
**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

# Autonomous Maintenance Programme for Lathe Machine

Thesis submitted in accordance with the partial requirement of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Manufacturing Process)

**By**

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# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS TESIS*

JUDUL: AUTONOMOUS MAINTENANCE PROGRAMME FOR LATHE MACHINE

SESI PENGAJIAN : **2007/2008**

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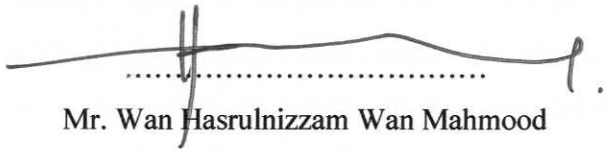
# APPROVAL

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process). The member of the supervisory committee is as follow:



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# ABSTRACT

This project is conducted as an initial study on development of Autonomous Maintenance for lathe machine (Model SM 200 X 1500). The main focus of this project are included identifying the existed abnormalities and suggestion for the remedy. Those two factors are important for initial step of Autonomous Maintenance Programme. Data collection from observation, fuguai investigation and focus group discussion were analysed by using SPSS programming. The result shows that are several of abnormalities were found such as dust, corrosion, chip scatter, coolant spill and others for 8 weeks observation. Most of abnormalities were fixed. However, some of the abnormalities cannot be worked out because of the limitation of technical knowledge and new part replacement which took longer time.

***Keywords***: *Autonomous Maintenance, Lathe Machine, Fuguai*

# ABSTRAK

Projek ini dijadikan sebagai kajian awal dalam membangunakn Program Penyelengaraan Sendiri pada mesin larik (Model SM 200 X 1500). Fokus utama projek ini termasuk mengenalpasti kewujudan dan cadangan penghapusan kegangilan yang timbul. Dua faktor ini adalah penting untuk langkah pertama dalam Program Penyelengaraan Sendiri. Dengan menggunakan program SPSS, data yang dikumpul berdasarkan pemerhatian yang dibuat, penyiasatan dan pembincangan berkumpulan dianalisis. Pemerhatian yang dibuat selama 8 minggu menunjukkan kewujudan beberapa keganjilan seperti habuk, pengaratan, cip yang bertaburan dan lain-lain. Kebanyakkan keganjilan ini dapat dianalisis tetapi terdapat juga beberapa keganjilan yang tidak dapat diselesaikan kerana pengetahuan teknikal yang terhad dan penggantian bahagian baru yang mengambil masa yang terlalu lama.

# DEDICATION

***For my beloved family:***

YM. Raja Ghazali Bin YM. Raja Ab'lah

Kasmani Binti Yaakub

Raja Muhammad Suwardi Bin YM. Raja Ghazali

Raihan Binti Jusoh

Raja Mohd Suhairi Raja Ghazali Bin YM. Raja Ghazali

Raja Suzaniwati Raja Ghazali Binti YM. Raja Ghazali

Raja Nor Idayu Binti YM. Raja Ghazali

Raja Mohd Hakimy Binti YM. Raja Ghazali

Raja Najwa Fadhlina Binti YM. Raja Ghazali

Nurul Hafizah Binti Md. Radzi

***For my adored friends:***

***4 BMFP 04/08***

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Raja Mohd Firdaus Bin YM. Raja Ghazali

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| | | |
|---|---|---|
| AM | - | Autonomous Maintenance |
| BM | - | Breakdown Maintenance |
| CBM | - | Condition Base Maintenance |
| CD | - | Condition-Directed |
| FF | - | Failure Finding |
| FMECA | - | failure mode, effect and criticality analysis |
| F-tag | - | *Fuguai* tag |
| JIPM | - | Japanese Institute of Plant Maintenance |
| MP | - | Maintenance Prevention |
| MTBF | - | Mean Time Between Failures |
| MTTR | - | Mean Time To Repair. |
| NPC | - | National Productivity Corporation |
| OEE | - | Overall Equipment Efficiency |
| OPL | - | One Point Lesson |
| PDCA | - | Plan, Do, Check and Act |
| PE | - | Performance Efficiency |
| PM | - | Preventive Maintenance |
| QM | - | Quality Maintenance |
| RE | - | Rate efficiency |
| RCM | - | Reliability-Centered Maintenance |
| RTF | - | Run-To-Failure |
| SE | - | Speed efficiency |
| TBM | - | Time Based Maintenance |
| TD | - | Time-directed |
| TPM | - | Total Productive Maintenance |

# CHAPTER 1
# INTRODUCTION

## 1.1 Background

Nowadays, lathe machine gives a big impact to manufacturing industries to produce the variable shape and process such as turning, threading, turning and external grooving and many more. Universiti Teknikal Malaysia Melaka (UTeM) as a technical university was established since 2001 which involve in manufacturing also has use the lathe machine. There are 16 lathe machines (Model SM 200 X 1500) that are located at machine shop FKP laboratory since established. Here, students will operate this machine with observation and some guidance by the technicians. Students from first years till final year are exposed to the lathe machine in their courses such as Manufacturing Process 1 and 2, so the frequency of usage of this machine is high in range between 15 hours per days. In this situation, the maintenance action is very important to avoid the breakdown problem from happen to the machine. There are no implementations of AM program to the lathe machine in machine shop laboratory until now. Although the machines have Preventive Maintenance, Breakdown Maintenance and Corrective Maintenance, but it does not help much. So the solution is to implement of AM program to the lathe machine at machine shop FKP laboratory.

