UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF OVERALL PERFORMANCE EFFECTIVENESS (OPE) AT THE SEMICONDUCTOR INDUSTRY: A CASE STUDY

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

by

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2016

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.). The member of the supervisory is as follow:

……

(Ir. PM. Dr. Puvanasvaran A/L A. Perumal)

DECLARATION

I hereby, declared this report entitled "Development of Overall Performance Effectiveness (OPE) at the Semiconductor Industry: A Case Study" is the result of my own research except as cited in the references.

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ABSTRAK

Overall Performance Effectiveness (OPE) telah digunakan untuk mencari dan mengenalpasti prestasi operator ketika mereka sedang bekerja atau melakukan sesuatu tugasan. Dengan mengenalpasti nilai OPE, prestasi operator dapat dianalisis dan juga sedikit tindakan serta cadangan boleh diberi. Di dalam projek ini, subjek utamanya ialah Mesin Honing 9 dimana kajian masa dengan menggunakan jam randik. Pemerhatian telah dilakukan di proses honing bagi megenalpasti aliran proses dan juga kerugian di stesen tersebut. Kajian masa telah dijalankan bagi mengumpulkan data-data yang berkaitan dengan OPE. Selepas kajian masa telah dilakukan, waktu standard di proses honing telah dikira dan juga telah menghasilkan sebuah jadual standard gabungan kerja. OPE boleh dikira dengan mendapatkan ketersediaan, prestasi dan juga kualiti operator di kawasan proses honing. Ketersediaan ialah apabila seorang operator boleh bekerja dengan menghasilkan produk. Bagi prestasi pula, nilai ini boleh diambil dari nombor sebenar pengeluaran operator dibahagi dengan nilai target setiap hari. Kualiti ialah nombor produk yang telah dihasilkan oleh operator. Keputusan menujukkan bnilai tertinggi OPE yang tertinggi ialah 70.84% pada minggu kedua pengumpulan data dan jumlah OPE yang paling rendah ialah 74.96% iaitu ketika minggu kedua. Di akhir projek ini, ketiga-tiga faktor OPE telah dianalisis. Cadangan bagi penyelidikan projek OPE ialah mengaplikasikan OPE ke atas semua mesin di bahagian honing.

ABSTRACT

Overall Performance Effectiveness (OPE) is used to identify and determine the performance of the operators during do their work or job tasks. By determine the value of OPE, the performance of the operators can be analyze and then some corrective action or recommendations can be suggested. In this project, the subject of study is the Honing process and it is focused on the Honing Machine 9 where the time study using direct stopwatch is conducted. The observation is done at the honing process to identify the process flow and also the losses at the section. The time study is conducted to collect the data that is related to the OPE. After time study is conducted, the standard time of the honing process is calculated and also the standardization work combination table can be developed. The OPE can be computed by obtaining the availability, performance and also the quality ratio of the honing process operators. The availability is the time operators working productively over the time scheduled. For the performance ratio, the value can be gained from the number of actual output of the operators over the expected output or their labor standard. Lastly, the quality is the number of good parts over the total parts produced by the operators. The result shows the highest OPE is during Week 3 which is 74.96% and the lowest OPE is on Week 2 which is 70.84%. At the end of the project, the three factors of the OPE are analyzed. Further study of the project the OPE is suggested to be continue at the Honing Machine 9 and also implemented the OPE to all the honing machines at the company.

DEDICATION

For the person that I love the most,

Muhammad Nor bin Talib

Razimah binti Ali

Noni

ACKNOWLEDGEMENT

I would like to thank Maruwa (M) Sdn. Bhd. and the manager, Mr. Maran, for the acceptance as an industrial part-timer. The opportunity provided enables author to gain knowledge beyond the book in university, and a chance to apply the knowledge that I have learned into the real working environment in the manufacturing industry. The experience that I have gain during the industrial training is the valuable asset to be well prepared for engineering life in the future.

