IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 11, Issue 6 Ver. II (Nov- Dec. 2014), PP 31-35
www.iosrjournals.org

Study of Queuing System of a Busy Restaurant and a Proposed Facilitate Queuing System

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Abstract: *In a restaurant waiting for service is a common phenomenon for the customer. Restaurant owners are not concerned about the matter of waiting customer though they do not want their customer would go another competitor's door. There are several determining factors for a restaurant to be considered as a good or a bad one. Taste, cleanliness, the restaurant layout and settings are some of the most important factors. These factors, when managed carefully, will be able to attract plenty of customers, However, there is also another factor that needs to be considered especially when the restaurant has already succeeded in attracting customers. This factor is the customers queuing time. Queuing theory is the study of queue or waiting lines. Some of the analysis that can be derived using queuing theory include the expected waiting time in the queue, the average time in the system, the expected queue length, the expected number of customers served at one time, the probability of balking customers, as well as the probability of the system to be in certain states, such as empty or full. Hence, queuing theory is suitable to be applied in a restaurant setting since it has an associated queue or waiting line where customers who cannot be served immediately have to queue (wait) for service. Researchers have previously used queuing theory to model the restaurant operation reduce cycle time in a busy fast food restaurant as well as to increase throughput and efficiency. In this study, the average service time, average idle time, and average waiting time at cash counter are measured.*
Keywords: *Customer, Queue, Restaurant, simulation mode, Time.*

I. Introduction

Restaurants would avoid losing their customers due to a long wait on the line. Some restaurants initially provide more waiting chairs than they actually need to put them in the safe side, and reducing the chairs as the time goes on safe space. However, waiting chairs alone would not solve a problem when customers withdraw and go to the competitor's door; the service time may need to be improved. This shows a need of a numerical model for the restaurant management to understand the situation better. Through simulation anyone can easily measure the performance criterion of the restaurant to understand the situation better as well to simulate any improvement decision.

II. Queuing Factors

Queuing models of the restaurant can be characterized by the following factors

2.1) Arrival time distribution: Inter-arrival time most commonly fall into one of the following distribution patterns: a Poisson distribution, a Deterministic distribution, or a General distribution.

2.2) Service time distribution: The service time distribution can be constant, exponential, hyper-exponential, hypo-exponential or general. The service time is independent of the inter-arrival time and Queue Lengths (optional), System capacity (optional), Queuing discipline (optional).

III. Indentations And Equations

3.1 The structural components of a service system discrete-event simulation model typically includes, System: is defined as an aggregation of objects joined in some regular interaction or interdependence toward the accomplishment of some purpose, Example: Production System. Components of a System are entity, attribute, and activity.

3.2 The state of a system is defined as the collection of variables necessary to describe a system at any time, relative to the objective of study. In other words, state of the system mean a description of all the entities, attributes and activities as they exist at one point in time

3.3 **Model Elements:** The structural components of model of this study include:
1) Model entities: customers, requests, and orders.

2) Model activities: brining food for customer, taking cash payment.
3)Model resources: waiter, cashier
4) Exogenous event: the arrival of a customer.
5) Endogenous event: completion of service of a customer.
6) Queue**:** waiting lines or waiting seats for order and cash payment
3.4 Model Logic: In this study each waiter considered as a server. When the first enter in the system then he can go any server. For the second customer there are five options. For each of them the waiting time be assumed zero as they got idle waiter. If the entire waiter is busy with the service then the new customer has to wait in queue. The customer has to also wait for food after placing order. If the waiting time is high then the customer can be annoyed and go anywhere. So if it is possible they have to reduce the expected waiting time both for the service and cash payment.

Parameters for building model in Arena:
1) Logic decides are used with 6 servers in arena software.
2) The probability of arrival of any server is considered by same percentage, for 6 servers the probability is considered as 16.67% for each server.
3) In case of 7 servers at proposed model the probability is considered as 14.28% for each server and for 5 servers probability is 20% for each server.
4) And Maximum arrivals 30 person, number of replication 1, and replication length infinity and the base time unit minutes are considered
5) In this study allocation of server is value added time and this is service.
6) Value added time and service time are analyzed in this model.

