

PRODUCTIVITY ENHANCEMENT BY OVERALL
EQUIPMENT EFFECTIVENESS (OEE) IMPROVEMENT
IN HABERDASHERY INDUSTRY: A CASE STUDY

SITI AMIRAH BINTI MOHAMAD NOOR
B051210139

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2015



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**PRODUCTIVITY ENHANCEMENT BY OVERALL
EQUIPMENT EFFECTIVENESS (OEE) IMPROVEMENT IN
HARBERDASHERY 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

SITI AMIRAH BINTI MOHAMAD NOOR

B051210139

910119-02-5938

FACULTY OF MANUFACTURING ENGINEERING

2015

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Productivity Enhancement by Overall Equipment Effectiveness (OEE) Improvement in Haberdashery Industry

SESI PENGAJIAN: 2014/15 Semester 2

Saya **SITI AMIRAH BINTI MOHAMAD NOOR**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (✓)**

- SULIT** (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
- TERHAD** (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
- TIDAK TERHAD**

Disahkan oleh:

Alamat Tetap:
No. 33G Kampung Batu Putih,

09700 Karangan Kulim,

Kedah Darul aman

Cop Rasmi:
(DR. EFFENDI BIN MOHAMAD)

Tarikh: _____

Tarikh: _____

****Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.**

DECLARATION

I hereby, declared this report entitled “Productivity Enhancement by Overall Equipment Effectiveness (OEE) Improvement in Haberdashery Industry” is the results of my own research except as cited in references.

Signature :

Author’s Name : Siti Amirah Binti Mohamad Noor.....

Date :

APPROVAL

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

.....

(Dr. Effendi Bin Mohamad)

ABSTRAK

Pada awal tahun 1990-an, Keberkesanan Peralatan Keseluruhan (OEE) telah dibatasi hanya sebagai alat pengukuran bagi Jumlah Penyelenggaraan Produktif (TPM), tetapi kini ia dilihat sebagai alat yang berasingan untuk mengukur prestasi sebenar pengeluaran di mana-mana jabatan atau organisasi. OEE adalah Metrik kuat pembuatan ukuran prestasi mengintegrasikan daripada penggunaan, hasil dan kecekapan proses, mesin pengeluaran garis yang diberi. Apabila dikaitkan dengan sebab-sebab bagi kehilangan prestasi, OEE menyediakan cara untuk membandingkan dan mengutamakan usaha penambahbaikan. Tujuan kajian penyelidikan ini adalah untuk membangunkan kaedah untuk meningkatkan OEE untuk Mesin Pointing di Jabatan Haberdashery dengan menggunakan Alat Lean. Berdasarkan analisis, faktor kehilangan Ketersediaan dikenalpasti dengan aktiviti yang tidak menambah nilai yang tinggi, dan dengan itu penambahbaikan dicadangkan. Peningkatan ini hanya memberi tumpuan kepada kerugian Ketersediaan dan tidak termasuk Prestasi dan Kualiti kerugian. Kaizen telah dilaksanakan untuk mengurangkan kerugian mesin tidak produktif berkenaan dengan masalah penetapan mesin. Set bulanan lengkap tali rata dibuat untuk mengatasi kekurangan peralatan di Jabatan Pointing. Selain itu, Prosedur Operasi Standard (SOP) bagi proses pencantuman tali rata cadangan untuk menyeragamkan kaedah yang betul. Peningkatan pada OEE dinilai berdasarkan keputusan pengurangan mesin downtime. Penambahbaikan membawa peningkatan dalam Ketersediaan dan OEE peratusan 13.63% dan 18.51%. Pengeluaran pada mesin meningkat apabila mesin berhenti dapat dikurangkan, sekaligus peningkatan pada produktiviti dapat dicapai.

