Improving Services for Transportation Logistics Provider by Simulation

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Abstract

This research aims to improve the efficiency of the transportation service provider. We consider the current service system of a company which now confronts the queuing problem. This does not only affect the traffic in the company but it extends to block the traffic outside. The objectives of this study are to identify a root cause of the company's queuing system, to find the capacity of the system, and to improve the company services. The challenge of this problem is to deal with the queues of both vehicle and customers in the system which are dependent. The goal of the company is to maintain the queue inside the area of the company. We analyze the problem and propose the new system which meets the company's goal. In addition, the result shows that, in the current process, the service can response customer on 36 – 48 vehicles/hour for maximum, the arrival of its customer exceeds the area of the company 's capacity, this affect to the length of queuing of customer outside the company. The simulation is used to compare the current and the proposed systems, the result shows that the proposed system can reduce average and maximum number of customer in queue are 85.29% and 62.50% respectively, it can reduce average and maximum waiting time of customer in the system are 14.88% and 43.92% respectively and it can reduce average and maximum waiting time of customer for each queue in the current system.

Key words: Queuing system; Capacity; Simulation Model; Arena; Transportation Service Provider.

1. Introduction

The transportation service provider plays an important role on the economics of Thailand, as Logistic becomes well known in this region. This business tends to grow more and more; as a result, the customers have more choices. In the economic world, reducing the price can attract more customers. Thus, most companies tend to reduce their cost to gain number of customers as much as possible. Unfortunately, there is a limitation of decreasing company cost.Thus, beside of reduction on the operation cost, some of the companies also pay attention to customer's satisfaction to service in this competitive business. One way to increase the customer's satisfaction is to response quickly to their customers by improving the company process.

In this paper, we consider the current system of one of the biggest service providers in Thailand which have branches around regions. This company confronted the low customer's satisfaction and traffic problem within the company area. After interviewing some of the company's customers, we found that the waiting time of the customers is quite long.

Therefore, the objectives of this study are to identify a root cause of the company's queuing system, to find the capacity of the system, and propose the new system to improve the company services.

2. Literature Review and Basic Theory

2.1 Literature Review

Simulation is one of the tools used to analyze the system problems and to compare models. It has been used in many fields especially in queuing problems as shown below:

Kaboudan (1997) used a simulation to analyze the system and suggested that changing the number of servers in the system should depend on the proportion of the number of customers in the queue and the number of servers. The results are shown that his suggestion can improve the system to be more efficiency.

Rattana (2006) used the simulation model with Arena to compare the new system with the current system of the withdrawal-deposit system at Siam Commercial Bank (SCB) for seek the best choice to develop the current system by comparing the waiting time of customer.

Pakakrong (2007) considered the bus transit system of Bangkok Mass Transit Authority (BMTA) and used the simulation to compare the number of passengers and waiting time of passengers during the rush hour. He allocated the official for work by proposed two new systems and compared their result with the current system. The result of study is shown that the new system can reduce waiting time of customers in the system.

Montol (2007) used the simulation model with Arena to analyze the system at the commercial bank to increase the utilization of the servers.

Tidanuch (2008) used the simulation model with Arena to compare the new system with the current system of sugarcane truck which delivers sugarcane to the sugarcane factory. The result of study is shown that the new system yield the waiting time of customers less than the current.

Narisa Kunthased et al. (2008) analyzed a waiting time and bottle neck in the system by using the simulation model with Arena at the Suwannabumi International Airport. The result of study is shown that the bottle neck of the system were an operation on the part of check-in and passport control. Their suggestions is to add the number of servers to increase the level of service of the system.

Nipa (2008) used Arena to simulate the administration of medication system at the hospital and proposed a new system provided the waiting time of customers less than current.

2.2 Basic Theory

A queuing process consists of customers arrive to the service facility, then wait in a queue if all servers are busy, eventually they receive the service , and finally they depart from the service facility. The structure of queuing system is shown as figure 1.