Besides that, I would like to thank the engineers from the honing sections and also the supervisor and the operators that involved in my case study. The engineers had taught useful guidance during the observation and also during the data collection. Without the help from the honing process team, the OPE determination wouldn't be finished successfully.

Nevertheless, I would like to thank my academic supervisor, IR PM DR Puvanasvaran, for the knowledge and also the guidance that have been taught. Many efforts also have been invested by him in concerning and solving some communication problems happen during the determination of OPE at the company. At last, I would like to thank other colleagues for willing to show help. It is really helpful especially when there had problem faced in the company and also during the report writing.

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CT	-	Cycle Time
NVA	-	Non Value Added
OPE	-	Overall Performance Effectiveness

CHAPTER 1
INTRODUCTION

1.1 Background of Study

Productivity according to Roghanian et al. (2012) is an important success factor of an organizational operation in the global and also competitive situations (Hodgetts & Kuratko, 1998; Nachum, 1999). Productivity also became the major area for operational and process management (Sink, Tuttle & Shin, 1989). Simply put, productivity is the production effectiveness where how much output is gained from a set of input. In other words, productivity also measures relationship between the output such as product, service produce and the input including labor, material, capital and another resource (Hill, 1993). In addition, two types of productivity can be measured which is labour productivity where the output is measured in the term of hour and total productivity factor where it is including the cost of labor, material and cost of equipment (Gunasekaran & Cecille, 1998). Therefore, productivity can be said as;

$$\text{Productivity} = \text{Output}/\text{Input}$$

Labor should keep their productivity high in order to survive in the global market and stay competitive (Razak et al., 2014). It is essential for any organization to study and identify the factors that directly affect the productivity of labor and take appropriate action to improve the productivity of labor (Attar et. al, 2014). One of the important factors to increase labor productivity is motivation. Motivation can be defines as the people reaction or behaviour in a certain situation (Joyce Essel, 2012; Razak et al., 2014). Motivation is a type of force which can energize people to

achieve goals. Every organization either public or private is goal oriented organization and all the efforts are push towards the successful of their goals and objectives. Employee can be motivated when they are excited and interested in their jobs. Some activities that can gain interest of workers are training programs, opportunities for outside education, contest, congratulatory messages from the top management and also the employee participation committees. Therefore, the relationship between the productivity and motivation can be said that the productivity is directly linked to motivation and but motivation is dependent on the productivity (Kalburgi & G.P., 2010).

According to Singh & Mohanty (2012), it is important to have the correct employee at the correct job with the right qualification and also experience because companies today are forced to function in a world full of change and under various complications in order to survive in the competition. The successful of an organization is based on the skill, experience and knowledge of the workforce. Because of this, training becomes a fundamental and effectual instrument to achieve objective and goal of the company. From training, it gives the employee chances to learn their job virtually and also improves themselves practically so that they can perform the job perfectly and then increase the productivity of company. Training can increase the efficiency and effectiveness of both employee and the organization as it become the most important factor in the business world (Khan et al. 2011).

Moreover, Bui Trung Kien (2012) and Razak et al. (2014) stated that the important elements in management that can affect the labor productivity are including the lack of labor inspection, poor relation between labor and their supervisor and also bad leadership skill. Thus, productivity improvement should be viewed as an organization-wide effort where all the employees of the organization need to help improve each activity of the organization (Hoffman & Mehra, 1999).

1.2 Problem Statement

Time passed by and we become more globalize. Fiouz Fallahi et al. (2011) in their study stated that labor productivity has become the determining factor in the industrial products competitiveness and also the industries profitability in the domestic and foreign markets due to the increasing of the globalization and also the competition in the industrial product market. Problems to increase productivity have long been a concern of researchers (Soekiman et al., 2011). According to Razak et al. (2014), Attar et al. (2014), in their study they stated that the factors that can affect the productivity are improper training, organization factors, working time factor, supervision factor, lack of skill, poor instructions, labor shortage and poor quality of labor.