ABSTRACT

In the early 1990s, Overall Equipment Effectiveness (OEE) was regarded only as measurement tool for Total Productive Maintenance (TPM), but now it is viewed as a separate tool for measuring true production performance in a department or organization. OEE is a powerful metric of manufacturing performance integrating measures of the utilisation, yield and efficiency of a given process, machine or manufacturing line. When associated with the reasons for performance loss, OEE provides the means to compare and prioritise improvement efforts. The purpose of this research study is to develop the methodology to improve the OEE for the Pointing Machine at Haberdashery Department by using the Lean Manufacturing Tools. The productivity losses based on previous OEE were studied to identify factors contributing to the unfavourable performance of the machine. Based on the analysis, the Availability loss factor is identified with the highest non-value added activities and thus improvements are proposed. The improvement only focuses on Availability loss and not including Performance and Quality losses. Kaizen was implemented to reduce the machine downtime losses with regard to the machine setting problem. The monthly complete set of belt is made to overcome the lack of equipment at Pointing Department. Besides, the Standard Operating Procedure (SOP) for joining process of belt proposed to standardize the proper method. Improvement on the OEE is evaluated based on the results of machine downtime reduction. The improvements bring out an increase in the Availability and OEE percentages of 13.63% and 18.51% respectively. The output of the machine increases when the machine downtime is reduced, therefore an enhancement of productivity can be achieved.

DEDICATION

This project is dedicated to my parents who have never failed to give me financial and moral support, for teaching me that even the largest task can be accomplished if it is done one step at a time.

ACKNOWLEDGEMENT

Firstly, I would like to express my gratefulness to Allah S.W.T for giving me strength and wisdom to finish my final year project. I also would like to express my gratitude to the following individuals for providing me the inspiration and help.

My deepest thank go to my supervisor, Dr. Effendi Bin Mohamad for help, motivation and precious advise. His constructive comments were vital to the development of this study.

Here, I thank my parents for helping me throughout the project and providing a financial support until I successfully completed this study. Their undivided love and support are the beacons that have continued to motivate me through the harshest of situations.

I also thank all my friends for their continuing encouragement and support. I am gratefully expressing my thanks to all my lecturers, friend and many other personnel I have spoken with about this study for sharing their helpfulness, ideas and kindness.

Last but not least, I wish to acknowledge to all persons who give supporting, advice, and assistance that are directly or indirectly involved to the success of my study. Thank you so much.

TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgment	iv
Table Of Content	v
List Of Figures	x
List Of Tables	xii
List Of Abbreviation, Symbols And Nomenclature	xiv
CHAPTER 1: INTRODUCTION	1
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Objective of Study	4
1.4 Scope of Study	4
1.5 Project Summary	5
CHAPTER 2: LITERATURE REVIEW	7
2.1 Lean Manufacturing	7
2.1.1 The Origin of Lean Manufacturing	7
2.1.2 LM Principle	8
2.1.2.1 Specify Value	8
2.1.2.2 Identify Value Stream	9
2.1.2.3 Flow	10
2.1.2.4 Pull	10
2.1.2.5 Perfection	10
2.1.3 Benefit of Lean Manufacturing	10
2.2 Major Waste in LM	11

2.2.1	Overproduction	12
2.2.2	Defect	12
2.2.3	Transportation	12
2.2.4	Waiting	13
2.2.5	Inventory	13
2.2.6	Motion	13
2.2.7	Over Processing	13
2.3	LM Tools	14
2.4	Total Preventive Maintenance (TPM)	15
2.4.1	Definition of TPM	16
2.4.2	Pillar of TPM	17
2.4.3	Benefits of TPM	17
2.5	Overall Equipment Efficiency (OEE)	18
2.5.1	Objectives of OEE	19
2.5.2	Fundamental of OEE	19
2.5.3	OEE Loses Data Classification	20
2.5.4	The Six Big Losses Attraction	21
2.5.4.1	Defining the Six Losses	21
CHAPTER 3: METHODOLOGY		23
3.1	Overview of the Methodology	23
3.1.1	The Process Planning Flo Chart	23
3.2	Data Analysis	26
3.2.1	OEE Productivity Losses	26
3.2.1.1	Histogram	26
3.2.1.2	Pareto Diagram	28
3.2.2	Root Causes Data Analysis	29
3.2.2.1	Brainstorming	29
3.2.2.2	Why Why's Analysis	30
3.2.2.3	Ishikawa Diagram	31

