



## Simulation by Queuing System at Immigration Department

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### Article Information

#### Keywords

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### Abstract

Waiting in line is a common problem that is faced by Malaysian especially when people want to get a service in the Malaysia government sector. Immigration Department Johor Bahru is one of the government sector that is facing this problem, particularly when people want to make or renew a passport. This problem occurs because there is no second option for the customers to go to a private sector in order to get the same service. It might cause dissatisfaction to the customers because they have to wait for a long time. This research recorded 400 customers in time between 7.30 am to 12.30 pm for 5 days. The process of making a passport includes identity processing, payment process and collecting process. This research modelled Discrete Event Simulation as a tool to calculate the average time of customers have to wait for the service and determine the best alternative to reduce the waiting time by using Arena software. As a result, the average time for the customers to wait for the service is approximately 38 minutes, 4 minutes and 12 minutes for identity processing, payment process and collecting process respectively. There are two better alternatives in reducing the waiting time that is by increasing the number of payment counter or increasing number of counters for each process. It can be concluded that there are pros and cons for each alternative. The first alternative is benefitted to the department while the other one is more beneficial to the customers

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### INTRODUCTION

Waiting in lines is a common problem faced by Malaysian. Queuing is a normal situation that people will go through in their daily life especially at the hospital, bank, and post office and even at the restaurant. Sometimes waiting in lines or queuing can make people feel annoyed. The worst is when they need to wait for hours before being served. It always happens when people want to get a service in the Malaysia government sector. For an instance, at the Immigration Department of Malaysia. They need to wait for hours and sometimes it can take almost half a day to register for a passport, border pass, visa, permit for foreign worker and other services.

Since there are many types of services offered at this department, so it only focuses on service to make or renew a passport. Usually, the customers will spend more than one hour for the waiting time before they get the services. Therefore, in this study the data collected are based on customer's waiting time, starting from their arrival time until the completed service time, including the waiting time before being served, service time, waiting time to make a payment and waiting time for collecting their passport. The normal variable like number of service counters, payment counter and counter for customer to collect their passport at the department is also collected. By using Discrete Event Simulation (DES), average time for customers to wait for each process will be calculated at the end of this study. Some scenarios will be tested to find the best alternative to reduce customer's waiting time.

#### *Problem Statement*

In Malaysia, usually when people go to the government department, they must wait for a number of times before being served. The same goes to the Immigration Department. The waiting time is based on their arrival and the situation. Unlike a hospital, there are options, whether they go to government or private hospitals to get a better services.

Unfortunately, for people to make or renew their passport, they do not have an alternative of a private sector. Instead, they can only count on the government sector of the Immigration Department here in Malaysia. Because of that, they need to wait for hours and sometimes spending the whole day just to wait in order to use the service. Every customer has limited patience for waiting in line (Dai and He, 2011). Based on the length of the queue, people can make a judgment as to how bad the services are. The major problem that was looked into this project is about the waiting time to serve the customer that will eventually affect the customers' time.

#### *Objective of the Study*

The specific objectives of the research are to calculate the average time customers have to wait for the service and to find the best alternative to reduce the waiting time.

#### *Scope of the Study*

This study is focused on the waiting time for the customer to get a service of doing passport and the waiting time to get their completed passport at the counter at Immigration Department Johor Bahru, Johor. The data were collected on the second week of August 2015 from Sunday to Thursday during peak hours which are between 7.30 am until 12.30 pm.

#### **LITERATURE REVIEW**

A customer who is waiting for a service is a negative experience especially waiting in a long queue length that arose in purchasing situation. They will wait in a given length of time for a service to begin (Jouini, 2012). Queuing situation can meet in hospital (Duda, 2011), in the bank (Al-Jumaily and Al-Jobori, 2011; Mutingi et al., 2015), in railway counter (Jacob, 2013), in industrial and manufacturing process (Akhavian and Behzadan, 2014), in a call centre (Dai and He, 2011), in a restaurant (Md. ManjurulAhsan et al., 2014) and many other services. This situation is not only affected the customer's satisfaction but also waste the customer's time. The length of the queue has been an issue at the immigration department as the customer need to line on the street for hours to get a service (Gleeson and Pollak, 2014). The customer has limited patience to waiting in line (Dai and He, 2011). Therefore, the immigration departments need a systematic queuing system in order to reduce the customer queue length. For this study, Discrete Event Simulation (DES) will be applied to improve the customer services.

