MODELLING OVERALL EQUIPMENT EFFECTIVENESS IMPROVEMENT WITH OVERALL PRODUCTION COST

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2016

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MODELLING OVERALL EQUIPMENT EFFECTIVENESS IMPROVEMENT WITH OVERALL PRODUCTION COST

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

by

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2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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SESI PENGAJIAN: **2015/16 Semester 2**

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I hereby, declared this report entitled "Modelling Overall Equipment Effectiveness (OEE) Improvement with Overall Production Cost" is the results of my own research except as cited in references.

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Date : 8th June 2016

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) (Hons.). The member of the supervisory is as follow:

……

(PROF. MADYA DR. CHONG KUAN ENG)

ABSTRAK

Kecekapan peralatan secara keseluruhan (OEE) adalah sejenis sistem ukuran untuk mengetahui prestasi peralatan, di mana diperlukan untuk menentukan nisbah pemberat setaraf bagi setiap parameter, walaupun pengurangan dalam setiap elemen adalah berbeza. Oleh itu, tujuan projek penyelidikan ini adalah untuk membina satu model matematik untuk menentukan perbezaan dalam nisbah pemberat bagi setiap faktor OEE untuk mesin THA Taper. Kajian ini memberi tumpuan kepada kadar peningkatan dalam setiap faktor OEE untuk mesin ini supaya dapat mengurangkan kos pengeluaran keseluruhan. Sistem Jumlah Pemantauan Fabrikasi (TFM) dijalankan untuk mengumpul data dari pangkalan data sistem untuk menentukan peratusan OEE semasa untuk mesin tersebut. Di samping itu, data yang dikumpul dianalisis dengan menggunakan alat "Excel" untuk menentukan hubungan bagi setiap data. Analisis ini digunakan untuk mengenal pasti lingkungan nisbah pemberat bagi setiap parameter OEE untuk menjalankan analisis "Forecasting". Melalui analisis "Forecasting" dengan menggunakan cara " Mean Absolute Deviation" (MAD), kumpulan nisbah pemberat yang paling sesuai bagi setiap parameter dengan perbezaan ralat yang paling sikit akan dipilih. Kaedah Rauof telah digunakan untuk membina model matematik dengan merujuk kepada kumpulan nisbah pemberat yang dipilih untuk menentukan nisbah pemberat setiap faktor OEE pada mesin tersebut terhadap kos pengeluaran keseluruhan. Menurut keputusan yang diperolehi, "Availability" (AV) muncul sebagai punca utama kepada peratusan OEE yang rendah dalam mesin ini. Oleh itu, tindakan penambahaikan perlu diberi tumpuan kepada AV supaya meningkatkan peratusan OEE yang tertinggi. Pengeluaran mesin telah dibuktikan berkadar terus dengan OEE dan peningkatan dalam pengeluaran mesin akan mengurangkan kos pengeluaran keseluruhan. Oleh itu, peningkatan dalam OEE dapat mengurangkan kos pengeluaran keseluruhan. Tindakan penambahaikan yang berkaitan dengan mesin THA Taper boleh dicadangkan dengan merujuk kepada model matematik yang dibina.

ABSTRACT

Overall Equipment Effectiveness (OEE) is a system measurement for the total equipment performance, in which requires to specify an equivalent weight setting for every single parameter, even though; each elementary losses are totally different. Hence, the purpose of this research project is to develop a mathematical model to determine the dissimilarity in weighting of each OEE factor for the THA Taper Machine. This study focuses on how much improvement in each OEE factor on the machine is able to reduce the overall production cost. Total Fabrication Monitoring (TFM) system is conducted to collect the data from the system database to determine the current OEE percentage of the machine. In addition, the data collected is analyzed using the Excel tools to determine the relationship of each data. This analysis is then developed to identify the range of weightage for each OEE parameter to be proceed on the Forecasting analysis. Through the Forecasting analysis using Mean Absolute Deviation (MAD), the most suitable weightage for each parameter is determined by selecting the OEE weightage combination with least error. Rauof method is used to develop the mathematical model by referring to selected OEE weightage combination to determine weightage of each OEE factor on the machine to the overall production cost. According to the result obtained, Availability (AV) appears to be the critical cause toward low OEE percentage of the machines and thus improvement action should be focus on AV in order to increase the highest percentage of OEE. Machines throughput was proved to be directly proportional to the OEE and increasing in the throughput will decrease the overall production cost. Hence, the production cost can be reduced as the OEE was improved. Improvement plans related to THA Taper machines can be propose by referring to the mathematical model developed.