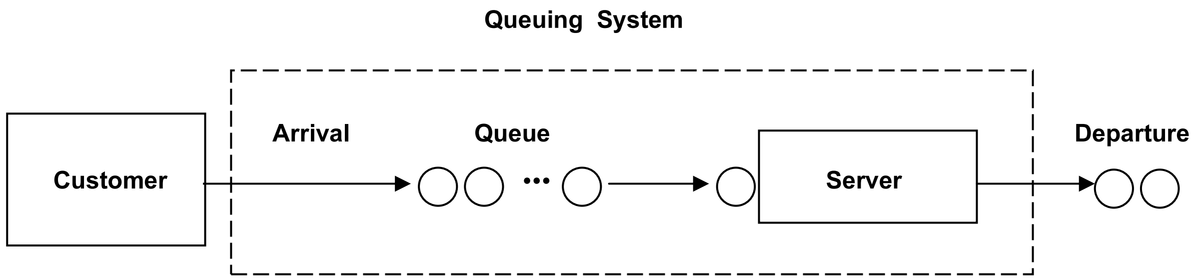

Figure 1: The structure of the queuing system

2.2.1 The Basic Element of The Queuing Process

The basic elements of the queuing process consists of 3 components:

1. Arrival or Customer
2. Queue or Waiting Line (maybe single or multiple)
3. Service facility or Server (maybe one or many)

The relation between number of customers and the waiting time can be shown as bellowed. The relation is also called the Little's Formula.

$$L_s = \lambda W_s \tag{1}$$

$$L_q = \lambda W_q \tag{2}$$

Where, L_s average number of customers in the system

L_q average number of customers in the queue

W_s average waiting time of the customers in the system

W_q average waiting time of the customers in the queue

2.2.2. Simulation Model

To simulate models, the basic process consists of five steps as the following:

1.) Define the model

2.) Set the object and scope of study

3.) Collect the data

4.) Analyze the input data before create a model by considering the appropriate distribution data from Minimum Square Error (MSE) and comparing the p-value from Hypothesis Testing.

5.) Create and validate the model

3. Steps and Research Methodology

There are seven steps of this work.

3.1. Preliminary study.

3.2. Collect the data and analyze the data.

3.3. Build models and validate them.

3.4. Analyze the current system.

3.5. Find the capacity of the current system.

3.6. Proposed the new system.

3.7. Compare the results and conclude the study.

4. Results of the Study

4.1. Preliminary Study on the Current System

First we study the current system, the dropping process consists of eight processes: customer enter the system, customer prepare the packages of product, customer drop the packages of product to checker, customer move vehicle out of the vehicle lane, customer wait for receive bill from clerk, clerk creating a bill, customer return to vehicle, customer exit the system. As we can be seen in Figure 2. The details of the system are shown bellowed.

4.1.1. The Basic Structure of the system

The area for operating consists of three stations for dropping process is separated by the destinations: station for destination A with two sub-stations, station for destination B with seven sub-stations, and station for destination C with two sub-stations. The customer can stop to drop the packages of product only first and third lane, the maximum number of vehicles to park in these lanes are seven vehicles/ lane.

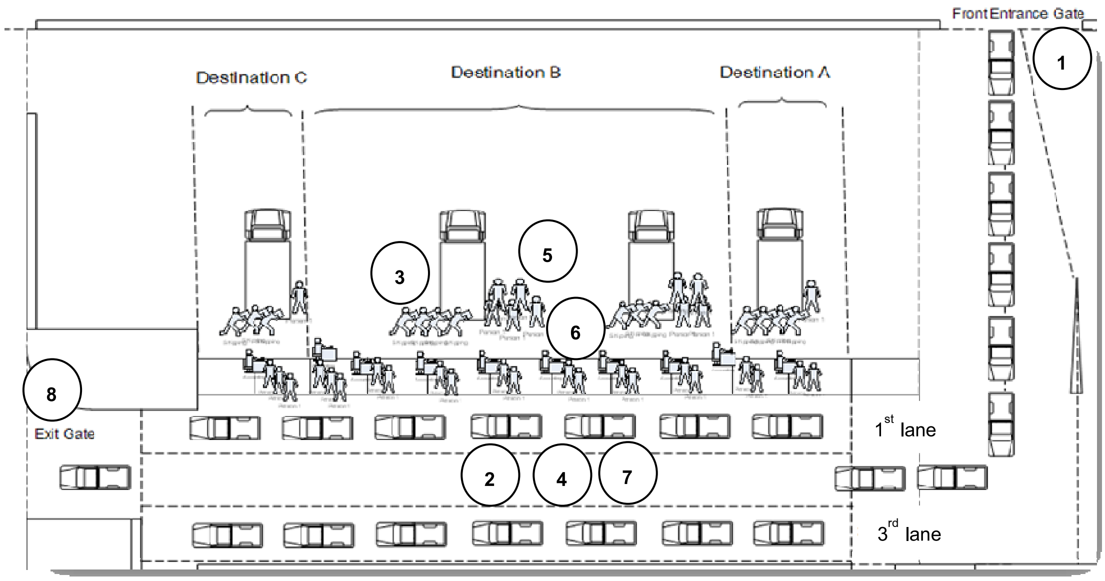

Figure 2: For each steps of dropping process happen in different area for operating on the current system

The service consists of two processes: Checker and Clerk. Checker's duty is to check the product, to load and to arrange products into trucks. Clerk input information into the computers and return bill to customers.