IV. Figures And Tables

Collected Data						
Customer	Last Arrival	Arrival Time	Service Time	Queue Time	Service Time For Cash	Queue At Cash
1	0	0	8	0	0.5	0.5
2	1	1	6	0	1.5	0
3	0	1	7	0	1	1
4	0.5	1.5	8	0	0.5	3.5
5	1	2.5	6	0	2	1.5
6	0.5	3	6	0	1	3
7	0	3	9	4	0.5	1
8	1	4	7	4	1	1
9	1	5	8	3	2	2
10	1	6	6	2.5	0.5	0
11	1.5	7.5	6	1.5	2	2
12	1	8.5	6	1	1	0.5
13	0	8.5	5	3.5	0.5	2
14	2	10.5	6	4	0.5	2.5
15	1	11.5	5	3	0.5	2
16	1.5	13	6	1	1	2
17	1	14	6	0.5	1	2.5
18	1.5	15.5	4	1.5	1	2
19	1	16.5	7	2	0.5	1.5
20	1	17.5	8	3	2	2
21	0	17.5	4	1	1	0
22	1.5	19	5	0	1	2.5
23	2	21	6	0	2	1.5

Figure: Collected Data up-to 23 customers

Data Distribution	
Name	*Expression*
Arrival Time	NORM (0.867, 0.618)
Waiter 1	4.5+GAMM (0.663,2.87)
Waiter 2	4.5+LOGN (2.16, 1.79)
Waiter 3	UNIF (3.5,8.5)
Waiter 4	3.5+5*BETA (0.508, 0.433)
Waiter 5	TRIA (3.5, 5.6, 9.5)
Waiter 6	5.5+ WEIB (0.797, 1.92)
Cash Service	0.35+LOGN (0.699, 0.755)

Figure: Data Distribution by **Arena Input Analyzer.**

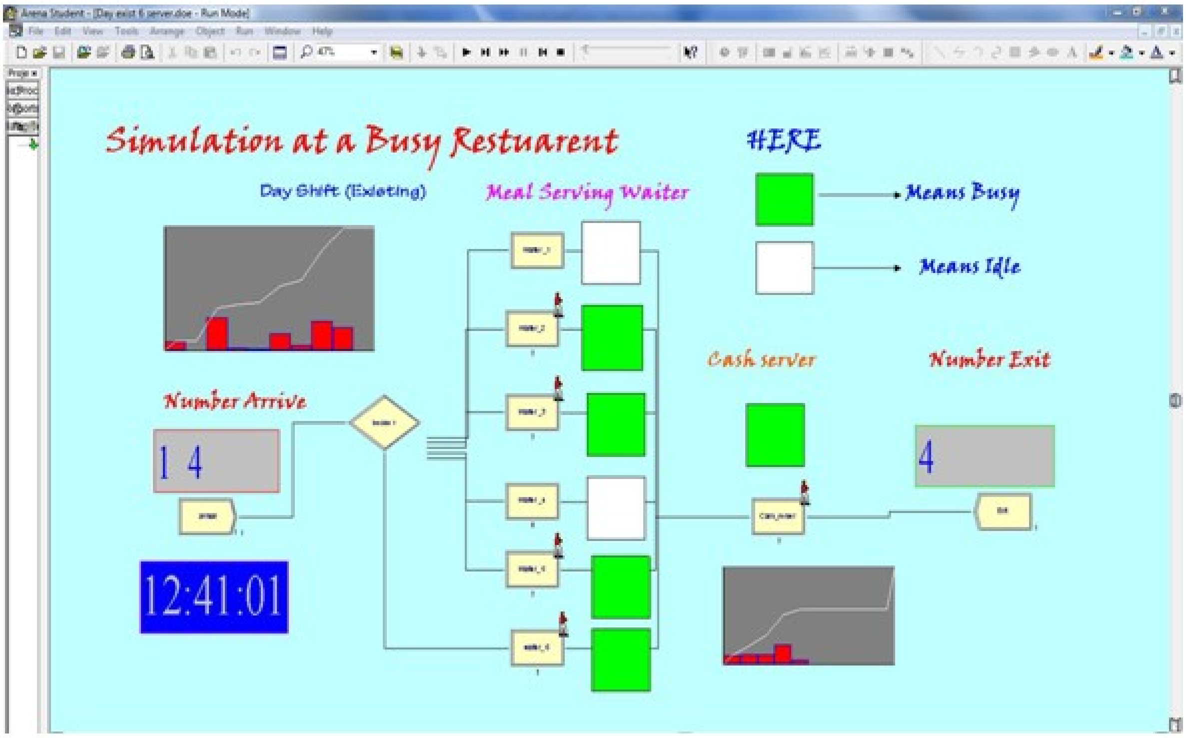

Figure: **ARENA** Model snapshot.

