



**OPTIMIZE PRODUCTIVITY THROUGH  
OVERALL EQUIPMENT EFFECTIVENESS  
AT FOOD AND BEVERAGE INDUSTRY**



**BACHELOR OF MANUFACTURING ENGINEERING  
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**Faculty of Mechanical and Manufacturing Engineering  
Technology**



**Rajadorai A/L Raju@Dorairaju**

**Bachelor of Manufacturing Engineering Technology with Honours**

**2021**

**OPTIMIZE PRODUCTIVITY THROUGH  
OVERALL EQUIPMENT EFFECTIVENESS  
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**RAJADORAI A/L RAJU@DORAIRAJU**



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2021**

## DECLARATION

I declare that this thesis entitled “Optimize Productivity Through Overall Equipment Effectiveness at Food and Beverage Industry” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature

:



Name

:

RAJADORAI A/L RAJU@DORAIRAJU

Date

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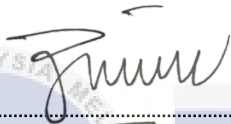
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## APPROVAL

I hereby declare that I have checked this thesis, and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology with Honours.

Signature :  :  
Supervisor Name : Ts. Dr. Amir Hamzah Bin Abdul Rasib  
Date : \_\_\_\_\_

TS. DR. AMIR HAMZAH BIN ABDUL RASIB  
Pensyarah Kanan  
Jabatan Teknologi Kejuruteraan Pembuatan  
akademi Teknologi Kejuruteraan Mekanikal dan Pembuatan  
Universiti Teknikal Malaysia Melaka

اونيورسيتي تيكنيكل مليسيا ملاك

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## DEDICATION

This dissertation is dedicated to my beloved parents, my supervisor and those who are unwavering affection, guidance and encouragement have enriched my soul and driven me to undertake and complete this work.



## ABSTRACT

In the era of Industrial Revolution 4.0, manufacturing sector should be able to meet up global market demand with assurance of consistence in producing quality product. Therefore, to maintain a smooth production the equipment effectiveness should be considered for better productivity in every manufacturing including Food and Beverages. Problem statement is used to define the problems of the study and can be used to determine the goal of completing the study. For an optimized productivity, the objective of the study should be start by identifying the factors that effects the production productivity in the manufacturing sector The Overall Equipment Effectiveness, OEE is one of the most effective tools that can be used to measure the performance of the equipment. This implements the second objective which is measuring the equipment's effectiveness using OEE. OEE can identify the performance, availability and quality of product produced by equipment. Hence, this determine the hidden losses that are found during manufacturing. Identification of losses leads to propose for improvement in equipment. Using OEE's evaluation, can suggest improvement for better equipment effectiveness. Besides objective there are other tools required to complete the study. Next, the data collection plays an important role of completing the study. The data collection is done using interviews, capturing image, literature review, and arranging given company data in spreadsheet for formulation and calculation. Next, the analysis is conducted using collected data. Evaluating availability, performance and quality determines the OEE's rate. These determines most effected element based on OEE evaluation and will be used for proposing improvement. These proposals are discussed with the industrial representative at the same time presenting the research to them for evaluation.

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## **ABSTRAK**

*Dalam era Revolusi Perindustrian 4.0, sektor pembuatan seharusnya mampu memenuhi permintaan pasaran global dengan jaminan konsisten dalam menghasilkan produk berkualiti. Oleh itu, untuk mengekalkan pengeluaran yang lancar keberkesanan peralatan harus dipertimbangkan untuk produktiviti yang lebih baik dalam setiap pembuatan termasuk Makanan dan Minuman. Pernyataan masalah digunakan untuk mentakrifkan masalah kajian dan boleh digunakan untuk menentukan matlamat menyiapkan kajian. Untuk produktiviti yang dioptimumkan, objektif kajian hendaklah dimulakan dengan mengenal pasti faktor-faktor yang mempengaruhi produktiviti pengeluaran dalam sektor pembuatan Keberkesanan Peralatan Keseluruhan, OEE adalah salah satu alat paling berkesan yang boleh digunakan untuk mengukur prestasi peralatan. . Ini melaksanakan objektif kedua iaitu mengukur keberkesanan peralatan menggunakan OEE. OEE boleh mengenal pasti prestasi, ketersediaan dan kualiti produk yang dihasilkan oleh peralatan. Oleh itu, ini menentukan kerugian tersembunyi yang ditemui semasa pembuatan. Pengenalpastian kerugian membawa kepada cadangan untuk penambahbaikan dalam peralatan. Menggunakan penilaian OEE, boleh mencadangkan penambahbaikan untuk keberkesanan peralatan yang lebih baik. Selain objektif terdapat alat lain yang diperlukan untuk menyelesaikan kajian. Seterusnya, pengumpulan data memainkan peranan penting dalam menyiapkan kajian. Pengumpulan data dilakukan dengan menggunakan temu bual, menangkap imej, tinjauan literatur, dan menyusun data syarikat yang diberikan dalam hamparan untuk perumusan dan pengiraan. Seterusnya, analisis dijalankan menggunakan data yang di kumpul. Menilai ketersediaan, prestasi dan kualiti menentukan kadar OEE. Ini menentukan elemen yang paling berkesan berdasarkan penilaian OEE dan akan digunakan untuk mencadangkan penambahbaikan. Cadangan ini dibincangkan dengan wakil industri pada masa yang sama membentangkan penyelidikan kepada mereka untuk dinilai.*