## 1.2 Objective

Specific objectives of this project are:

a. To identify and analyze the abnormality of lathe machine (Model SM 200 X 1500).
b. To identify the solution for abnormalities eliminating the abnormality at the lathe machine (Model SM 200 X 1500) for Autonomous Maintenance.

## 1.3 Scope

The scope of this project is to focus on developing the AM program to the lathe machine (Model SM 200 X 1500) lathe machine at FKP laboratory in UTeM is used for case study. The AM program is suitable to this lathe machine (Model SM 200 X 1500) and not applicable to other type of lathe machine. Overall, the project is undergoing in 5 month which is started on December 2007 till April 2008. Figure 1.1 shows the register plate of the lathe machine.

| | |
|---|---|
| **MARK** | **: MOMAC SPA** |
| **TYPE** | **: Precision lathe** |
| **MODEL** | **: SM 200 X 1500** |
| **IMMATRICULATION N. °** | **: 44.459** |
| **YEAR OF BUILT** | **: 2002** |

Figure 1.1: Register plate of lathe machine

## 1.4 Importance of Study

The important of this study are as follows:

a. To make the lathe machine (Model SM 200 X 1500) in machine shop laboratory have longer working life.
b. To design the safer working place and friendly working environment for the lathe machine.
c. Will be a reference for academic studies which is related to AM program.

## 1.5 Report Outline

Overall of this report is divided into 6 chapters. Chapter 1 is mainly describe about the introduction which is the background, objective, scope of study, important of study and study outline. Chapter 2 is the literatures review which in this chapter, it will discuss the definition and the introduction of TPM generally includes each TPM pillars. This chapter is based on the reference which had gathered in reference part. Then, Chapter 3 describes all information for the lathe machine (Model SM 200 X 1500) includes parts of machine, maintenance and operation of lathe machine. Beside that, this chapter will also explain the fundamental of metal cutting which involve in turning operation. Chapter 4 explains the methodology that will be used to gather the data required to support the development and analysis of the study. This chapter also describe of the process planning, flowchart, data gathering method and analytical technique of *Fuguai*. Chapter 5 shows the results, analysis and discussions that carried out from this project through the development of AM program for lathe machine (Model SM 200 X 1500). Chapter 6 covers the conclusion and the recommendation of the whole project that has been done.

# CHAPTER 2
# MAINTENANCE

## 2.1 Introduction

Maintenance is the combination of all technical and administrative actions, including supervision actions, intended to retain and item in, or restore it to, a state in which it can perform a required function (Pintelon *et al*., 2002). The maintenance process should be considered as one of an organization's basic operation (Pintelon *et al*., 2000). The aim of the maintenance process is to support and serve the primary process, that is, to turn inputs into valuable outputs and to add customer value. The maintenance process should keep equipment or assets in a desired operating condition so as to satisfy the requirements of the primary process (Campbell, 1998). The goals of the maintenance processes are:

a. To increase primary process capability.
b. To improve primary process performance such as quality, profit, etc.
c. To satisfy regulatory requirement, such as safety, hazard and environmental standards in a cost effective manner.

Maintenance functions that support equipment operational requirements include predictive, preventive, corrective, operational maintenance, performance analysis, overhaul, modification and testing. Proper planning and scheduling ensures efficient use of maintenance resources and reduces unscheduled maintenance activities (Dowling, 1997). Beside, there are number of familiar approaches to deal with maintenance process for example TPM, RCM, LCC / ILS / ISA etc (Nakajima, 1988; Smith, 1993):

a. RCM systematically focuses on the operational consequences of every failure, and analyzes the failure mode of the relevant functional failures by using FMECA. Then the mostly effective maintenance tasks are selected to deal with the failure mode.

b. LCC / ILS / ISA are an approach to minimize the total cost in the entire life cycle of the equipment. It emphasizes the integration of the logistic support activities of a technical system such as purchase, operation, maintenance, training inventory, technical data and documents, retirement and disposal, as well as the cost related to these activities in the equipment design phase.

c. TPM is part of "zero-defect" manufacturing strategy, which involves total quality management, total employee empowerment, and the just-in-time concept. TPM optimizes equipment effectiveness through a maintenance program including maintenance prevention, preventive maintenance, and maintenance improvement. It involves employee, including autonomous operator maintenance on the shop floor, all departments and top management.