3.2.2.4	Failure Mode and Effect Analysis (FMEA) Technique	32
3.2.3	OEE Evaluation Data Analysis	33
3.2.3.1	Histogram	33
3.3	Kaizen Implementation Method	34
3.3.1	Four Phases of the Deming Cycle	34
3.3.2	Flow Chart Operating Procedure	37
CHAPTER 4: RESULT AND DISCUSSION		38
4.1	Introduction of Company Background	38
4.1.1	Haberdashery Division Manufacturing	38
4.1.1.1	Machine	40
4.1.1.2	Products	42
4.1.1.3	Material	43
4.2	OEE Productivity Losses Data	45
4.2.1	OEE Data Calculation	45
4.2.2	The Losses of the Previous OEE Data	47
4.2.2.1	OEE Data	48
4.2.2.2	Availability Data	49
4.2.2.3	Performance Data	50
4.2.2.4	Quality Data	51
4.2.2.5	Identify the OEE Factors Losses	51
4.2.3	The Reason of the Machine Breakdown in Pointing Department	52
4.2.3.1	Downtime Machine for Line G	53
4.2.3.2	Downtime Machine for Line H	54
4.2.3.2	Downtime Machine for Line I	55
4.2.3.4	Downtime Machine for Line J	57
4.2.3.5	Average Data of Downtime Machine for Month Period	58

4.2.4	Pareto Diagram	59
4.3	Root Causes Analysis Data	60
4.3.1	Brainstorming	60
4.3.1.1	Flat Belt	60
4.3.1.2	Spinner Set Problem	61
4.3.1.3	Wire Swing	62
4.3.2	Why Why's Analysis	63
4.3.3	Ishikawa Diagram	64
4.3.4	Failure Mode Effect Analysis (FMEA) Technique	64
4.4	Kaizen Implementation	66
4.4.1	Data Collection	66
4.4.1.1	The Process Flow of Belt to be Replaced	67
4.4.1.2	Current Method on Belt Joining Process: Thermofix Joining	69
4.4.1.3	Flat Belt Problem	70
4.4.1.4	Frequency of the Broken Belt for a Month	70
4.4.1.5	Different Number of Belts Size Involved	71
4.4.2	Data Evaluation	72
4.4.2.1	Suggested Solution of Flat Belt Problem	72
4.4.2.2	The New Process Flow of Belt to be Replaced	73
4.4.2.3	Suggested Solution	74
4.5	OEE Data after Implement Kaizen	78
4.5.1	OEE Factors Data	78
4.5.2	OEE Data Calculation	82
4.5.3	Comparison of OEE for Previous and Current Data	85
4.5.3.1	Productivity Increase Calculation	86
CHAPTER 5: CONCLUSION AND RECOMMENDATION		87
5.1	Conclusion	87
5.2	Recommendation	88

REFERENCES

89

APPENDICES

A: Project Picture

B: Gantt Chart

C: FMEA Rating Scale

D: Upgrading Preventive Maintenance

E: Project Form

LIST OF TABLES

1.1	Comparison of World Class OEE Factor and Pointing Process Factor for Previous Five Months	3
2.1	LM Tools and Techniques	14
2.2	OEE Machine Loss	20
2.3	The Six Big Losses that Relate to Losses in OEE	21
3.1	The steps of SOP development to assemble the new belt	37
4.1	Low Frame Machine Part and Functions	42
4.2	The production output, downtime and scrap data for Machine G9	45
4.3	The OEE Data of Line G, Line H, Line I, Line J for four month period	47
4.5	The Availability Data of Line G, Line H, Line I, Line J for four month period	48
4.6	The Performance Data of Line G, Line H, Line I, Line J for four month period	50
4.7	The Availability Data of Line G, Line H, Line I, Line J for four month period	51
4.8	The Total Average Data of Availability, Performance, Quality and OEE for Four Months Period	53
4.9	The Frequency of Downtime Machine Occurrences based on certain Reason for Line G from Jun to September	54
4.10	The Frequency of Downtime Machine Occurrences based on certain Reason for Line H from Jun to September	55
4.11	The Frequency of Downtime Machine Occurrences based on certain Reason for Line I from Jun to September	57
4.12	The Frequency of Downtime Machine Occurrences based on certain Reason for Line J from Jun to September	58

4.13	FMEA of Long Processing Lead Time for Flat Belt Replacement	65
4.14	The procedure to fix the new belt	68
4.15	The materials and equipment that use for belt joining process	69
4.16	The Problem and Causes of Belt Not Durable	70
4.17	Frequency of the broken belt for one month	70
4.18	Length of belt (1) for Low Frame Machine	71
4.19	Length of belt (3) for Low Frame Machine	71
4.20	Suggested solution related to flat belt problem	72
4.21	Current PM of Pointing Machine	76
4.22	Upgrading the Current PM of Pointing Machine	77
4.23	The OEE Data of Line G, Line H, Line I, Line J for two month period	78
4.24	The Availability Data of Line G, Line H, Line I, Line J for two month period	79
4.25	The Performance Data of Line G, Line H, Line I, Line J for two month period	80
4.26	The Quality Data of Line G, Line H, Line I, Line J for two month period	81
4.27	The production output, downtime and scrap data for Machine G9	82
4.28	Comparison of OEE and Availability data after implementing Kaizen	85