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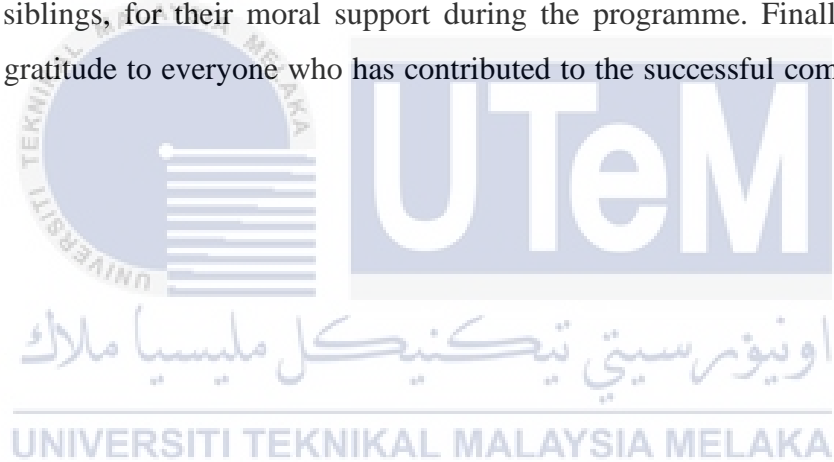


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## LIST OF SYMBOLS AND ABBREVIATIONS

TPM	-	Total Productive Maintenance
OEE	-	Overall Equipment Effectiveness
OOE	-	Overall Operation Effectiveness
SMED	-	Single Minute Die Exchange
TEEP	-	Total Effective Equipment Performance
F&B	-	Food and Beverage



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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

In the era of globalization, the customers are demanding for a high-quality product at the same time requesting it at an affordable price. In today's manufacturing, there are greater complexity and uncertainty due to the upraising globalization of markets and operations with varied consumer expectations and drastic reductions in product lifecycles and manufacturing, P. Dicken (2007). Hence, the global competitive market, manufactures are keen to know various method on manufacturing their product with low production cost with good quality standards. Based on this problem, manufactures are focused on optimizing their production productivity through various performance measuring tools. Based on Ericsson (1997) research, with proper accuracy in performance measure data can lead to a long-term equipment effectiveness. This can be achieved through Total Performance Measure, TPM.

TPM serves as a tool that address hidden cost and unwanted procedures in the manufacturing process. Besides that, TPM also helps in optimization of equipment ensuring the performance, availability and quality is at its best. In supporting to this statement, Fleischer et al, (2006) highlights that availability and productivity of production facilities are important to stay competitive in manufacturing industry. TPM concept was launched by Nakajima (1988) in the 1980s to provides a metric evaluation the equipment performance at the same time highlighting the losses found in it. These identification and measure of losses will support in improving in equipment effectiveness and thereby increasing production

productivity. These measurements can be done using the performance measure tool called Overall Equipment Effectiveness, OEE.

Similarly, to TPM, OEE is used to measure performance of productivity using TPM's identification of losses that is found on the equipment. OEE is becoming a widely popular concept that is used as a quantitative tool which is essential in measuring productivity, Huang et al (2003). Today in industries, the OEE concepts are modified according to requirement but at the same time the basic principles are still being used. For instance, the use of Six Big Losses is still used to categorize the losses that is found on the equipment.

Ericsson and Dahlean (1993) proves that 80% of disturbance occur during production was due to machine down time. In addition to that statement, Suehiro (1992), states that idling and minor stoppages causes 20% to 30% of disruption. Hence to resolve these losses into categories Nakajima (1988) introduces the Six big Losses to categories these losses which later can be used to calculate availability, performance rate and quality. These values are the basic elements to determine the OEE rate. OEE rate determines the standard of equipment performance. Nakajima (1988) suggest that the standards of equipment should possess an availability of 90%, performance rate of 95% and the quality rate at 99% which can result an OEE rate of 85% which is the world standard performance efficiency result. Ljungberg (1998) supports these suggestions by highlighting world class performance assures that idling and minor stoppages can be eliminated which causes a smooth production.

Consequently, the purpose of these study is to ensure an optimized production productivity by enhancing Overall Equipment Effectiveness, OEE in manufacturing industry. It is a achievable process whereby first the losses data are identified, collected and categorized according to the concept of Six Big Losses. Then with the data, availability,

performance rate and quality are calculated. Then these values are used to determine the OEE rate which can determine the standards of equipment effectiveness based on World Class OEE indicator.

