Analysis and Improvement of Extrusion Machine Breakdown in Solder Wire Manufacturing Operation using QC tools

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ANALYSIS AND IMPROVEMENT OF EXTRUSION MACHINE BREAKDOWN IN SOLDER WIRE MANUFACTURING OPERATION USING QC TOOLS

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

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

……

(Project Supervisor)

DR. MOHAMMAD KAMIL BIN SUED

ABSTRACT

Henkel (M) Sdn Bhd is a multinational company from Germany and its main product manufactured is solder wire. Henkel currently focus on minimizing machine breakdown in order to increase its productivity. This project is carried out in order to identify the cause of machine breakdown in extrusion machine and to propose solution to eliminate the identified causes of machine breakdown. This study is started with data collection. The data is collected using check sheet and analysed with Pareto chart. Parts that breakdown the most from equipment with highest failure is identified. Then, brainstorming session is carried out to identify all potential root cause. Less significant root causes were eliminated through survey and interview. Cronbach's Alpha is used to determine the reliability of the survey. Last, solutions is suggested based on approaches used by other researchers or industries. Certain solutions couldn't be investigate further due to time constraint and lack of data. The best solutions available will then be proposed to the industry. Implementation is not carried out as defined in scope.

ABSTRAK

Henkel (M) Sdn Bhd adalah sebuah syarikat multinasional dari Jerman dan produk utamanya yang dihasilkan adalah wayar pateri. Henkel kini memberi tumpuan kepada pengurangan kerosakan mesin untuk meningkatkan produktiviti. Setakat ini, tiada tindakan yang komprehensif dilakukan bagi mengenal pasti punca kerosakan mesin. Projek ini dijalankan bagi mengenal pasti punca kerosakan mesin dalam penggunaan mesin. Projek ini dimulakan dengan pengumpulan data. 'Checksheet' dan rajah Pareto digunakan bagi pengumpulan data. Bahagian yang bermasalah telah dikenal pasti. Kemudian, sesi perbincangan dijalankan bagi mengenal pasti punca yang berpotensi. Kaedah kaji selidik dan temubual akan digunakan bagi menghapuskan punca yang kurang utama. "Cronbach Alpha" digunakan untuk menentukan kebolehpercayaan penyiasatan. Seterusnya, pendekatan oleh penyelidik dan industri lain akan digunakan bagi menyelesaikan masalah ini. Namun begitu, terdapat penyelesaian yang tidak dapat dikaji oleh kerana kekurangan masa dan maklumat. Penyelesaian yang terbaik akan dicadangkan kepada industri. Projek ini hanya sampai tahap pencadangan penyelesaian sahaja.

DEDICATION

To my beloved supervisors, Henkel (M) Sdn. Bhd., family and friends.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EQUATIONS

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

ANSI	-	American National Standards Institute
CMMS	-	Computerized Maintenance Management System
DoE	-	Design of Experiment
HOQ	-	House of Quality
KPI	-	Key Performance Indexs
LCL	-	Lower Control Limit
MRR	-	Maintenance Request and Repair
MTBF	-	Mean Time between Failures
OEE	-	Overall Equipment Effectiveness
PPM	-	Predictive and preventive maintenance
QFD	-	Quality Function Deployment
SPS	-	Semiconductor Products Sector
TPM	-	Total Productive Maintenance
UCL	-	Upper Control Limit

CHAPTER 1

INTRODUCTION

1.1 Background

Machines are the main components in manufacturing and production systems. Machine breakdowns can disturb performance measures of the systems by resulting in significant reduced in production. Cost involved for machine breakdowns is significantly higher compared to preventative maintenance cost involved for the same machine. Apart from that, when the machine is under repair, there will be no output from the workers and machine. Besides that, it also causes delayed in delivery time (Hartmann *et al*., 2004). Thus, reducing machine breakdowns is very important in production.

In order to remain competitive and achieve the markets' need in the manufacturing sector, it is important for an organization to improve their production line from time to time. Several methods such as Total Productive Maintenance (TPM) and Overall Equipment Effectiveness (OEE) are frequently executed in many organizations to boost up the effectiveness of their production line (Ying Zhang, 2014)

1.2 Problem Statement

Henkel (M) Sdn Bhd, Ipoh is a multinational company that is active in manufacturing solder wire. Same as other companies, Henkel encountered problems in machine breakdown that affects their productivity and lead time. When the machine breaks down, it leads to an increase in the process lead time and a decrease in productivity and OEE. Henkel is currently focusing on minimizing machine breakdowns. Current measure implemented managed to reduce the number of machine breakdown. However, more studies are needed to further improve on performance of the machines. So far there is no comprehensive work done to identify the root cause of machine breakdown.

1.3 Objectives

The objectives of this project are:

i. To identify the causes of machine breakdown
ii. To propose solutions to eliminate the identified causes of machine breakdown

1.4 Research Questions

i. What are the potential root cause in the machine breakdown?
ii. What are the potential solutions to address the identified cause of machine breakdown?

1.5 Scope

This project discussed around extrusion machines that are involved in the manufacturing of solder wire in Henkel, Ipoh. In tackling this problem, quality tools such as Pareto and cause and effect diagram will be used in problem evaluation. To design the solution for the identified root causes, Cause and Effect Diagram, brainstorming sessions, interview, Cronbach's Alpha testing will be used. The improvement proposal will be selected based on case studies from other researchers or House of Quality (HOQ) if design is involved. The historical data will be collected from year 2013 to June, 2015. The limit of this study is up to the stage of proposing solutions only but not implementation.

