



MEASURING OVERALL EQUIPMENT EFFECTIVENESS OF PRESSURE DIE CASTING MACHINE

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**MASTER OF MANUFACTURING ENGINEERING
(INDUSTRIAL ENGINEERING)**

2019

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JIGA (INDUSTRIAL ENGINEERING)**

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Faculty of Manufacturing Engineering

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ELNIE CARINA ANAK JIGA

**A thesis submitted
in fulfillment of the requirement for the degree of Master of
Manufacturing Engineering (Industrial Engineering)**

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2019

DECLARATION

I declare that this thesis entitles “Measuring Overall Equipment Effectiveness of Pressure Die Casting Machine” 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 :

Date :

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment Master of Manufacturing Engineering (Industrial Engineering).

Signature :

Supervisor Name :

Date :

DEDICATION

Only

My beloved father, Jiga anak Jerai

My appreciated mother, Radang anak Madek,

My adorable brother and sisters,

Iviana Anak Jiga

Effaryna Anak Jiga

Delfio Anak Jiga

My supportive friends,

For giving me moral support, money, cooperation, encouragement and also understandings.

Thank you so much and love you all forever

ABSTRACT

This project focused on measuring the Overall Equipment Effectiveness (OEE) of pressure die casting in one of the casting company in Malacca. In manufacturing environments, OEE has become the foundation in improving the business strategy since it identifies the direct and 'hidden' productivity and quality costs which refer to the production lost. For the past 100 years, the manufacturing sector has become an incredible contribution to the global economic growth and it has a wide acknowledgement in the area of poverty mitigation. Thus, manufacturing company needs to increase their productivity for them to survive and to attain breakthrough. Productivity is mostly affected by the losses in terms of materials, machines or equipment. Thus, implementation of OEE will help in identifying the potential losses and the process which is falling off. Besides, by using OEE, the big picture of the problem and the details surrounding the problems can be answered. The casting company in which the project is held did not have their own OEE data since, they do not know on how to implement OEE. Therefore, the aims of this project are to measure the value of Overall Equipment Effectiveness of pressure die casting machine, to analyze the problems which lead to decrease in effectiveness through Six Big Losses and to enhance the machine effectiveness through recommended solution. The scope of this project includes the five pressure die casting machine, the data for the OEE value calculation, the problem which contributes to the decreased in effectiveness and the recommended solution to countermeasure the problem. To measure the value of OEE, data are collected by using time study. These data are then calculated using OEE formula and then, compared with the world class value. Then, the problems are identified by using Pareto Chart. The problems identified from Pareto Chart are then group into the categories in Fishbone Diagram. The problems are then analyzed further using Why-Why Because Logical Analysis (WWBLA) to identify the root causes and countermeasure for the problems. From the result, it can be known that the OEE value for each pressure die casting machine is still below the world class value which is 85%. From the problems identified using Pareto Chart, it is found that the countermeasure for the problem can be concluded by making a working list for daily cleaning and maintenance. Using the working list of the daily cleaning and maintenance, the task executed can be tracked.

