OPTIMIZING NUMBER OF BOOTHS: CASE STUDY IN POST OFFICE

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This report submitted in accordance with requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) with Honours.

By

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2011

DECLARATION

I hereby declare that this report entitled "Optimization Number of Booths: Case Study at Post Office is the result of my own research except as cited in the references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) with Honours. The members of the supervisory committee are as follow:

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ABSTRACT

This technical report presented the study of optimizing the number of booths (counters) in industry service. The industry service sector selected is the post office which is located at Ayer Keroh, Melaka. The purpose of selecting this title was to optimize the number of booths in the post office and hence reducing the customer waiting time. Queuing theory and model were applied in the post office with the aid of journals and information found as references. Data collection was done randomly for five days in two weeks time in the post office by recording the customer arrival time and departure time to get the inter arrival time of customers and service time. A set of questionnaires was prepared to conduct a survey on the limitation of waiting time of 50 customers in the post office. The idea of carrying out this survey was to identify the waiting time of the customers and make further improvement from that situation. Queuing theory and simulation method were the main technique used to model and analyse the queuing system. The results obtained in simulation were compared to results obtained in queuing model.

ABSTRAK

Laporan teknikal ini menyajikan kajian mengoptimumkan jumlah kaunter dalam industri perkhidmatan. Perkhidmatan sektor industri yang dipilih adalah pejabat pos yang terletak di Ayer Keroh, Melaka. Tujuan pemilihan judul ini adalah untuk mengoptimumkan jumlah kaunter dan mengurangkan masa pelanggan menunggu dalam sistem. Sistem garisan dan teori antrian telah diterapkan di pejabat pos berdasarkan jurnal dan maklumat yang dicari. Pengumpulan data dilakukan selama lima hari buat dua minggu secara rawak di pejabat pos dengan mengambil masa pelanggan tiba dan keluar dari pejapat pos untuk mendapatkan waktu antara kedatangan pelanggan dan masa perkhidmatan oleh pelayan. Satu set senarai soalan telah disediakan kepada 50 pelanggan untuk menjalankan penyelidikan terhadap pelanggan tentang had masa menunggu di kaunter pejabat pos. Idea untuk melaksanakan kajian ini adalah untuk mengenalpasti masa pelanggan menunggu di kaunter dan membuat perbaikan secara lebih lanjut. Teori antrian and simulasi merupakan teknik utama yang digunakan untuk menganalisa seluruh system antrian. Keputusan yang diperolehi dalam simulasi akan kemudian dibandingkan dengan hasil pada model antrian.

DEDICATION

This Project Sarjana Muda is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time. This is also dedicated to my brother who always gives me moral support and guides me for my project.

Also, this Project Sarjana Muda is dedicated to my supevisor Dr Adi who has been a great source of motivation and inspiration.

Finally, this project is dedicated to all those who believe in the richness of learning.

ACKNOWLEDGEMENTS

I would like to convey my gratitude to my Project Sarjana Muda supervisor Dr Adi. He provides me valuable knowledge and guidance on the information to be included in the project. Besides, Dr Adi also spends his free time to help us in overcoming difficulties met during data analysis of the project. He always works together with us and give his ideas when we carry out the project. His kindly but rigorous oversight of this project constantly gives me the motivation to perform to my maximum ability.

Besides, I must also thank Mr. Sivarao for giving information to us on the tips of completing Project Sarjana Muda. He had answered all the doubts and questions of students during the Project Sarjana Muda talk.

I would like to extend my appreciation to Universiti Teknikal Malaysia Melaka for giving me this opportunity to learn more knowledge through this study.

