



**KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN  
MALAYSIA**

**Optimizing Number of Servers in Surface  
Mounting Technology at Cubic Electronic  
Sdn Bhd to Increase Efficiency**

Thesis submitted in accordance with the requirements of the  
Kolej Universiti Teknikal Kebangsaan Malaysia for Bachelor of Manufacturing  
Engineering (Honours) (Manufacturing Process)

By

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June 2006

## DECLARATION

I hereby, declare this thesis entitled “Optimizing Number of Servers in Surface Mounting Technology at Cubic Electronics Sdn Bhd to Increase Efficiency” is the results of my own research except as cited in the reference.

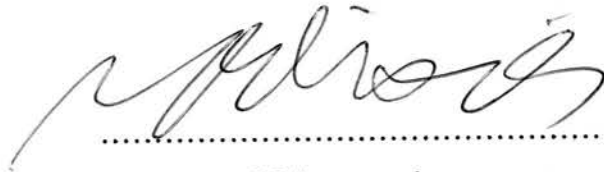
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## APPROVAL

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**SESI PENGAJIAN :** 2002/2006

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## **DEDICATION**

*For my family; Mr. Kamaruddin, Mrs. Rokiah,  
Nor Nizaha, Nur Syazana, M.Firdaus  
and Nur Fatin Syamimi*

## **ABSTRACT**

Nowadays industry is facing with problems in maintaining the quality and increase efficiency. To improve efficiency, industry needs to do continuous improvement over long period. One of manufacturing problem is how to eliminate queue in using any resources. This project is an attempt to improve efficiency in manufacturing industry by using simulation model. Specifically this project is in Surface Mounting Technology (SMT) Line 12 at Cubic Electronics Sdn. Bhd. Computer simulation is considered as a method for studying the behavior of business systems under a variety of assumed conditions for analyzing the simultaneous interaction of many variables to produce valuable insights into problems. Several scenarios of production line were simulated to find the best solution in order to reduce waiting time in queue, processing time and finish product time.

## **ABSTRAK**

Dewasa ini industri berdepan dengan masalah untuk mengekalkan kualiti dan meningkatkan efisien di dalam servis yang diberikan atau produk yg dihasilkan. Bagi meningkatkan kecekapan, industri memerlukan pembaikan bagi tempoh masa yang panjang. Salah satu dari masalah di dalam sektor pembuatan ialah bagaimana untuk memusnahkan barisan @ “queue”. Projek ini adalah percubaan bagi meningkatkan efisien di industri pembuatan menggunakan model simulasi. Khususnya projek ini dilaksanakan di Surface Mounting Technology (SMT) Line 12 di Cubic Electronics Sdn. Bhd. Simulasi komputer diambil kira sebagai kaedah bagi menganalisa kelakuan sistem perniagaan di bawah pelbagai keadaan bagi menganalisa tindak balas serentak bagi pelbagai pembolehubah untuk menghasilkan tanggapan yang berguna di dalam masalah yang terlibat. Beberapa senario bagi kawasan produktif telah dilaksanakan bagi mencapai kaedah yg terbaik untuk mengurangkan masa menunggu di dalam barisan, masa penghasilan produk dan masa menyiapkan produk.



## **ACKNOWLEDGEMENT**

Here I would like to acknowledge my gratitude to people who helped me in the past and present. Firstly I would like to thank god for giving this opportunity to me to complete this work. Most importantly to my parents, Mrs. Rokiah Hassan and Mr. Kamaruddin Ariffin for support me for the whole time period of this project. I am deeply indebt to my supervisor, Prof. Madya Dr. Adi Saptari for helping me with this project from beginning until it is complete. He gave me almost full guideline to conduct this research, provided me with additional data and knowledge. My warm thanks also go to the manager of Post Office Ayer Keroh for letting me conduct a survey at the post office and his full cooperation within the section. My greatest appreciation delivers to Mr. Ghaffar Salleh, his assistant; Miss Anie, Ikram and all people from Cubic Electronics Sdn. Bhd. that had helped me through this project. No words can count for their kindness. Last but not least, I would to thank Muhamad Syahrir, Nor Nizaha, Nur Syazana, Muhammad Firdaus, NurFatin Syamimi and all people that involve either direct or indirect in this research. I appreciate your cooperation and kindness.