DEDICATION

I would like to dedicate my thesis to my beloved parents, Mr. Tam Jiunn Wee and Mdm. Phang Yoke Kim, who made it possible for me to complete this thesis.

Also, to my friends and Mr. Alan Ng Kam Choi for all the help and encouragement.

Thank you for the undivided loves and supports.

ACKNOWLEDGEMENT

Many individuals have sacrificed their time and effort as well as patience to come out with this thesis. First of all, I would like to express my deepest appreciation to PM. Dr. Chong Kuan Eng as my project supervisor for his supervision, enthusiastic helps and guidance in this report. I offer my sincere appreciation to him for every suggestion provided and guiding me throughout the course of this research endeavour. This study would not have been possible without the helps and supports from him.

Besides that, I would like to express my gratitude towards the Discrete Department staff at Semiconductor Company especially to Mr. Alan Ng Kam Choi who has piloted me for my final year project. Last but definitely not the least, I wish to thank all my parents and friends for their kind co-operation, understanding, support, and encouragement which has made the completion of my Degrees study possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

AFC	-	Average Fixed Cost
Al	-	Aluminium
AM	-	Autonomous Maintenance
AT	-	Actual Throughput
Au	-	Gold
AV	-	Availability
DPMO	-	Defect per Million Opportunities
DTFS	-	Deflash/Trim/Form/Singulation
DUT	-	Device Under Test
EOL	-	End of Line
EPT	-	Equipment Performance Tracking
FOL	-	Front of Line
JPIM	-	Japan Institute of Plant Maintenance
MAD	-	Mean Absolute Deviation
MAPE	-	Mean Absolute Percent Error
MSE	-	Mean Squared Error
OEE	-	Overall Equipment Effectiveness
PM	-	Planned Maintenance
POT	-	Plant Operating Time
PP	-	Performance
QC	-	Quality Control
QM	-	Quality Maintenance
ROC	-	Rank-Order Centroid

SMED	-	Single Minute Exchange of Die
SOT	-	Scheduled Operating Time
SPC	-	Statistical Process Control
TFC	-	Total Fixed Cost
TFM	-	Total Fabrication Monitoring
THA	-	Test Handler Assembly
TPM	-	Total Productive Maintenance
TPR	-	Theoretical Processing Rate
TSNP	-	Thin Small Non Leaded Package
YIELD	-	Quality
ZF	-	Zero Fail

CHAPTER 1

INTRODUCTION

This chapter basically start with introducing the background of study and company background. It is followed by the problem statement of Research Company. The objectives, scope and significance of study are discussed in the succeeding segment. At the end of this chapter, the organization of the report is stated to briefly explain the content of each following chapter.

1.1 Background of Study

Nowadays trends and markets lead companies to be more and more competitive. To reach the best level of competitiveness, general productivity always needs to be improved within a company. Yet, the ideal solution is to increase the efficiency of overall production cost in the company. Overall production cost is a cost incurred by a business when manufacturing a good or producing a service. It includes both fixed and variable costs for operating a business. Fixed costs are those expenses that tend to remain the same regardless of changes in the production output. Whereas, variable cost are vary depending on the company production output, that is, it increase when the production volume increase or vice versa. Identification of the causes for the loss in overall production cost can be done by apply work measurement methods on the system. Work measurement has been around for decades, but it is still a very important tool to identify where improvements are needed.

According to Hamlin (1978), he stated that “Before any improvement can be made, it is essential that the present status be known. As improvements are suggested and evaluated, there must be a base for comparison.” (Nakajima, 1988) developed the Total Productive Maintenance (TPM) for the goal to provide a continuous and overall improvement in equipment. TPM is not just a maintenance program, moreover, an equipment management program. The concept of continuous, total quality improvement and employee empowerment are combined and promoted in TPM.

It is not an uncommon thing for managers, engineers or even operators to be constantly finding ways for improvements at this time and Overall Equipment Efficiency (OEE) is the key measure used in production operations to indicate the efficiency of a system. Nakajima (1988) developed OEE as a hierarchy of metric to evaluate how effectively the manufacturing operation is utilized. It encourages ingenuousness in sharing of information and sources where it leads to maximization of performance in terms of speed, availability in terms of uptime and yield in terms of quality. The best idea of implementing OEE in the operation is that it generally allows comparison between processes across plants, divisions, offices and companies. Some sort of work measurement such as the time study and Single Minute Exchange of Die (SMED) must be employed in order to measure the performance with OEE. The causes of failure that prevents the equipment to perform its required function will be identified. In turn, suggestions are devised to improve the efficiency of the system.