From Figure 1.1, it shows that the monthly yield percentage of the production is below the company target which is 95%. Every month, the average production by the operator is below the company target. According to Razak et al. (2014), he stated that in order to survive in the global market and stay competitive labor should keep their productivity high. Based on the graph below, it clearly can be seen that the productivity is low. So, from this problem, it leads to the reason why this study is conducted at Maruwa (M) Sdn. Bhd.

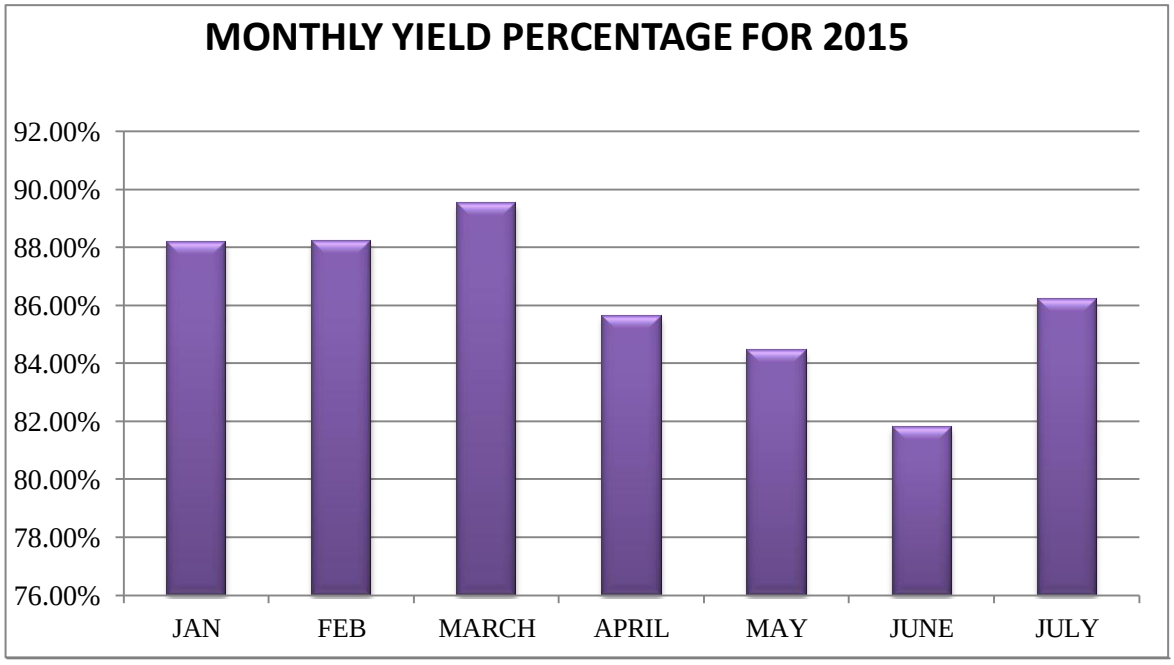

Figure 1.1: Monthly yield percentage for 2015

1.3 Objectives

The objectives of this study are:

a) To identify the Six Big Losses at the Honing Process.
b) To determine the Overall Performance Effectiveness (OPE) of the operator at the Honing Process.

1.4 Scope of Study

This study is focused on the productivity and the employees' performance of Honing Process. Besides that, this study is only focused on the performance of the employees and not covers the performance of the machine at the Honing Process. This study is carried out at Maruwa (M) Sdn. Bhd. located in Batu Berendam, Melaka. In order to identify the Six Big Losses at the Honing Process, the data would be collected and then the Overall Performance Effectiveness (OPE) is calculated based on the data

collected. All the data collection, analysis and evaluation would be done in PSM II. This case study is only conducted at the Honing Machine 9 and only focused on the morning shift of working day. The data collection for four weeks would be done for availability loss only as for performance and quality loss the data is from the historical data.