LIST OF FIGURES

1.1	Percentage OEE of Machine Line G for Previous Five Months	2
1.2	Average of OEE Factors Data for Four Month Period	4
3.1	The Flow Chart of Process Planning	24
3.2	Bar Chart	27
3.3	Pie Chart	28
3.4	Pareto Diagram	29
3.5	Brainstorming	30
3.6	Why why's analysis	30
3.7	Ishikawa Diagram	31
3.8	Failure Mode and Effects Analysis (FMEA) Techniques	32
3.9	Grouped Bar Chart	33
4.1	Pointing Department Location	39
4.2	Pointing Department	39
4.3	Low Frame Pointing Machine	40
4.4	Pointing Stem	42
4.5	Process flow of stem production	43
4.6	Hard Steel Wire	43
4.7	Mild Steel Wire	44
4.8	Stainless Steel Wire	44
4.9	Brass Wire	44
4.10	General Information of OEE Data at Pointing Department	45
4.11	The Average of OEE Data for Four Month Period	48
4.12	The Average of Availability Data for Four Month Period	49
4.13	The Average of Performance Data for Four Month Period	50
4.14	The Average of Quality Data for Four Month Period	51
4.15	The Total Average of Availability, Performance, Quality and OEE Data	52

4.16	The Percentages of Downtime Machine Reason for Line G	53
4.17	The Percentages of Downtime Machine Reason for Line H	55
4.18	The Percentages of Downtime Machine Reason for Line I	56
4.19	The Percentages of Downtime Machine Reason for Line J	57
4.20	The Average Percentages of Downtime Machine Reason for All Line	58
4.21	Pareto Diagram for Downtime Machine Reason	59
4.22	Brainstorming of Machine Setting Problem at Pointing Department	60
4.23	Mill Belt 1 and 3 for Pointing Machine	61
4.24	Spinner Blade Problem	62
4.25	Wire Swing	62
4.26	Why Why why analysis diagram	63
4.27	Pareto Diagram of Broken Flat Belt	64
4.28	The process flow of belt to be replaced	67
4.29	Thermofix joining system	67
4.30	Processing Lead Time for Flat Belt Replacement	73
4.31	The Flow Chart of Operating Procedure	74
4.32	The Average of OEE Data Two Month Period	79
4.33	The Availability of OEE Data Two Month Period	80
4.34	The Performance of OEE Data Two Month Period	80
4.35	The Average of Quality Data Two Month Period	81
4.36	General Information of OEE Data at Pointing Department	82
4.37	Comparison of OEE and Availability data after implementing Kaizen	85

LIST OF ABBREVIATION, SYMBOLS AND NOMENCLATURE

MIDA	-	Malaysian Industrial Development Authority
TPM	-	Total Preventive Maintenance
OEE	-	Overall Equipment Effectiveness
VSM	-	Value Stream Mapping
WIP	-	Work in Process
AMO	-	Autonomous Maintenance Program
SPC	-	Process Control
SMED	-	Single Minute Exchange of Die
MIDA	-	Malaysian Industrial Development Authority
TPM	-	Total Preventive Maintenance
OEE	-	Overall Equipment Effectiveness
FMEA	-	Failure Mode Effects Analysis
SOP	-	Standard Operation Procedure
QC	-	Quality Control
PM	-	Preventive Maintenances

CHAPTER 1

INTRODUCTION

Chapter 1 of this report will give a concise introduction on the study conducted that contains the background of the problem statement, the objectives to be achieved throughout the project and the scope of the study which clearly defined the boundaries or limit of this study. This chapter also provides a structure of the report which generally describes about chapter division and related contents to that particular chapter. All in all, it summarizes the progress of the whole project, including how the whole project has been carried out.