A waiting line system or queuing system happens when individuals who are usually the customers who are involved in counting in one or more server that provide a service to them. This service is actually requested by the customer and for each service, it will take a specific time based on the service given by a server (Al-Jumaily and Al-Jobori, 2011; Gamarnik and Stolyar, 2012). In this system, there are several pattern that is involved in this queuing system which are First Come First Serve (FCFS), Last Come First Serve (LCFS), Priority Service (PRI), and Shortest Process First (SPF) (Akhavian and Behzadan, 2014; Al-Jumaily and Al-Jobori, 2011; Gamarnik and Stolyar, 2012). FCFS basis is usually used in service counter as they said that this concept are fairer to the customer. In the Immigration Department of Malaysia, they also used this concept in order to serve their customer. There are two types in queuing system which are single-channel queuing system and multiple-channel queuing system.

A simulation model is a process of creating and analyzing a model of a system for a real world system. Akhavian and Behzadan (2014) stated that, this model helps an organization to achieve high level of efficiency of their service. Simulation model will stimulate from the real system with factual data and capable to

investigate a range of real world problem. Besides, Mutingi et al. (2015) said that to discover the best alternative in form of service time and staff's utilization rate by using simulation model is the best option.

Duda (2011) stated that the DES had been widely used in modelling health care system for many years because it is more flexible for that system. Ferreira et al. (2008) has conducted research at the hospital surgical centre where there is a problem of lack of surgery bed because of the high number of surgeries per day. They use this method to analyse the impact of increasing number of beds, number of surgeries per day and changing the scheduling strategies. At the end of their research, they found that, increasing a number of beds would lead to a flexible schedule to achieve a significant improvement towards the surgical centre productivity.

Based on Jacob (2013) and Ferreira et al. (2008), DES is a computer program that is written to imitate the behaviour of the system. To study the behaviour, validation model and verification model are used. This method can evaluate the efficiency of an existing system and from that evaluation, a new system operation can be designed (Duda, 2011; Akhavian and Behzadan, 2014). In immigration service system, this method can be applied to improve the existing system.

In each system, there are some scenarios that occur. For each scenario, it can be tested to evaluate the model and the appropriate concept can be chosen (Duda, 2011; Jacob, 2013). The flow map of DES is complex enough to be considered in real system. Therefore, the system can be built to catch the real system behaviour. DES typically include in a service system in order to achieve a high efficiency to serve a customer (Md. ManjurulAhsan et al., 2014).

Based on Al-Jumaily and Al-Jobori (2011), many researchers try to get a full advantage to invent a new technology to increase customer satisfaction. They try to reduce an average waiting time that customer need to wait before the service begin and to improve a quality of service (Mutingi et al., 2015). According to Al-Jumaily and Al-Jobori (2011) and Dai and He (2011), dealing with all customers fairly should be equal to the performance of the system. The most important variable need to be considered is the arrival time and the service time for each customer. When more than one customer arrives at the same time, the queue will start to occur. Other than that, if service times for each customer take too long, it will cause a queue length for another customer.

**METHODOLOGY**

This research referred to the simulation modelling process as in Figure 1. After understanding the issue or problem to be modelled, the next stage is to formulate the aim and set the objectives of this research. The data are collected using the primary data collection method by observation, it is very important to define clearly the variable to model at the early stage of data collection so that the data that has been collected is meaningful. Figure 2 shows the customer flow process at the immigration department.

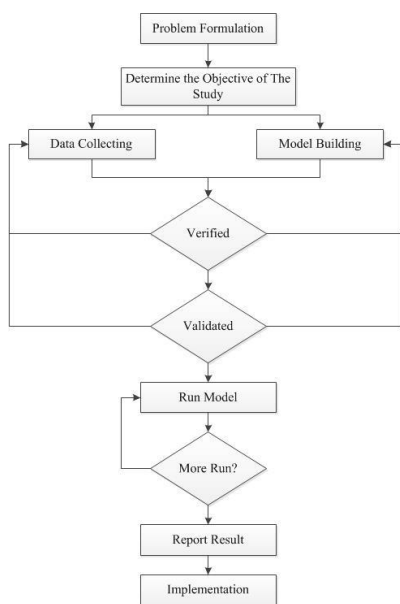


Fig.1.