CHAPTER 2
LITERATURE REVIEW

2.1 Equipment Performance

Environment in manufacturing field are very versatile and are exposed to many disturbance that can alter system status and influence its performance. Types of disturbance are machine breakdown, rushing orders or even withdrawal of orders (M. Ozkok, 2013). Besides that, issues on huge losses due to wastage is common problem faced in production. The wastage can be caused by machinist, maintenance personal, process itself, problem due to tools, and component that are not available in time. Other types of waste are inactive machines or manpower, machine breakdown, parts rejected and bottleneck of a process (Ranteshwar *et al*., 2013).

For a manufacturing company to remain or improve their competitiveness in the market, they need to develop innovative product that are high quality with short lead time. It is also important for a manufacturing company to keep improving performance of their production system to reduce cost. According to Slack and Lewis (2008), manufacturing output in terms of quality, speed, dependability, cost and flexibility are defined as a performance objectives.

2.1.1 Case Study

Therefore, TPM has been implemented in many industries in order to solve and eliminate problem related to wastage. The purpose of TPM is to enhance quality and productivity apart from maximize effectiveness of equipment used in production. TPM involved idea of creating a system for productive maintenance to increase life span of an equipment. It should involves every employee in the company, from management to operators (F.T.S Chan et al., 2003).

The idea of lean has been used globally in managing a manufacturing company to deal with the challenges involved. TPM is one of the lean tools founded by Nakajima and it is a famous concept to improve performance of production (Andersson & Bellgran, 2015). According to a case study, 'On the Complexity of Using Performance Measures: Enhancing Sustained Production Improvement Capability by Combining OEE and Productivity', carried out by C.Andersson and M. Bellgran in 2014, they used OEE and productivity as their performance measure. In their study, they also stated that OEE can also act as a Key Performance Indicators (KPIs) in the industry of semiconductor. The case study with a period of 10 weeks was carried at a manufacturing company in automotive industry that manufactured and provided products for heavy vehicles (Andersson and Bellgran, 2015).

Apart from that, another case study was carried out by S.R. Vijayakumar and S. Gajendran in year 2014 on an injection moulding machine at Unitech Plasto Component Pvt. Ltd, Chennai. In their study, they also used TPM and OEE to improve the injection moulding process in that company and to eliminate or reduce six major loses that is important for survival of a company (S.R Vijayakumar & Gagendran, 2014).

Besides that, F.T.S. Chan *et al* (2003) carried out a case study on a machine in electronics manufacturing company. The effectiveness after implementation was observed in the study. In their study, TPM was defined in terms of OEE and Six Big Losses. In their improvement plan, Pareto chart was used to determine all stoppages on a specific machine for a week. These few case studies involved TPM, OEE and six big losses. Some even involved productivity, lead time and KPIs.

OEE is frequently applied in various industries such as semiconductor. In 1995, Motorola had encountered extraordinary growth. A better management was therefore needed in order to encounter this unpredictable growth. An improvement was required in the mainly used equipment as they are the bottleneck of the manufacturing. Therefore, capacity analysis tool is used in a facility that manufacture semiconductor on Motorola Semiconductor Products Sector (SPS). Throughout the improvement process, TPM and OEE were used and it had resulted in a savings of 90,000 USD (Giegling *et al*, 1997).

A research was also carried by R. Sharma and V. Trikha (2011) in a piston manufacturing industry in India. The main equipment of production are foundry, CNC Lathe, grinding, drilling and etc. The machines are expected to perform at its maximum capacity. However, there are several machine breakdowns and affect the operation time and productivity. The breakdowns were frequent and took up a long time. The machines were not fully utilized due to several reasons. Therefore, TPM and OEE was introduced to maximize effectiveness of equipment, increase competitive advantage and to reduce equipment downtime while improving quality and capacity.

2.1.2 OEE

There are many factors that can contribute to the breakdown of a machine. For example, improper storage of the machine, the machine was operated beyond its capability, improper maintenance, not replacing damaged or loosen parts or by allocating unexperienced operators to operate the machine (Wehrspan, 2003). The original definition of OEE was first founded by Nakajima that divide the six big losses into three main categories such as availability, performance and quality (Andersson & Bellgran, 2015).

$$OEE = Availability\ x\ Performance\ x\ Quality$$

Equation 2. 1 OEE

i. Availability
    a. In availability, downtime loss in taken into consideration. It would include any situation that the planned production was stopped for a period of time.
    b. Examples of situation are failures of equipment, material shortages, and changeover time (David & Chris, 2012).

$$Availability = \frac{Available\ Time - Down\ Time}{Available\ Time} x100\%$$

Equation 2. 2 Availability

ii. Performance
    a. Performance is the ratio of number of actual products processes to ideal maximum products that could be produced during operating time in percentage form.
    b. Examples are machine wear, sub-standard materials and operator inefficiency (David & Chris, 2012).

$$Performance = \frac{Theoretical\ Output}{Actual\ Output} x100\%$$

Equation 2. 3 Performance