1.1 Background of Study

Malaysian Industrial Development Authority (MIDA, 2012) state that the largest economic in Malaysia is manufacturing by contributing 32% of overall economic and specifically 79% of the total export compared to other sectors. For the better economic achievement courses in Malaysia, more focuses and attention should be given for the industry to further improve the development.

The elimination of seven most critical wastes is frequently related to lean manufacturing. It is intricate the effects of changeability in demand, supply or processing time. Nakajima (1988) had launched Total Preventive Maintenance (TPM) concept and had offered the measureable metric of Overall Equipment Effectiveness (OEE) to determine the productivity of particular machine.

The study is carried out in a Haberdashery Industry. The Research Company is one of the manufacturing industries which have implemented TPM in their operation system. Since it was launched in April 2014, the Research Company still has to face of many challenges in order to maintain the TPM programme. This company is still looking for the best way to improve the implementation of TPM in order to achieve their objective to be successful company that implements this programme.

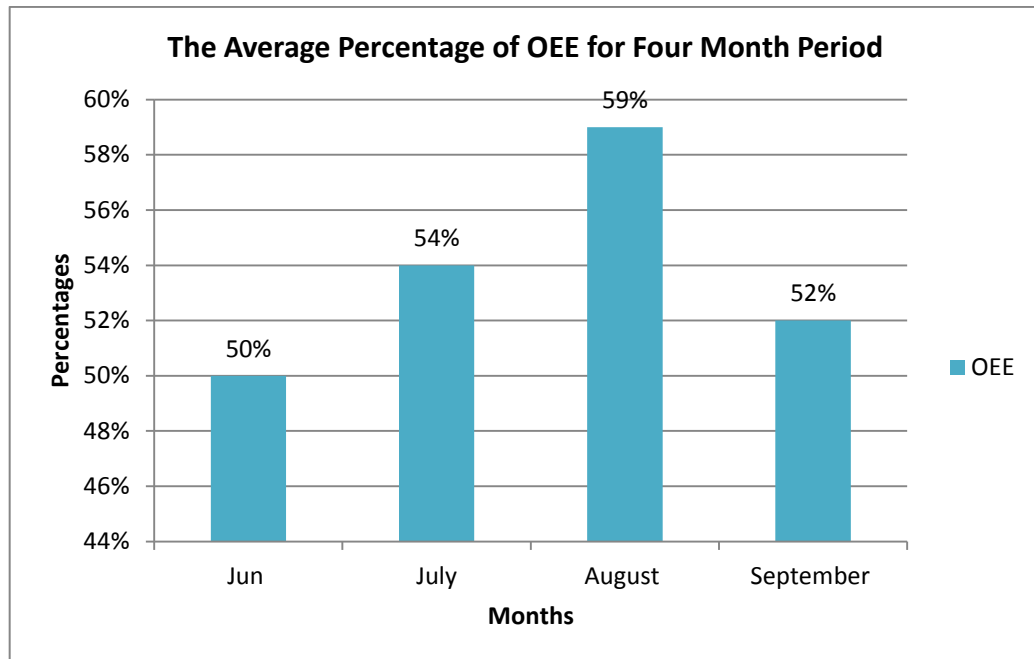


Figure 1.1: The Average Percentage of OEE for Four Month Period

Figure above shows the average of OEE percentage (%) for four months period from Jun to September. The graph indicated unprogressive OEE% of Pointing Machine for Line G, H, I and J. Lean manufacturing is the techniques and process being implemented by companies around the world that intent to reduce unneeded and unproductive tasks, activities and attitude in the work environment. In additional, lean manufacturing is a complete procedure in order to reduce waste and improve the organization production and morale. There are many tools and techniques in lean manufacturing that can be implemented but we need to select the effective lean tool and technique to achieve success.

1.2 Problem Statement

The prior data of OEE of Research Company is unsatisfactory compared to the general manufacturing framework. The OEE stands at an average of 50% to 60% where else benchmark of world class OEE rating is at least 85%. The table below is the example of the OEE% for Pointing Machine for previous five months.

Table 1.1: Comparison of World Class OEE Factor and Pointing Process Factor for Four Month Period

OEE Factors	World Class	Average of Pointing Process for previous four months
Availability	90.0%	66%
Performance	95.0%	84%
Quality	99.9%	96%
OEE	85.0%	54%

According to the comparison of world class factor and average of pointing process factor for previous for four months, availability is 66%, performance is 84% and quality is 96%. The achieved result shows distance between both factors. The major reason for the distance is availability factor level in this process. In other to improve the OEE for pointing process, we need to enhance the availability of factor level.