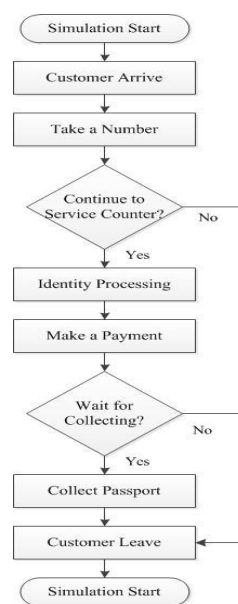


Fig.2.

Customers will first arrive at the immigration department and take a queue number. The customer will be called based on their queue number. If the waiting time before getting a service is too long, some of the customer may leave the system before their queue number are called. For the customer who is willing to wait for the service, they will wait for their queue number to be called by the service counter for customer's identity processing. Identity processing includes keying-in all the customer details, thumb printing and taking a picture for the passport. After completing the process at the service counter, customers will proceed to make a payment for a passport at the payment counter. Once the customer has made a payment, the passport will be printed. To collect the completed passport, the customer needs to wait for several times. The customer can decide whether to wait to take the passport on the same day or take the passport on the next day. If they decide to collect the passport on the same day, they need to wait for their queue number to be called by the collecting counter. After collecting their passport, the customer may leave the system.

In this research, the DES and Arena Software had been used. The data has been verified and validated to see whether the model is rightly built and represented the real situation. Table 1 shows the data of the number of resources and entity in the immigration department at Johor Bahru.

TABLE I  
TYPES OF RESPONDENTS

Types of respondents		Total
Resources	Service Counter	9
	Payment Counter	2
	Collecting Counter	2
Entity	Customers	400

#### *Discrete-Event Simulation (DES)*

Discrete Event Simulation (DES) is a model that can be defined as one in which the stated variables change only at those discrete points in time at which events occur. The DES is conducted over time by a mechanism that moves simulated time forward. The system stated is updated at each event along with capturing and freeing the resources that may occur at that time. DES allows much flexibility by allowing the researcher to evaluate the existing system to ask "what if" question. From that, they can design new system operation to improve the existing system.

A model is an abstract and simplified representation of a system. In this research, the model is built to see where long queuing occurs. From that, it can optimise at which event it occurs and reduce waiting time as well. Furthermore, this research shows how sensitive the result that has been obtained, which is the total waiting time and counter which gives minimum waiting time.

One of the crucial steps in DES is model verification to show the performance of the built model (Pena et al., 2014). Model Verification is ensuring whether this model is conducted in the way it is focused. It focuses more on the computer program as it eliminates any unintentional errors in the logic of the model. The verification activity concentrates on the identification and eliminates the errors in the software that has been used in this research. In this model, the simulation model developed has been run. The purpose of this model verification is to check whether the computer simulation program is building the right model.

## **RESULTS AND DISCUSSIONS**

#### *Analysis of Service Time*

There are three processes before getting a passport which are identity processing, payment process and collecting process. From the three processes, identity processing takes more time than other two processes. Figure 3 shows service time for identity processing faced by the customers in the morning session. It shows that out of 262 there are about 15 customers being served more than 10 minutes. Mostly the service time for identity processing does not take a long time. It depends on the customer themselves. Some customers have a problem to thumbprint or take a long time to take a picture.

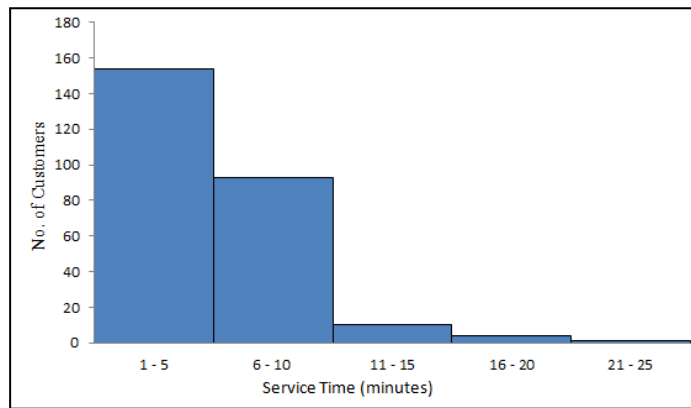


Fig.3.