1.2 Company Background

This study is based on the semiconductor company which offers semiconductor and system solutions addressing three central challenges to modern society which are energy efficiency, mobility and security. The company is located in Batu Berendam Free Trade Zone, Melaka and has become the largest backend manufacturing site with accumulative investments of more than RM 6 billion. This company has been start operated in 1973 and continuous growing its operation through different methods such as enlarging the manufacturing facilities, test-equipment and adding new products. At present, it is the largest manufacturing sites of the semiconductor assembling and testing. The vision and mission of the company is to shape the microelectronics by creating innovative products, leading edge solution and benefit and provide opportunity to the best talent worldwide in order to offer the best value to the customer and shareholders. Besides that, the company has been constantly enlarging its operations and expanding its manufacturing facilities by investing in state-of-art technologies and adding new product lines to meet customer's demand for its product.

This study is focusing on the Discrete Department in the semiconductor company. For the Discrete Department, it inspect and carry out the testing on the semiconductors components for the automotive and industrial sector. There are total of 14 taper machine available in the Discrete Department. The 14 taper machine is the most expensive machine that can be found in the company. The chips are the main products testing in this department. Only the good quality chips can proceed to next step of manufacturing while the unwanted or scrap chips are send for rework depending on its level of defects. The chips will then undergoes further process to be produce the products such as microcontrollers, sensors and discrete semiconductor for automotive applications.

1.3 Problem Statement

The benchmark of world class to be established for a typical manufacturing capability is to achieving at least 85% OEE standard (Wang and Lee, 2001). Each company may require different equipment in computing OEE due the level of accuracy and the data collection ability. In order to improving the OEE standard, the root causes that drop the OEE percentage must be found and eliminated by effective method. The current problem found is the low OEE percentage (approximately 70% OEE) on the production line especially in the Test Handler Assembly (THA) Taper machine which are not able to achieve the 85% OEE standard. The cost of products is high and the company wants to reduce the production cost in order to be more competitive in the market. However, there is no direct measures on how much improvement in each OEE factor in the THA Taper machine is able to reduce the overall production cost. Hence, the weightage of each of the OEE factor (Availability, Performance Efficiency and Quality) of the machine to the overall production cost need to be determined.

1.4 Objectives of Study

The purpose of this study is to develop a model to determine the influence of each parameter in the OEE to the THA Taper machine on the overall production cost. The aims that are needed to achieve include:

a) To understand the Thin Small Non Leaded Package (TSNP) manufacturing processes and Taper machine process flow.
b) To collect the data for each OEE parameter of the machine and analyze the data.
c) To develop a mathematical model to determine the weightage of each OEE factor on the machine and propose improvement on the machine to reduce the production cost.

1.5 Scope and Limitation of Study

This study mainly focused on the improvement of Overall Equipment Effectiveness of the testing machine on the overall production cost. The execution of this study only cover on the THA Taper Machine located at Discrete Department. The product studied is the Thin Small Non Leaded Package (TSNP). The data is collected from the system database using the Total Fabrication Monitoring (TFM) system in order to measure and evaluate the system for whole production and provides a detail overview of the equipment efficiency to the users. The scope of this study starts from the observation of the whole processes and then narrows down on testing process to conduct the time study for calculating the OEE percentage. The current state analysis is conducted using excel tool as a baseline to demonstrate the status of operation with the graph. Raouf method is used to develop the mathematical model to determine weightage of each OEE factor on the machine to the overall production cost. The most crucial parameter will be set as the target of improvement to increase the highest percentage of OEE. The improvement plans can be propose by refer to the model developed in order to reduce the overall production cost.

1.6 Significance of Study

This study aims to reduce the overall production cost of the semiconductor company based on the OEE improvement models. Through this study, the weightage between the availability, performance efficiency and quality of the THA Taper machine on the overall production cost can be identify. Yet, the semiconductor company can be more competitive by offering great quality product with low production cost.

Moreover, this study can be used as future reference and research for the academicians and also provide some potential benefits to the semiconductor manufacturing company. The engineers able to focus on the model developed to determine which parameter is the most crucial problem to be solve. The solution methods from this study will be deliver to