1.5 Significant of Study

The intense competition today forces the organization to study how they can improve the productivity of company. Productivity is an important factor in every organisation because loss and profit of company depend on the labor productivity for example how productively an employee works (Maartje Maarleveld & Iris de Been, 2011). Pekuri et al. (2011) in their study stressed that productivity is important to the competitiveness and world prosperity so productivity has been an interest since the beginning of industrialization. Productivity can be probably one of the important basic variables governing economic production activities (Singh et al., 2000; Tangen, 2005). Furthermore, study have shown that productivity is important for an organization so that the organization is more competitive, achieve goal and meet stakeholder value propositions and maintain their strategic and financial health (Bui Trung Kien 2012). Hence, to improve the efficiency, it is very necessary to understand the factors that can affect the fluctuation of labor productivity (Razak et al., 2014).

1.6 Summary

In a nutshell, this chapter is introducing the background and the objectives of the study that would be conducted at Maruwa (M) Sdn. Bhd. Besides that, the problem statement and also the scope of the study would be clarified in order to limit the range of study. Moreover, the significance of this study also would be discussed in this chapter. The following chapters consist of the literature review and knowledge needed for the study and the methodology used for the whole project.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter is primarily covering the general information and historical data of the project which have been done previously, either the research by educational institutes or the similar implementation of OPE in manufacturing industries or related field. All of the information and data included in this chapter serve as the guideline in designing and planning of the project completion. Besides that, all of these are used to support the result and discussion obtained in PSM 2.

2.2 Overall Performance Effectiveness (OPE)

OPE is the Total Productive Maintenance (TPM) that is normally used in the manufacturing to analyze the people/process performance. OPE stands for Overall Performance Efficiency.

OPE indicates how effective People/Processes are running and it provides a tool to base improvement efforts in support of business objectives (Roa, 2011). According to Shye-Nee Low et al. (2014) OPE is the developed performance measurement, that originated from the concept of overall effectiveness equipment (OEE). The OPE is extended the OEE (Overall Equipment Effectiveness) principal, an important measure of TPM (Productivity Press Development Team, 1999). Like OEE, the OPE depends on a worker's:

a. Availability, during working hours,
b. Performance efficiency, and
c. Quality of the product produced

The above factors of OPE are affected by different factors making OPE to vary from a desired level. When the overall worker effectiveness is at its peak level, this level could be achieved by the overall output (performance and quality) of a worker. However, OPE of a worker hardly is at this level since he/she is affected by a variety of factors (Soragaon et al., 2010).

2.2.1 Factors of OPE

The common OEE factors which are availability, performance, and quality are the basic elements used in measuring operator effectiveness. But in measuring the contributions human beings make, it is useful to look deeper and consider additional factors (Kronos Incorporated, 2007). Thus, for OPE the factors are availability, performance and quality. These three factors are explained in below.

2.2.1.1 Availability

Soragaon et al. (2012) stated that availability is the actual time a worker spends to do their work out of the total time in a shift. A worker may not be available on work, sometimes, because of specific reasons, which can causes his availability efficiency decrease. A worker who remains absent beyond these allowed limits will be treated as non-available during working hours, and the time of non-availability is noted down.

$$\text{Availability} = \frac{\text{Time operators are working productively}}{\text{Time scheduled}}$$

According to Kronos Incorporated in 2007, availability is a basic measure, and utilization is the most important component of availability. There are many things that affect workforce availability, and also the potential output of equipment and the plant. For example:

a) Absenteeism and utilization: Standard labor utilization measures which include the times when worker are unavailable due to meetings, training aor other company activity, employee illness and approved or unapproved leaves.

b) Scheduling: Involves the worker having the right skill at the right time. Beyond simply providing a worker, the worker skills and experience, as weel as their working schedules need to be considered.

c) Indirect time: Includes the machine downtime, materials delay, shift changeover and idle time.