Graph Number of Customers versus Service Time

*Analysis of Customer Waiting Time*

The operation hours at immigration department Johor Bahru, Johor on Sunday to Wednesday is from 7.30 a.m. to 5.30 p.m. while on Thursday is from 7.30 a.m. to 3.30 p.m. The morning session which is from 7.30 a.m. until 12.30 p.m., the result came out that the number of customers is higher than in the evening. There are too many customers who come at the same time and that created a longer queue to take place during a morning session. It can be said that during the morning session, the immigration department was really congested and crowded compared to the evening session.

The waiting time is shown in Figure 4 is a total waiting time for customers after they have completed all the process. From Figure 4, there are 70 out of 262 customers have experienced a long waiting time that is more than 2 hours. This situation might cause customers' dissatisfaction. Mostly the total waiting times for customers completed all the process is between one hour and 2 hours. However, there are several customers who experienced shorter waiting time. Out of 262 there are about 42 customers having a short waiting time which is one hour and below.

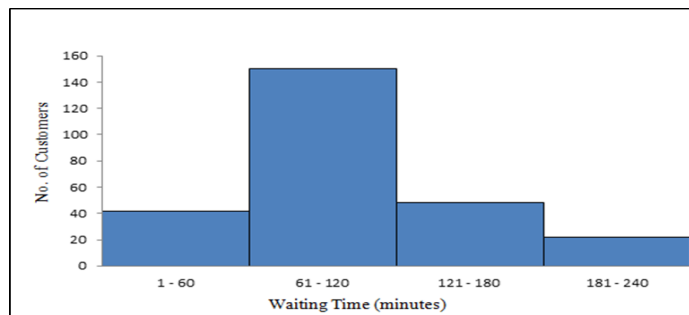


Fig.4.

Graph Number of Customers versus Waiting Time

*Arena Software*

The Arena Model builds based on the flow chart that have been constructed in the earlier part of the study. The real data are used in order to generate the right model.

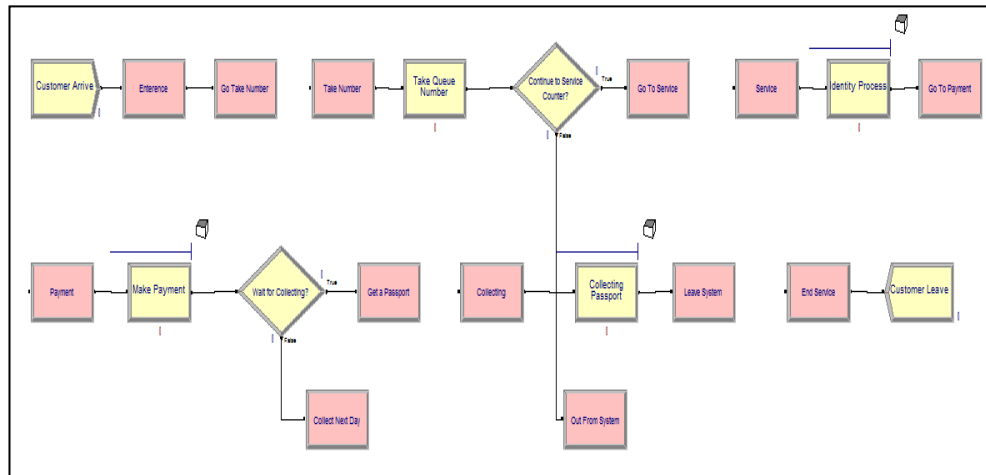


Fig.5. Flowchart Process for Process of Make a Passport

Figure 5 shows a transformation process from the actual process into ARENA. By using this software, this model can be validated and verified to continue this study. This simulation model is run for 400 customers with 1500 minutes, which is during peak hours and this replication is occurring in 10 hours which is the opening hours of this department. The data that have been observed is inserted into the input analyser to get the best fit to determine the expression of each delay type. Then, the model is checked to ensure the model is free from any error and the simulation run will take place and SIMAN reports will be appeared if the model is no faulty.

For all process, the movement of the customers is being considered for every process. Movement from one counter to another counter are assumed to be constant for one minute. Service time data for each processes are analysed in the input analyser to determine the delay type. Table 2 shows the result on the input analyser for each service of processes involved in delay types.

TABLE 2  
DELAY TYPE

Process	Delay Type
Identity Processing	$3.5 + 21 * \text{BETA}(1.54, 2.77)$
Make a Payment	$-0.001 + 1 * \text{BETA}(0.327, 0.359)$
Collecting Passport	$-0.001 + 1 * \text{BETA}(0.199, 0.204)$

*Model Validation*

Arena output has been compared with actual situation data to validate the data. Table 3 shows the comparison of DES and actual data by using the software, which is Arena. It can be seen that, average data and DES for identity processing is validated.