My family members, my course mates and my friends are mentioned last to emphasize the special nature of their tremendous encouragement, support and patience all through my candidature.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

Sec	-	Seconds
Min	-	Minutes
Pn	-	Steady-state probability of having n customers in system
λ	-	Arrival rate
μ	-	Service rate of one server
ρ	-	Server utilization
L	-	Long-run time-average number of customers in system
LQ	-	Long-run time-average number of customers in queue
w	-	Long-run average time spent in system per customer
wQ	-	Long-run average time spent in queue per customer

CHAPTER 1
INTRODUCTION

1.1 Introduction

Everyone must have experiences in queuing and it has become part of our life. Lines are encountered everywhere for example ticket counter in bus station, counters in cinema, and ATM machine. According to statistics in United States of America, people are estimated to spend 37 billion hours per year just for waiting in lines. Queuing theory has been developed since many years ago with the publications beginning at early twentieth century. Erlang (1990) was the first who developed the first paper of historic significance and until 1958, Philip Morse had published the text book namely *Queues, Inventories and Maintenance* and this queuing theory had be applied as a discipline within a single test since 50 years ago.

The framework of the analysis of queuing theory is about categories queues into four main criteria. The criteria include average arrival rate (λ) and the distribution of arrivals (usually assumed to be random), average service rate (μ) and the distribution of service times, queue discipline and the number of servers assigned to the queue. However, there are also assumptions in queuing theory as once the customers joined the queue, customers are assumed not to leave the queue. The population of customers can be infinite as the number of customers is not limited and also can be finite. The output for queuing model can be either stable or not stable depending on the situation. If the output is considered as stable means the servers are able to serve the customers on time whereas if the output is not stable, this indicates that the customers arrive faster than to be served.

Jones and Dent (1994) had identified three types of customers in service industries which are the "watchers", "neutrals" and "impatients". "Watchers" mean customers who enjoy do not mind to wait while "neutrals" describe customers who express either enjoyment or frustration. Customers who do not like waiting and might cut queues or complain are considered as "impatients". The existing research suggested that waiting for a particular service has become a negative experience to the customers and the speed of service is an important service attribute (Katz et al., 1991; Roslow et al., 1992). Kostecki (1996), Pruyn and Smidts (1998) also mentioned that waiting may imply significant costs in terms of detrimental impact of the service firm. However, the cost of waiting is often mathematically intractable and the cost is difficult to be estimated accurately. In previous studies, the negative impact of service waiting

Queuing system is defined by two elements which are the population source of its customers and the process or service system itself. Customers in this case only involve human as this project mainly focusing in the waiting line of customers in system. The performance characteristics can actually be calculated for different waiting line systems. In order to solve the efficiency of waiting lines, queuing theory is applied. The queuing theory in this case includes the mathematically analysis of related processes such as the arrival and departure time of the customers, waiting time in the queue and also the time being served by the server. The method like simulation will also be used to assist in optimizing the current queuing system so that the waiting line will be reduced and hence enhancing customer satisfaction.

Simulation modeling is a well-established technique that duplicate the "features, appearance, and characteristics" of a real business or management system by using iconic and symbolic model (Render and Stair, 1997). Simulation is the imitation of operation of a real-world process or system over time. Simulation can either be done by hand or computer where the simulation model usually makes assumption on the operation of the system. Some models which are easy can be solved by using mathematical methods. However in the real-world, there are models which are more complicated and are virtually impossible to be solved mathematically. In this case,

computer-based simulation ought to be used to imitate the behavior of the system over time and evaluate the important statistical information. When observing the real system, data are collected and simulated to estimate the measures of performance of the system.

Harpell et al. (1989), Elridge and Watson (1996) have found that simulation is the tool which is most widely used in decision making. Currently simulation is widely implemented by the service industries like in hospital, fast food restaurant, bank or even post office. Models can be classified into mathematical or physical. Simulation in service industries is considered as dynamic simulation as the systems often change over time.

This project mainly studies about the queuing system in post office where the purpose is to observe the current queuing situation and to propose further improvement for the management. The number of booths in the post office ought to be optimized to so that the customer waiting time can be reduced. The post office selected is located at Ayer Keroh, Melaka. Currently the post office contains five booths where each booth provides one or more services to the customers. The services include normal posting, Pos express, Pos Laju and others. The operating time for the post office is from 8.30am to 5.00pm.