2.2.1.2 Performance

Kronos Incorporated stated in their paper published in 2007 that performance is the measurement of output, which determines whether delivering or producing a service or product took as long as company labor standards indicated it would (whether tangible units are manufactured or specific services are delivered). Performance output includes:

a) Availability of materials, processes, tools and instructions: Shop floor issues such as misplaced or worn tools, missing processes or instructions, or material shortages, will slow the production and limit the output. Hence, likely have a negative impact on quality.

b) Training and skills: Employees need to know how to do the tasks they are assigned. Definitely these factors will affect the ability of worker to deliver the expected output throughout a complete shift.

c) Indirect support staff: A workforce that is not well trained or skilled will require the additional support staff, including maintenance technicians, quality assurance personnel and supervisors.

$$\text{Performance} = \frac{\text{Actual output of the operators}}{\text{The expected output}}$$

In addition, performance is the rate of output of a worker. That is, the number of component parts/products turned out by the worker to the total number fixed to him. A variation in this value from the peak may occur because of specific factors affecting worker (Soragaon et al., 2012).

2.2.1.3 Quality

Soragaon et al. (2012) stated in their research paper that quality is the number of good product produced to the total number of product need to be produced by the worker. In other words, the number of component parts/products produced by a worker that meets the specification limits to the total number produced by him in a specified time period. Again, quality factor calculated in percentage is computed by multiplying the ratio of the accepted output product to the total output from a worker with 100. Output product that produced right the first time is considered as the accepted output. Mathematically,

$$\text{Quality} = \frac{\text{Good parts}}{\text{Total parts produced}}$$

Kronos Incorporated stated in their published paper in 2007 that at the end of the day, the important thing need to know is if the output of production met specified quality levels. While quality is certainly a function of the materials used, it is impacted by a few human factors:

a) Employee knowledge: Employees need to understand the quality drivers of their specific operations. This is because; employee skills directly affect the quality of the output. Knowledgeable operators know when to stop production for corrective actions, should quality fall below specified limits. Besides that, they also know how to measure their work and understand how the processes operate, what adjustments keep processes to spec as they run and how variability can affects the quality. Applying this type of knowledge, it can decrease the amount of wasted product and cuts scrap.

b) Proper use of instructions and tools: Whether the workers use the right tools and follow the right procedures (SOP).

2.2.2 Advantages of OPE

Using OPE concepts provides a real-time method of recognizing the cumulative effect of workforce variables. It gives managers hard data to diagnose, correct, and improve the financial performance of manufacturing operations. Just as worker influence performance throughout the operation, OPE data can quantify the effects of their actions. OPE addresses smaller details, such as on-time performance, and answers larger questions, such as whether a training budget is justified. Three things will power the competitive advantage of the manufacturers:

a) A stream of innovative products that attract customers
b) Highly flexible and effective supply chains
c) An effective and highly motivated workforce

OPE helps manufacturers to develop an effective and highly motivated workforce by helping them to identify where people need better training, processes, materials, or indirect support. It is a productivity tool for managers that can help them to manage better as they convert labor dollars into profits.

2.3 Time Study

Time standards of a process can be defined as the time required to produce a product at a work station with the following three conditions stated as below (Meyers, 2002):

a) A well-trained and qualified worker or operator

Experience is normally what makes a well-trained and qualified operator and time the operator performs the work is the best sign of experience. The time needed to become a qualified operator or worker varies with the job and the person itself. The biggest mistake that usually made by a new time study personnel is time-studying someone too early. A good rule of thumb is to start with a well-trained and qualified worker and to give that person two weeks on the job prior to the time study. For new job or task, predetermined time study systems are used. This standard seems hard to achieve at the first place because the time is set for well-trained and qualified worker.

b) Standard working speed

For each job or task, only one time standards can be used despite the fact that individual differences between the workers can cause various results.

c) A specific task or job

It is a detail explanation of what must be completed or finished. The explanation must include material specification, the tools and equipment being used, the prescribed work method, the positions of incoming and outgoing material and some extra requirement such as quality, safety, maintenance tasks and housekeeping.

Meyers (2002) also stated that time study can be defined as the work measurement which involved the technique of establishing the time standard to perform a given task/job. It is based on work content measurement of the prescribed method and also the allowance for fatigue, personal or unavoidable delays. Establishes time values are