TABLE 3  
COMPARISON OF WAITING TIME

Average Waiting Time (minutes)	Actual data	Discrete Event Simulation
Identity processing	34.4275	37.567
Make a payment	15.11	3.7958
Collecting passport	32.475	12.293

*Scenarios of Improving Waiting Time*

Different scenarios were presented for reducing customers waiting time. This research has provided some changes in the number of service counter, number of payment counter and number of collecting counter.

TABLE 4  
TYPES OF SCENARIO

Scenario	Changes
1	Increase in the number of service counter
2	Increase in the number of payment counter
3	Increase in the number of collecting counter
4	Increase in the number of service counter and collecting counter
5	Increase in number of counters for each process

There are about five scenarios being tested. It shows an improvement in the average waiting time when the scenarios are applied. The comparison of the scenarios can be seen in Table 5. From Scenario 1, 3 and 4, the increase in the number of service counter and collecting counter only reduced the process that happen in that counter while the other processes will increase the waiting time and remain the same like a real situation. Scenario 2 shows increasing numbers in payment counter led to increasing waiting time in one process that is collecting process while the other process's waiting time decrease. Scenario 5 shows, if the counter for each process is added by one counter, it can reduce waiting time for all process and have the lowest average waiting time among the other scenario.

TABLE 5  
COMPARISON BETWEEN SCENARIOS

Average Waiting Time (minutes)	Arena	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Identity processing	37.567	8.7612	16.962	37.567	8.7612	5.6402
Make a payment	3.7958	11.066	0.30445	3.7958	11.066	0.36298
Collecting passport	12.293	37.186	34.421	0.04670	0.22155	0.91060
<b>Total Average Waiting Time</b>	53.6558	57.0132	51.68745	41.4095	20.04875	6.91378
<b>Time Reduced</b>	-	3.3574	-1.96835	-12.2463	-33.60705	-46.74202

From Table 5, comparison between five scenarios shows that Scenario 5 has a better result compared to others. For Scenario 2, even there are decreasing waiting time for two processes by adding one payment counter, but the total average waiting time that has been reduced for all the process only 2 minutes compare to Scenario 3 who reduced 12 minutes for all process even though it only decrease the waiting time at one process when adding one collecting counter.

The difference of total average waiting time for all process between actual output and five scenarios shows that the waiting time that reduced in Scenario 5 is higher compared to other Scenario. It clearly shows that Scenario 5 is the best alternative to reduce the waiting time for the process of making a passport.

**CONCLUSIONS**

Simulations are one of the technique that provides the best alternative for reducing waiting time in any type of system either production system or servicing system and even in our daily life. From this research, it was found that the use of Discrete Event Simulation (DES) has given an improvement in the process of making a passport in the immigration department. Besides, the Arena software helps a lot in identifying the problem of long waiting time that happens in this department and provides the best alternative to reduce the waiting time based on the scenario given. From the objectives that was stated in an earlier chapter, the average customer's waiting time for each service have been calculated. From the result obtained, this research has achieved the second objective which to find the best alternative to reduce the waiting time for a customer. There is one best alternatives to reduce the waiting time that is increasing number of counters for each process. DES model had reduced about 32 minutes in identity processing, 3 minutes in the payment process and 11 minutes in collecting process from the Scenario 5.

**RECOMMENDATIONS**

Servicing industry especially in government service should apply this simulation tool because it is one of the best alternatives to optimise waiting time. It is important for a service that are inclusive in the government department like Immigration Department, The National Registration Department and Department Of Road Transport. It can help the government to reduce waiting time in order to improve the service in the government sector. In the cases that have been deliberated in immigration department, the system should increase the number of counters and the staff as well, and thus the customer will not have a longer waiting time to get a service.

In the future research, it is recommended to do more observation towards the situation that happens in this system. Therefore, it would be more accurate determination of the real situations when the percentage of the situation to likely be happening can be predicted or calculated well and at the same time, the best alternative can be raised which can help to fully overcome the problems that occur in the system. Other than waiting time, they could also consider the utilization rate for each counter and optimise the rate of utilization for each staff. They need to reduce waiting time and at the same time the staff should be fully utilized. They can also consider all the costs that are involved in order to solve the problems happen in the system.

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