## 1.2 Problem Statement

Every manufacturing company aspect a smooth production without any disturbance. To achieve such performance, it is not impossible but requires long time and effort. This is because it requires to collect data from various departments and production lines. Hence with a precision data collection for performance measure of an equipment, production line or the whole plant can be calculated. Nachiappan and Anantharam (2006) claims that it is necessary to incorporate right metric measurement for effective decision making. As mentioned earlier, to compete with global market, manufactures must first know the factors that can affect the production productivity. Once knowing these factors, then the performance measure can be done by using the OEE performance measuring tool. OEE is introduced to manufacturing companies to provide performance measurement of equipment and overall process for better productivity. Similarly, P Gibbons and S Burgess (2010) stated that the enhancement of OEE as a measurement framework in the manufacturing industries provides a good benchmark.

Besides that, both small and large cooperate companies face the problem of identifying root cause of failures found in equipment. This is mainly due to unnecessary procedures causing reduction in performance of equipment. Underperforming equipment leads to increasing the cycle time of production with results in higher production cost. Therefore, TPM can be used as it is one of strong methods to enhance productivity quality at the same time reduce production cost, Mcadam and Duffner (1996). Besides that, the Eight Pillars of TPM allows manufactures to identify root and hidden cause and suggest improvement action for manufacturers for improvement. In addition to this assertion, TPM guarantees the participation of employees from the highest levels of management in

maintenance tasks that maximize available resources and enhance OEE, Campbell and James (2006). We can safely assume that OEE is the best performance measure to determine the equipment effectiveness with the implementation of TPM where it helps in identifying the hidden losses which leads to a reduced production cost and a more optimized and effective productivity.

### 1.3 Research Question

In regarding to the problem statement, there are research question which are identified.

RQ1: What are the factors that effects the production productivity in the manufacturing industry?

RQ2: How to measure the performance of equipment effectiveness during the manufacturing process?

RQ3: How does the Overall Equipment Effectiveness, OEE can improve the equipment effectiveness?

### 1.4 Objective

The main objective of the study is to ensure manufacturing industry to have an optimized production productivity with enhancement of Overall Equipment Effectiveness, OEE. In regarding to primary objective there are several specific objectives that need to be accomplished in this study.

- i) To identify the factors that can affect the production productivity in manufacturing industry.

- ii) To measure the Overall Equipment Effectiveness, OEE of equipment in manufacturing industry.
- iii) To propose action for improvement in the efficiency of equipment in the manufacturing industry.

## **1.5 Scope**

The study first focuses on knowing the factors that can affect the production productivity. Next, the production performance is measured with OEE to know if the equipment is working in optimized and fully utilized condition. The performance measure is done before and after implementing the TPM concept to compare results. This is because TPM able to identify the hidden losses found in equipment and eliminate them to reduce production cost and increase in the production rate. This technique will reduce downtime and unnecessary stoppages proportionally increasing equipment performance and quality rate of product.

## **1.6 Expected Result**

The expected outcome of this study is the factors that affect the performance measure of an equipment can be identified. First, implementation of TPM allows manufacturers to identify the hidden losses, failures and other procedures that contributes to the performance of machine. This is because that, the factors can cause the cycle time for the manufacturing process to increase causing an increase of production cost and not fully utilized machine performance. Hence modified, improvement or elimination of waste should be done on these factors for better performance.

After using TPM, the state of equipment can be determined with the usage of OEE. This is because OEE able to calculate the availability, performance and the quality of a

machine, production line also the overall process itself. Hence, this tool would bring out the best results in determining the performance of equipment. Based on the results, we can compare the performance measure before and after the implementation of TPM. With the results known, the type of losses can be categorized based on the Six Big Loss found in the OEE then improvement can be done to increase its value.

## **1.7 Thesis Frame**

Chapter one focuses on the introduction of the overall thesis's introduction. The introduction part elaborates details of the study. This is followed by the problem statement that is faced in the study. Based on the problem statement, a research question is developed which later allow to develop the objective for this study. Finally, after going through the objective, an expected result is created for the study that is being conducted. As an overall conclusion, a summary is written to tell the whole study in a summarized version.

Next, in chapter two is about the literature review that have been gathered for this study. This chapter allows to gather, read, and understand the previous case studies and journals made which is similar to the title of the study. This chapter tells the information about the factors that affects the performance measure, implementation of TPM into manufacturing, the 8 Pillars of TPM, tools that able to measure performance, introduction of OEE, the 6 Bis Losses of OEE, calculation of OEE and the status of OEE based on worldwide performance guideline. The technique of writing this chapter will be based on the findings in case study, journals and articles that has been done in the past. Hence, many subtopics are made to provide a detail explanation of this study.

Furthermore, chapter three explain the methodology of the study is being conducted. Based on the previous studies being conducted, chapter 3 tells on the tools and technique that is used to conduct the study. The details of the techniques and tools that is used on this