ABSTRAK

Projek ini berfokuskan kepada pengukuran Kecekapan Peralatan Secara Keseluruhan (OEE) pada mesin tuangan acuan tekanan di salah sebuah syarikat tuangan di Melaka. Dalam persekitaran pembuatan. OEE telah menjadi asas dalam meningkatkan strategi perniagaan kerana ia mengenal pasti produktiviti dan kos kualiti langsung dan tersembunyi yang merujuk kepada kerugian dalam pengeluaran. Sejak 100 tahun yang lalu, sektor perkilangan telah menjadi penyumbang utama kepada pertumbuhan ekonomi dan ia mendapat pengiktirafan yang meluas dalam menangani kemiskinan. Oleh itu, syarikat pembuatan perlu meningkatkan produktiviti mereka untuk membolehkan mereka bertahan dan memperoleh kejayaan. Produktiviti selalunya dipengaruhi oleh kekurangan dari segi bahan, mesin atau peralatan. Oleh itu, pelaksanaan OEE akan membantu dalam mengenal pasti potensi kerugian dan proses yang bermasalah. Selain itu, dengan menggunakan OEE, gambaran besar tentang masalah dan butiran berkaitan masalah boleh diselesaikan. Syarikat tuangan tempat projek ini dijalankan tidak mempunyai data OEE mereka sendiri disebabkan mereka tidak tahu bagaimana untuk melaksanakan OEE. Oleh itu, projek ini bertujuan untuk mengukur nilai Kecekapan Peralatan Secara Keseluruhan mesin tuangan acuan tekanan, untuk menganalisis masalah-masalah yang menyebabkan penurunan keberkesanan melalui “Six Big Losses” dan mencadangkan penyelesaian untuk meningkatkan keberkesanan mesin. Skop projek ini adalah pada lima mesin tuangan acuan tekanan, data untuk pengiraan nilai OEE, masalah yang menyumbang kepada penurunan keberkesanan dan cadangan penyelesaian untuk mengatasi masalah tersebut. Untuk mengukur nilai OEE, data dikumpulkan dengan menggunakan kajian masa. Data-data ini kemudiannya dikira menggunakan formula OEE dan kemudian, perbandingan dengan kelas dunia dilakukan. Kemudian, masalah dikenal pasti menggunakan carta Pareto. Masalah yang dikenal pasti dari carta Pareto kemudiannya dikelompokkan ke dalam kategori menggunakan rajah “Fishbone”. Masalah ini kemudiannya dianalisis dengan menggunakan “Why-Why Because Logical Analysis” (WWBLA) untuk mengenal pasti punca-punca dan penyelesaiannya. Dapatan menunjukkan bahawa nilai OEE untuk setiap mesin tuangan acuan tekanan masih berada di bawah nilai kelas dunia iaitu 85%. Melalui permasalahan yang dikenal pasti menggunakan carta Pareto, dapat disimpulkan dengan menyediakan senarai kerja pembersihan harian dan penyelenggaraan. Dengan menggunakan senarai kerja pembersihan harian dan penyelenggaraan, tugas yang dilaksanakan dapat dikesan.

ACKNOWLEDGEMENTS

First of all, I would like to take this opportunity to express my sincere acknowledgement to my respected supervisor, Associate Professor Ts. Dr. Effendi bin Mohammad from the Faculty of Manufacturing Engineering Universiti Teknikal Malaysia Melaka (UTeM) for the great mentoring, unwavering patience and the kindness that was given to me to complete the project. His easy to understand explanations help me to grow and learn on how to become a researcher now.

Secondly, I would like to give my heartiest and thousand thanks to Tuan Syed, CEO of the pressure die casting company for allowing us to do our project at the company. Besides, I also would like to thank Mr. Shanizam my supervisor at the company for always willing to lend a helping hand during my project by his endless patience due to any of my confusion about this project.

Last but not least, I would like to give special thanks to all my friends, my postgraduate team mates under Associate Professor Ts. Dr. Effendi bin Mohammad, my classmates, operators and supervisors of pressure die casting and every single person who gave me much motivation and cooperation mentally in completing this report. They had given their critical suggestion and comments throughout my project. Thanks for the great friendship.