## 2.2 Types of Maintenance

There are several common of maintenance; Breakdown Maintenance, Preventive Maintenance**,** Corrective Maintenance and Maintenance Prevention.

### 2.2.1 Breakdown Maintenance (BM)

BM means that people waits until equipment fails and repair it (Venkatesh, 2007). It could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost. BM rested on the concept of highly skilled and dedicated maintenance team poised ready to step in when plant failed for what ever reason (Willmott, 1994).

### 2.2.2 Preventive Maintenance (PM)

The objective of PM is which is one of the most important maintenance activities, is to improve and prolong building and equipment life, avoid unplanned maintenance activity, and lower overall maintenance costs and this method used at early era 1951 (Dowling, 1996). It is a daily maintenance (cleaning, inspection, oiling and re-tightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. Preventive maintenance is keeps equipment functioning by controlling equipment components, assemblies, subassemblies, accessories, attachments, and so on. It also maintains the performance of structural materials and prevents corrosion, fatigue, and other forms of deterioration from weakening them (Suzuki, 1994).

PM can be broken down into four task categories (Smith, 1993):

a. Time-directed (TD) tasks: Performing PM tasks at predetermined intervals with the objective of directly preventing or retarding a failure's tasks are basically overhaul actions. Any planned intrusion into equipment, even an inspection, is an overhaul-type action and may be considered a TD task. TD consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems TD refers to preventive maintenance activity that is scheduled based on an interval of time (for instance daily, weekly, monthly, etc.). Others name for TD are TBM and periodic maintenance.

b. Condition-Directed (CD) tasks: Identifying a measurable parameter, such as belt wear, that correlates with failure onset, and specifying a value of that parameter when action may be taken before full failure occurs. CD tasks are non-intrusive and are an integral part of predictive maintenance. CD process involves the continual monitoring of all major components or systems, with any deviation from a normal range of tolerances causing an alarm to be generated automatically. Others word for CD is CBM.

c. Failure Finding (FF) tasks: Inspecting a system, subsystem, or piece of equipment to determine if it is in working order and to identify potential hidden failures. Only discovered deficiencies are repaired to avoid failures when performing FF tasks.

d. Run-To-Failure (RTF) tasks: Allowing equipment to run until it fails, with no preventive maintenance performed. RTF tasks normally are used under the following circumstances: when proper safeguards are in place to avoid accidents; when no PM task will do any good regardless of how much money is spent; if a potential PM task is too expensive and it is less costly to replace a component or subsystem when it fails; and when equipment is of such low priority that when a failure occurs, there is little, if any, impact on operations. Two fundamental preventive strategies are differentiated, time-and condition-based preventive maintenance. In time based preventive maintenance after a fixed period of time a component is serviced or overhauled, independent of the wear of the component at that moment. In condition-based preventive maintenance one inspects a condition of a component, according to some schedule (Gude *et al.*, 2007)

### 2.2.3 Corrective Maintenance

Corrective Maintenance improves equipment and its components so that PM can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability. Successful implementation of corrective maintenance includes the following fundamental support efforts (Dowling, 1997).

a. Accurate identification of the root cause of equipment problems - Without this ability, corrective action cannot be planned or scheduled.

b. Planning and scheduling repair activities to minimize both cost and interruption of the production schedule - Proper planning and scheduling allows complete repair of the root cause and resultant damage caused by identified problems.

c. Proper safe repair procedures - Repairs must be properly completed and implemented. In many cases, poor maintenance or repair practices result in more damage to critical equipment and systems than the observed failure mode. It is crucial that all repairs are made by personnel who have the necessary knowledge, skills, abilities, repair parts, and tools required to return the equipment or system to as-new condition.

d. Adequate time to repair - Plant management must provide adequate maintenance windows for all critical plant systems before either preventive or corrective maintenance can be effective. Equipment maintained in as new condition experiences significantly lower life cycle costs compared to equipment maintained in the breakdown mode.

e. Verification of repair - The verification process ensures that the repair was properly made and that all incipient problems, deviations from optimum operating conditions, or other potential limitation to maximum production capacity and reduced product quality have been corrected.

### 2.2.4 Maintenance Prevention (MP)

MP indicates the design of new equipment was established at early era 1960.Weakness of current machines are sufficiently studied (on site information leading to failure prevention, easier maintenance and prevents of defects, safety and ease of manufacturing) and are incorporated before commissioning a new equipment.

## 2.3 The Six Big Losses

It is a vital importance to understand and measure disturbances to the manufacturing process Johnson and Lesshammar (1999) classify such disturbances as chronic and sporadic according to their frequency of occurrence. Chronic disturbances are usually small, hidden and complicated because they are the result of several concurrent causes. Sporadic disturbances are more obvious since they occur quickly and as large deviations