Enquiry Line 1	2.1	2819	2804	25.77	13	92
Enquiry Line 2	1	3524	3521	1.89	1	54
Electronic Clearing	1.46	1513	1513	0.82	1	39

It's well known that increasing service rate has a significant effect on reducing waiting times and hence reducing queue length. This improvement could be achieved by applying one or combination of the following: [7]

1- Using more servers.
2- Providing service more rapidly.
3- Utilize automated systems.

Naji S. Abdelwanis, Magdi Ahmed El Hadiri, and Abdelaziz.EL.Abdelsalam, "Modeling and Analysis of Customer Service in Banking System Using Arena Software," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 5, Issue 9, pp. 184-187, 2023.

Queue length and waiting time can be best evaluated by either queuing theory or by simulating the system [10]. This work goes with the second option by developing and analyzing a model using Arena simulation software. Discrete event simulation is widely used by researchers in service providing systems such as banking systems, airports, and healthcare [9].

Process analyzer was used to compare among different proposed scenarios in order to find the best one. These scenarios were proposed based on information from the bank management regarding applicable changes in the system.

- Scenario No1: Allocating two servers in deposit line 1, deposit line 2 and three servers in enquiry line 1.
- Scenario No2: Allocating two servers in deposit line 1, deposit line 2, and one server in enquiry line 1.
- Scenario No3: Allocating one server in deposit line1, two servers in deposit line2, and one server in enquiry line 1.
- Scenario No 4: Allocating one server in deposit line1, deposit line2, and enquiry line 1.
- Scenario No 5: Allocating three servers in deposit line 1, deposit line 2 and enquiry line1.
- Scenario No 6: Allocating two servers in deposit line 1, one server in deposit line 2 and two server in enquiry line 1.
- Scenario No 7: Allocating one server in deposit line 1, deposit line 2, and two servers in enquiry line 1.
- Scenario No 8: Allocating two servers in deposit line 1, three servers in deposit line 2 and two server in enquiry line 1.
- Scenario No 9: Allocating one server in deposit line 1, two servers in deposit line 2, and enquiry line 1.
- Scenario No 10: Allocating two servers in deposit line 1, deposit line 2, and enquiry line1.
- Scenario No 11: Allocating three servers in deposit line 1, two servers in deposit line 2, and enquiry line 1.
- Scenario No 12: Allocating two servers in deposit line 1, one server in deposit line 2, and enquiry line 1.

To evaluate the proposed scenarios, the model was run for 10 replications and statistics regarding waiting times and numbers of customers in queues were compared for all scenarios. Based on the results, Scenario No 10 is selected to be the best scenario. This is because it results in the least number of customers in queues (deposit line1,1, deposit line2,1, and enquiry line1,1). Also utilization of personnel is at average level of utilization 45%. Table 5 presents a comparison between the situation before and after the improvements.

TABLE 5. Comparison between before and after improvements

Category	Number in Queue		Utilization	
	Before	After	Before	After
Deposit Line 1	9	1	88%	44%
Deposit Line 2	5	1	92%	46%
Enquiry Line 1	12	1	90%	44%

IV. CONCLUSİON

Discrete-event system simulation was implemented to evaluate the current processes at the main branch of the NCB in Benghazi. Arena software was utilized to model the current process and to provide several solutions that could be used to improve the services at the branch. The bank has to deal with an increasing demand in the number of customers. This results in long queues in front of the service counters and long delays, which leads in turn to dissatisfaction of customers, who may even choose to leave without being served.

After running the simulation model we concluded that:

- The two lines of deposit and one of the enquiries lines experience average long waiting times of approximately 20, 14, and 26 min. This results in long queues of average values of 9, 5 and 14 respectively.
- High utilization of resources resulted in the previously mentioned under 1 above, and the electronic clearing counter, of an average value of 89%.
- There are clear differences between the two enquiry lines regarding to all statistics considered.

By comparing different possible strategies, we recommend:

- Adding another employee to each deposit counters.
- Adding another employee to the enquiry line 1 counter, and at the same time distributing the inquiry types to take approximately equal times in the three counters.

REFERENCES

[1] Azmat, N. (2007). Queuing Theory and its Application: Analysis of the Sales Checkout Operation in ICA Supermarket. Dalana: University of Dalarna, Department of Economics & Society.

[2] Ullah, A., Khalid, I., Xiao-dong, Z. and Muhammad, A. (2014), Sub-optimization of Bank Queuing System by Qualitative and Quantitative Analysis, 978-1-4799-3134-7/14/$31.00©2014 IEEE.

[3] Zottolo, M., Williams, E. and Ülgen, O. (2007), 'Simulation Implements Demand-Driven Workforce Scheduler for Service Industry', Proceedings of the 2007 Winter Simulation Conference, USA.

[4] Shannon, R. (1998), 'Introduction to the Art and Science of Simulation', Proceedings of the 1998 Winter Simulation Conference, USA.

[5] Kelton, W. D, Sadowski, R. P., & Sturrock, D. T. (2007). *Simulation with Arena: Fourth edition*. New York: McGraw Hill.

[6] Law, A. M. (2006). How to build valid and credible simulation models. Proceedings of the 2006 Winter Simulation Conference, 2006, 58-66.

[7] Annas, M. (2017). Modern Hypermarket Receiving Yard Utilization: The Implementation of a Simulation Model, 2(4), 33–39

[8] Xian, T. C., Hong, C. W., & Hawari, N. N. (2016). Modeling and simulation of queuing system for customer service improvement: A case study, 040020, 040020. https: //doi.org/10.1063/1.4966087.

[9] Robinson, S. (2015). Modelling without queues: Adapting discrete-event simulation for service operations. Journal of Simulation, 9(3), 195–205. https://doi.org/10.1057/ jos.2014.21.

[10] Fazeeda Mohamad and Siti Filza Saharin, (2019). Application of Discrete Event Simulation (DES) for Queuing System Improvement at Hypermarket. FGIC 2nd Conference on Governance and Integrity, KnE Social Sciences, pages 330–346. DOI 10.18502/kss.v3i22.5059.

[11] Mayowa Rafiat Ajiboye and Others (2020). A simulation Model for Customer Flow Analysis in A commercial Bank in Nigeria. European Journal of Technique (EJT), Vol 10, Number 1, 2020.

Naji S. Abdelwanis, Magdi Ahmed El Hadiri, and Abdelaziz.EL.Abdelsalam, "Modeling and Analysis of Customer Service in Banking System Using Arena Software," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 5, Issue 9, pp. 184-187, 2023.