Finally, I would like to thank everybody who was important to this Master Project (MP) report, as well as expressing my apology that I could not mention personally each one of you.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
TPM	Total Productive Maintenance
OEE	Overall Equipment Effectiveness
AM	Autonomous Maintenance
OFE	Overall Factory Effectiveness
OPE	Overall Plant Effectiveness
OTE	Overall Throughput Effectiveness
PEE	Production Equipment Effectiveness
OAE	Overall Asset Effectiveness
TEEP	Total Equipment Effectiveness Performance
PMTS	Predetermined Motion Time System (PMTS)
MOST	Maynard's Operation Sequencing Technique
WWBLA	Why-Why Because Logical Analysis
GF	Go Forward
NF	No Forward
IEE	Institute of Electrical and Electronics Engineers
PDC	Pressure Die Casting

CHAPTER 1

INTRODUCTION

1.1 Research Background

In the fourth quarter of 2018, Malaysia's economy as a whole grew at 4.7% with the current price of Gross Domestic Product (GDP) value at RM1.43 trillion and constant price at RM1.23 (Department of Statistics Malaysia, 2019). GDP is the most important variable in analyzing the economic growth since it consist of the key summary statistics of economic activity (Konchitchki and Patatoukas, 2014).

GDP consists of five types of economic sectors, namely services, manufacturing, construction, mining and quarrying and agriculture. Figure 1.1 shows the growth rate for each of economic sectors in the fourth quarter of 2018. All of the economic sectors show positive growth rate except for agriculture. At the same time, it can be seen that services and manufacturing contribute the most in the economic growth (Department of Statistics Malaysia, 2019).

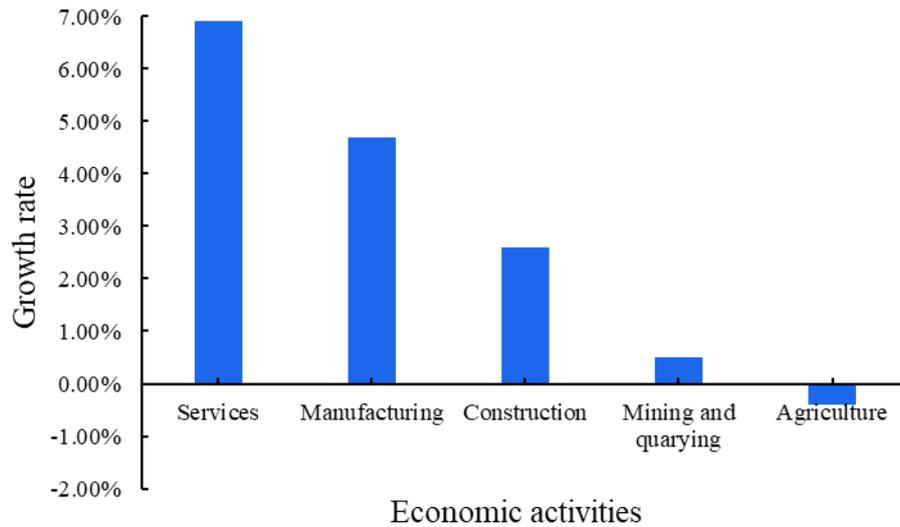


Figure 1.1: Relationship between economic activities and growth rate

(Department of Statistics Malaysia, 2019)

Ng and Chong (2018) in their study stated that manufacturing sector becomes an outstanding sector in contributing to the nation's gross domestic product growth. It also attracted an enormous amount of foreign direct investment to this country over these past twenty years. For the first nine months of 2018, the manufacturing foreign direct investments have risen 249% higher than the same period in 2017 which make the investment up to RM48.8 billion (Bernama, 2019).

Therefore, for the manufacturing organization to remain competitive, they start to turn into Total Productive Maintenance (TPM) and lean manufacturing (Binti Aminuddin et.al., 2016). In today's manufacturing environment, lean and extremely efficient production processes are in demands (Sharma et. al., 2017). In tackling the underlying issues related to these two business improvement strategies, Overall Equipment Effectiveness (OEE) becomes the foundation by identifying the direct and 'hidden' productivity and quality costs, in term of production losses. Not only used in monitoring the productivity and quality of production performance, OEE also used as an indicator and driver of performance improvements (Binti Aminuddin et.al., 2016).