The working hour is between 8.00 am.and 7.00 pm. The schedule of workers is shown in Table 1.

Table 1: Number of checkers and clerks in each time period

Time period	Destination A		Destination B		Destination C	
	Checker (person)	Clerk (person)	Checker (person)	Clerk (person)	Checker (person)	Clerk (person)
8.00 am. - 9.30 am.	-	-	5	5	-	-
9.30 am. - 12.00 am.	1	1	9	8	1	1
12.00 am.- 1.00 pm.	1	1	4	3	1	1
1.00 pm. - 2.00 pm.	-	-	5	5	-	-
2.00 pm. - 5.30 pm.	1	1	9	8	1	1
5.30 pm. - 7.00 pm.	1	1	4	3	1	1

4.1.2. Number of Queuings in the system There are three queuings in the dropping area: Queue for parking, Queue for waiting for checkers, Queue for waiting for clerks.

4.1.3 Assumptions of the study

1.) The queue of the vehicle waiting for parking is single and infinite.

2.) Queue discipline is First Come First Serve (FCFS) rule.

3.) Only two lanes are permitted for parking, for each lanes can park on seven vehicles for maximum.

4.) All checkers have the same service rate and all clerks have the same service rate.

5.) Consider the dropping process in the case of regular situation only.

6.) No package can be laid in the vehicle lanes.

4.2. The Cause of the Problem in the Current System

We use the observation and simulation to find the causes of the problem.

1.) The label of the direction of sign is not posted in the appropriate place. Therefore, the car driver cannot see that sign which causes the vehicle turned to the wrong direction. As the result, the customers need to make another trip to get to the right station. It takes a long time to get back in a line especially a truck which has big size and move slowly.

3.) The customers for destination A block other customers. The customers for other destination cannot get into the vacant vehicle lanes through the middle lane.

4.) In the current system, there are vehicle 's lines crossing each other in front of entrance gate which causes an obstruction of the system.

4.3. The Capacity of Current System

The capacity of the current system is shown as Table 2. Our result shows the number of customer exceed the system 's capacity during 9.30 am.– 5.30 pm.

Table 2: The Comparison of capacity and arrival rate

Time period	Capacity (veh./hr.)	Arrival rate (veh./hr.)
8.00 am.– 9.00 am.	42	2
9.00 am.– 9.30 am.	40	24
9.30 am.– 12.00 am.	48	59
12.00 am.– 1.00 pm.	36	64
1.00 pm.– 2.00 pm.	40	57
2.00 pm.– 5.30 pm.	48	68
5.30 pm.– 6.00 pm.	36	26
6.00 pm.– 7.00 pm.	36	4

The result also shows that the utilization for checkers and clerks at some stations is less than half of others. This means that the current process is not efficient. The analysis shows that the system can be improved by not fix the checkers and the clerks on the station. That is they should provide their service whenever they are available. In the next step, we compare the current system and our proposed system.

4.4. Comparisons of the system

4.4.1. Number of the Customers in the Queue

Table 4 shows the number of customers waiting in the parking queue. The result of study shows that the proposed system can reduce the average number of customers from 0.34 vehicle to 0.05 vehicle and reduce the maximum number of customers in the parking queue from 64 vehicles to 24 vehicles. The reduction percentages of average and maximum number of customers are 85.29 and 62.50 respectively.

Table 4: Comparison of number of customer in the queue for parking

Model	Number of customer in the queue for parking	
	Average (Vehicle)	Maximum (Vehicle)
Current system	0.34	64
New system	0.05	24
Percentages of change	85.29	62.50

4.4.2. Waiting Time of the Customers in the System

The average waiting time in the system is reduced from 11.29 minutes to 9.61 minutes or 14.88% of reduction. The maximum waiting time in the system is 118.42 minutes for the current system. Our proposed system reduces the waiting time to 66.41 minutes or 43.92% of reduction is shown as Table 5.