Entity		Entity	
Time		**Time**	
VA Time	Average	VA Time	Average
Entity 1	7.7203	Entity 1	7.6285
Wait Time	Average	Wait Time	Average
Entity 1	6.9135	Entity 1	9.6668
Arena Output Result of Existing Day Shift		*Arena Output result of Existing Night Shift*	

Figure: Arena Output Result of **Existing Day & Night Shift**.

From the data analysis by '**ARENA Simulation Software"** average waiting time of night shift has found greater than day shift though two shift use same **(6) six** servers. To reduce night shift waiting time 7 waiters / servers are distributed for night shift and 5 waiters/ servers for day shift. Then a model is built on the new distribution and result has given below:

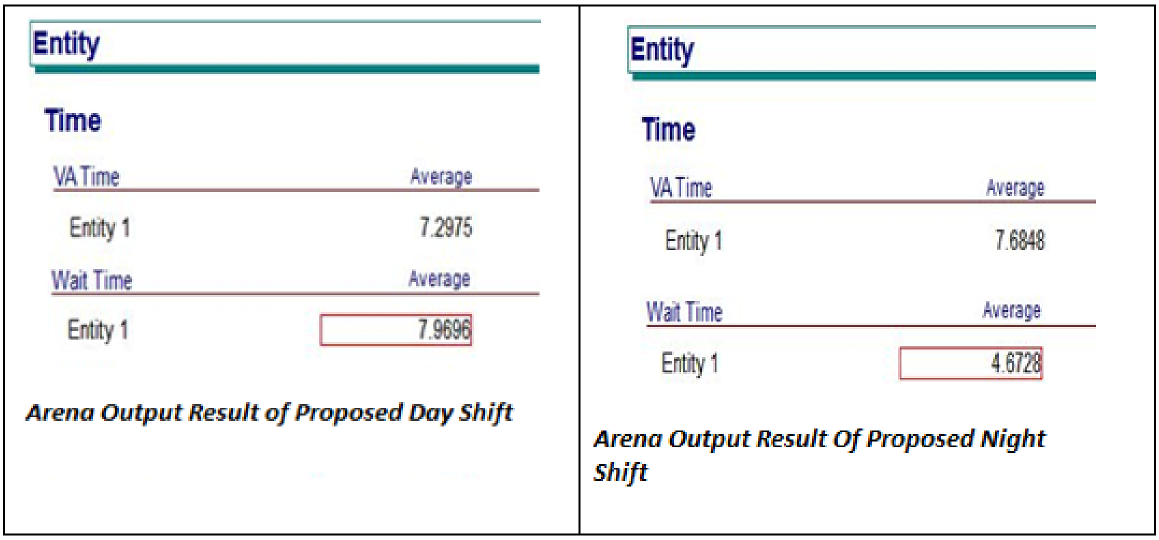

Figure: Arena Output Result of Proposed Day & Night Shift.

Comparison Between Existing & Proposed Model			
	Existing Model	**Proposed Model**	**Result**
Shift	**Avg.Waiting Time (Min)**	**Avg.Waiting Time (Min)**	
Day	6.91	7.96	1.05 (Increasing)
Night	9.66	4.67	4.99 (Decreasing)

From the analysis of the real system waiting time is relatively high in night shift than day shift. So an alternative model has proposed by shifting a server from day to night. From the performance measurement of the proposed model the waiting time decreased expectedly at night shift than day shift. So this model can be used as an improvement technique for the service of the restaurant.

V. Conclusion

After analyzing a existing simulation model we proposed a new model with shifting server to reduce waiting time for customers. with simulation we simulate the proposed model to validate. This gives us positive result. So we can use simulation for simulate any service system.

Acknowledgements

Praise to Allah S.W.T, the Most Merciful and the Most Compassionate. Peace upon him Muhammad S.A.W, the messenger of Allah.

We would like to appreciate our friend and classmates who helps us and support us to complete this project. A special gratitude goes to our course teacher, Rezaul Hasan Shumon, who helps us by stimulating suggestion and encouragement through this path.

Finally we would like to thanks the staff and the customer of the Panshi restaurant, who helps us as long as possible, without there co-operation it was quit difficult to complete this project.

This project has been done by Md. Manjurul Ahsan, Md. Raisul Islam , Md. Ashiqul Alam ,the student of Shahjal University of Science Technology .

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