1.2 Problem Statement

For the past 100 years, the manufacturing sector is considered as one of the significant economic contributors in the Asian sub-continent. It has an incredible contribution to the global economic growth and a wide acknowledgement in the area of poverty mitigation. Thus, it is important for the manufacturing industry to increase their productivity for them to survive and attain breakthrough (Nallusamy and Muthamizhmaran, 2015). But to increase productivity, production plants are faced with capacity problems. The top management instantaneously decides to increase over time, purchasing new equipment or adding shifts (Aman et al., 2017).

One of the solution to overcome the capacity problems is there must be a cooperation between top management with the plant floor production operators. They should improve the present machine performance, the reliability of the equipment, the performance of the operators and minimizing the whole idle time. With these solutions, it can help to increase the capacity and instead of adding new machine, the production plant can devote their valuable time and money towards the production process (Aman et al., 2017).

Besides that, in manufacturing industries, losses in terms of materials, machines or equipment that occur affect the productivity. Each week, in many automated lines, shortstop failures occur which takes around 1 to 2 minutes. But these failures do not aware by the industries since they are more focused on the failures which take down for several hours (Centres and Mes, n.d.). The operators also do not consider the machine stoppages which occur around 60 seconds or less than the official downtime. Stoppages that do not need maintenance to come also not consider as stoppages. These losses eventually affect the productivity of the industries. Thus, for decades until now, a variety of efforts have been seeking to improve the decision making in the plant floor production operations (OEE: A management strategy, 2017).

The greatest struggle for the manufacturers is knowing what is actually happening on the shop floor. Thus, to understand the situation on the shop floor, Overall Equipment Effectiveness (OEE) is implemented. OEE can proactively be utilized on the shop floor for identifying the issues and at the same time promote accountability. It acts as the cornerstone of the continuous improvement strategy since, it identifies the potential losses and understand the process which is falling off. The big picture of the problem and the details surrounding the problems can be answered using OEE (How to monitor OEE, 2017).

For this project, after discussion with the Chief Executive Officer (CEO) of the company, Tn. Syed, it is found that the company has no OEE data. This is because the company does not exposed to OEE, hence, they do not know on how to implement the OEE. Thus, OEE is proposed to be done at the company.

1.3 Objectives

The objectives of this project are:

1. To measure the value of Overall Equipment Effectiveness of pressure die casting machine
2. To analyze the problems which lead to decrease in effectiveness through Six Big Losses
3. To enhance the machine effectiveness through recommended solution

1.4 Scope of the Project

This project will be conducted at the pressure die casting area which focused on the pressure die casting machine. In this project, all the five pressure die casting machine is involved in the project. The data for the OEE calculation such as the schedule losses, schedule downtime and unscheduled downtime are the main focused during the data

collection. From the data collection, the factors which contribute to the lowest OEE data is identified and then, breakdown into Six Big Losses. From the Six Big Losses, the main problem is determined and focused on. Lastly, the scope of this project is focused on the improvement for the problem identified from the Six Big Losses.

1.5 Dissertation Outline

This dissertation is composed of five chapters. Each chapter discuss on a diverse point closely related to this project. The following is the brief outline of the chapters:

Chapter 1: The current chapter explains and focuses on the introduction, problem statement, objectives and scope of the project.

Chapter 2: This chapter focuses on the project background which consist of a literature review of the related topics in the project such as Total Preventive Maintenance (TPM), calculation of OEE including six major losses, and discussion about Pareto chart, Why-Why Because Logical Analysis (WWBLA) worksheet and Fishbone diagram.

Chapter 3: This chapter highlights the methodology to measure and analyze the current OEE of the company. In general, it includes the overall framework on how the project is carried out step by step.

Chapter 4: This chapter is pinpointed on the collected data throughout the project. The data is then interpreted and discussed.

Chapter 5: This chapter gives a detailed summary of all the chapter described in the dissertation. It also provides the final research conclusions and the various lessons, learn from the study. Provide the ending of opportunity for improvement, areas which lead the continuity of further study in this field.