Table 5: Comparison of waiting time in the system

Model	Waiting time in the system	
	Average (Minute)	Maximum (Minute)
Current system	11.29	118.42
New system	9.61	66.41
Percentages of change	14.88	43.92

4.4.3. Waiting Time of the Customer in the Queues

Table 7 shows the waiting time of the customers for each queue. The proposed system reduces the waiting time for parking from 0.9 minute to 0.12 minute on average while the maximum waiting time is reduced from 48.68 minutes to 19.74 minutes. The customer spent their time on average waiting time in queue for the checker in the current system on station for destination A, B, and C are 6.08, 0.29, and 4.23 minutes, respectively. The maximum waiting time in queue for checker in the current system on station for destination A, B, and C are 100.31, 26.22, 86.54 minutes. The waiting time in queue for checker in the proposed system are 0.11 minute on average and 16.47 minutes for maximum. The average waiting time in queue for clerk in the current system are 4.52 minutes, 0.06 minutes, and 3.95 minutes for destination A, B, and C, respectively. The maximum waiting time in queue for clerk in the current system for Destination A, B, and C are 89.26 minutes, 13.61 minutes, and 84.30 minutes, respectively. The waiting times for clerk in the proposed system are 0.01 minute on average and 6.48 minutes for maximum.

Table 6: Comparison of waiting time in the queue

Queue	Current System		New System	
	Average (Minute)	Maximum (Minute)	Average (Minute)	Maximum (Minute)
Queue for parking	0.90	48.68	0.12	19.74
Queue for checker				
Station for destination A	6.08	100.31	-	-
Station for destination B	0.29	26.22	-	-
Station for destination C	4.23	86.54	-	-
No fix on station	-	-	0.11	16.47
Queue for clerk				
Station for destination A	4.52	89.26	-	-
Station for destination B	0.06	13.61	-	-
Station for destination C	3.95	84.30	-	-
No fix on station	-	-	0.01	6.48

5. Conclusions and Discussion

In this study, we consider the queuing problem of the service provider which is one of the largest companies in Thailand. The objectives of this study are to find the root cause of the problem in the current system, to find the capacity of the current system and to propose a new system to improve the efficient of the service provider system. Our results show that the current system is not sufficient to provide the service to the customers. This is because the customer rate exceeds the system capacity; especially during 9.30 am.– 5.30 pm. of the day. The simulation results suggest that the utilization of the current system can be increased. We have proposed a new system which improves the efficient of the process by showing that the number of customers in queue and the waiting time of customers for each queue and the system are reduced. As the result, the customer satisfactions can increases.

Reference

[1] Mahmoud Kaboudan, (1997). *A dynamic server queuing simulation*. Computer Operations Research. 25: 431-439.

[2] Montol Yingsoong, (2007). *Reduction of Customer Waiting Times at Teller Counters in A Commercial Bank* . National Operations Research Conference 2008. Ramkhamhang University.

[3] Nattapon Tongbai, (2009). *The Allocation of Service Units to Improve Freight Distribution : A Case Study of Cement Manufacturer*. The 9th Industrial Academic Annual Conference on Supply Chain and Logistics Management. The tide resort hotel. Chonburi.

[4] Narisa Kanthaset, (2008). *Simulating International Passenger Terminal in the Suwannabhumi Airport : Modeling and Solutions*. The 8th Industrial Academic Annual Conference on Supply Chain and Logistics Management. Long beach hotel. Petchburi.

[5] Nipa Jongjoho, (2008). *Simulation of Outpatient Dispensing Service*. The 8th Industrial Academic Annual Conference on Supply Chain and Logistics Management. Long beach hotel. Petchburi.

[6] Prakakong Atthakaloonpan, (2007). *Simulation of The Public Bus System of Bangkok Mass Transit Authority : A Case Study of Zone 2 Division 1*. Master of Science Independent Study in Statistics. Kasetsart University

[7] Roongrat Pisatchpen, (2008). *Handbook of Simulation with Arena* . SE-EDUCATION Co. Ltd., Bangkok.

[8] Rattana Goodtha , (2006). *The simulation of customer service queuing system in Siam Commercial Bank Khon Kaen University Branch* . Master of Arts Program Independent Study in Business Economics. Khon Kaen University

[9] Thidanuch Puttasimma. (2008). *Simulation for Sugarcane Truck Management*. Master of Science Independent Study in Computer Science, Faculty of Science, Khon Kaen University.

[10] Wipawan Singpring, (2002). *Operation Research Book 2*. Academic Services Devision. King Mongkut's University of Technology North Bangkok : Bangkok.