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**LIST OF SIGN AND SYMBOLS**

Item	Description
FIFO	first-in-first-out
LIFO	last-in-first-out
FCFS	first-come-first-served
$\lambda$	Customer arrival rate
$\mu$	Service rate per server
$L_q$	The average number of customers waiting for service
$L_s$	The average number of customer in the system (waiting and / or being served)
$r$	The average number of customers being served
$\rho$	The system utilization
$W_q$	The average time customers wait in line
$1 / \mu$	Service time
$W_s$	The average time customers spend in the system (waiting line and service time)
$P_0$	The probability of zero units in the system
$P_n$	The probability of n units in the system
$M$	The number of servers (channel)
$L_{max}$	The maximum expected number waiting in line
$x'$	Mean
$s^2$	Variance
$\alpha$	shape parameter
$\beta$	scale parameter
$\mu$	mean
$\sigma^2$	Variance
$k$	Variable

Item	Description
$k$	Variable
$x_1, x_2, \dots, x_k$	Sample
SIMAN	SIMulation Analysis
pdf	probability density function
$a$	Arrivals distribution
$b$	Departures (service time) distribution
$c$	Number of parallel servers ( $= 1, 2, \dots, \infty$ )
$d$	Queue discipline
$E$	Maximum number (finite or infinite) allowed in the system (in queue plus in-service)
$f$	Size of the calling source (finite or infinite)
$M$	Markovian (or Poisson) arrivals or departures distribution (or equivalently exponential interarrival or service time distribution)
$D$	Constant (deterministic) time
$E_k$	Erlang or gamma distribution of time (or equivalently the sum of independent exponential distributions)
$GI$	General distribution of interarrival time
$G$	General distribution of service time
FCFS	First come, first served
LCFS	Last come, first served
SIRO	Service in random order
$GD$	General discipline (i.e., any type of discipline)
$p_n$	probability of $n$ in the system
$L_s$	Expected number of customers in system
$L_q$	Expected number of customers in queue
$W_s$	Expected waiting time in system
$\hat{c}$	Expected number of busy servers
$\lambda_{eff}$	Effective arrival rate at the system

# **CHAPTER ONE**

## **INTRODUCTION**

# **CHAPTER 1.0**

## **INTRODUCTION**

### **1.1 Background**

Now days manufacturing becomes one of the important industries, especially in developed countries such as Japan, United State, China and Malaysia. Towards the developing of great environment, technology is greater catalysis of a new revolution of human thinking. With technology, a lot of things become more easily to operate. Machine is one of the human revolutionary to increase labor's role and to facilitate difficult machining process. In order to increase productivity and efficiency together with decrease cost, company facing problem to optimized the number of machine. This problem is related to our real life problems such as mail queue problem on computer, patient facing delays, golfing queues and scheduling, and queuing for toilets. According to problems mentioned, research had been done on analyzing the waiting line process in internet queueing systems with the transform approximation method by Dr. Martin J. Fisher. By referring to this problem, it can be contribute with the machine problem.

By considering to the manufacturing system, queueing line exists in it. As the product started to be produce, it involve with several changing processes. In the process of changing production line, the product is required to wait before being machined. This creates the queue or waiting line in the system. By referring to the queueing problem in real life situation, the application of queue scenario and queueing methodology can be apply in order to solve this problem.

### **1.1.1 Queuing System**

Waiting for service is part of our daily life. In restaurant, queue exist while waiting to be served, people “queue up” at the checkout counters in grocery stores, and even at post office, people “line up” waiting for service in post offices. And the waiting phenomenon is not an experience limited to human being only: Jobs wait to be processed on a machine, planes circle in stack before given permission to land at an airport, and cars stop at traffic lights. Unfortunately waiting line cannot be eliminated without incurring inordinate expenses. In fact, in order to achieve it is by reduce its adverse impact to tolerable levels.

The study of queues deals with qualifying the phenomenon of waiting in lines using representative measures of performance, such as average queue length, average waiting time in queue, and average facility utilization. The results of queueing analysis can be used in the context of a cost optimization model, where the sum of the costs of offering the service and of waiting is minimized.

### **1.1.2 Elements of a Queuing Model**

The principal actors in a queueing situation are the customer and the server. Customers are generated from a source. On arrival at the facility, they can start service immediately or wait in a queue if the facility is busy. When a facility completes a service, it automatically “pulls” a waiting customer, if any, from the queue. If the queue is empty, the facility becomes idle until a new customer arrives.

From the standpoint of analyzing queues, the arrival process is represented by the inter-arrival time between successive customers, and the service is described by the service time per customer. Generally, the inter-arrival and service times can be probabilistic as in the operation of a post office or deterministic as in the arrival of applicants for a job interviews.

*Queue size* plays a role in the analysis of queues, and it may have a finite size as in the buffer area between two successive machines, or it may be infinite as in mail-order