1.2 Background of Problem

One of the main problems in queuing system was the queue discipline. All the factors regarding the rules can be combined under this heading. One of the rules was followed by the server in accepting customers during service. The rules include first-in-first-out (FIFO), last-in-first-out (LIFO) and random selection for services (RS). In some situations, customers get priority in service over others. In many occasions in service system provides service at a faster rate than customers arrive, the queue or waiting lines may grow if the arrival time of the customers and the service processes are random. If the waiting line or queue is too long, customers may get angry and leave the system. In this case, customer behaviors like balking, reneging and jockeying can be happened.

When taking consideration into the input process, if the arrivals time and service time are scheduled, queue can be avoided. However in the real system, the arrivals are external factors meaning cannot be estimated. Therefore the input process can only be described in terms of random variables which can represent the number arriving during a time interval or time interval between successive arrivals. For service mechanism, staffs cannot perform in constant speed as human might feel tired when providing services. The uncertainties involved in service mechanism are number of servers, number of customers being served at any time and also the duration and mode of service. The system capacity is also one of the problems in queuing system. If the room is large, one can assume that the arrival of customers to be infinite.

Currently customers do not have to present physically at a place to wait in a line as many people are paying the electricity bills or other bills via internet. It is much preferred by customers as online paying is more convenient as customers do not have to waste time in queuing in a line. However, waiting line is apparent when the computer system is down or performs in slower speed when the server is overloaded. Problems like the money paid is not received by the server may be occurred if there are server or connection problems. After all, customers would decide to pay at the counter instead of online paying.

1.3 Statement of Problem

As one of service industries, post office must serve the customers satisfactorily. Customers will complain if the customers feel that the service was bad. Therefore, there are questions to be stated to post office service such as:

- Is the service of the post office sufficient to customer satisfaction?
- What is the impact of waiting in a long queue in the post office?
- What is the current system in the post office and what arrangement will be better in order to serve customer better?

1.4 Objective

- To identify customer satisfaction level of post office services.
- To model the queuing system in the post office.
- To optimize the number of booths in the post office by using queuing theory and simulation method.

1.5 Scopes

This study will only take place in the Ayer Keroh post office. To identify how customer perception on post office services, questionnaires are provided to 50 customers in the post office. The arrival time was taken randomly during the office hour and the service time was also taken randomly. Duration of data was taken several times and the duration was one hour per day. The queue discipline was based on current practice in the post office. The results obtained from queuing model were used to optimize the number of booths and hence reducing customers waiting time.

1.6 Importance of Study

By applying queuing theory and simulation method, some inputs to improve post office service were developed. These include the improvement in queue in the post office. Besides, by studying this project, the waiting lines can be improved by rearranging the system. Customer satisfaction can be enhanced if the waiting line is improved.

1.7 Organization of Report

Chapter 1 basically discussed about the introduction of queuing system and simulation in service industries. The current application of queuing system was discussed in this

chapter. Besides, the background of problem and statement of problem were also described in this chapter. The objectives, scope and importance of study were covered in Chapter 1.

Chapter 2 studied about the basic queuing theory in service industries and the application of the queuing model to the service industries. The history of queuing theory was discussed in this chapter to show the evolution of this theory. Some queuing models with different distribution were also determined in this chapter. Besides, application of simulation in service industry was also included in this chapter.

Chapter 3 described about the working procedures for whole project. Project methodology is very important to determine the method and technique used for the whole project. All the procedures and steps were list out to provide the understandable guideline to make sure the project run in organized order. The major technique used in this study is queuing theory to determine which model will be the best to optimize the number of booths in service industry in the following chapter.

Chapter 4 showed the development of the model where the introduction and the problem statement were covered. Conceptual model was also included in this chapter where the scope, level of details, assumptions and simplifications were covered.

Chapter 5 showed the data collected from the post office and the analysis of the data. A suitable model of queuing theory was selected to manually calculate the output with the aid of Minitab software and Witness software to compare the results. The detail explanation and discussion on the results was also provided in this chapter. Optimization of the number of booths was shown in the end of the chapter.

In Chapter 6, the suitable and relevant recommendations were suggested to improve this research. The recommendations were based on the responses from the survey and situation found in the post office.