The OEE tools are used to evaluate performance and productivity of the machine. Figure 1.1 shows the OEE of pointing process with 54%. There are three main time losses which are downtime loss (availability), speed loss (performance) and quality loss (quality) with 66%, 84% and 96% respectively. There are the several possible causes of this condition:

- a. The time lost due to key equipment breaking down which causes the production to be stopped for more than 10 minutes
- b. The 6 big losses of OEE are not defined and measured accurately

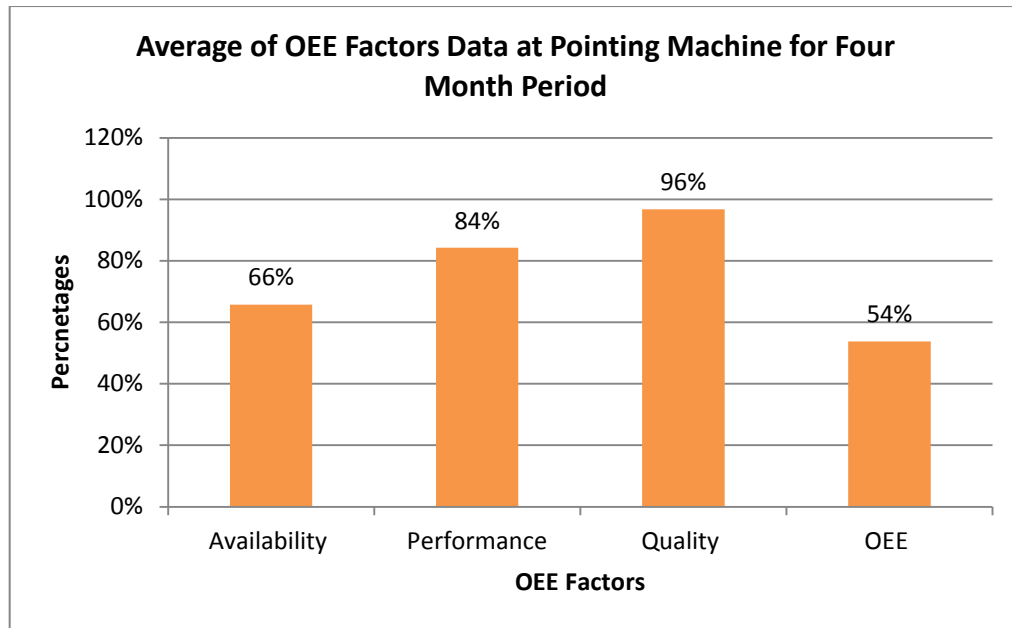


Figure 1.2: Average of OEE Factors Data for Four Month Period

OEE is fundamentally a tool that helps manufacturing companies improve their core by reduction of costs, enhancing quality, and enhancing productivity. Moreover, OEE is part of a continuous improvement approach that supports of the manufacturing process through employee involvement and authorization. Nakajima (1988) stated that, OEE measurement is a powerful way of analyzing the efficiency of the individual machine. It is an operation of availability rate, performance rate and quality rate where to measure of the equipment losses.

1.3 Objectives of Study

The objectives of this study are:

1. To identify the productivity losses based on the previous OEE in Haberdashery Industry at Pointing Machine Line.
2. To maximize the availability of equipment by minimizing breakdowns and setup time through Lean Tools.
3. To evaluate percentage of OEE improvement based on the operating time to enhance productivity.

1.4 Scope of Study

This study mainly focuses on the improvement of OEE of the pointing machine in Research Company through Lean Tools. The prosecution of this study only covers on pointing machine in Research Company. The scope of this study starts from the validation the productivity losses based on the current Overall Equipment Effectiveness at the Pointing Machine Line. Next, the OEE data on machine performance is an initial key point to identify the equipment losses and establish improvement to eliminate them. The study also includes the conduct of future state analysis for the purpose of evaluating the percentage of OEE improvement based on the operating time to enhance productivity. Improvement of performance and quality is not in the scope of this study.

1.5 Project Summary

For ease to read and comprehension, this report is written by following and according the arrangement of chapter which have been decided. This report is divided into five major parts, which is each of them consist different explanation according to the chapter.

Chapter 1: Introduction

This chapter clarifies about the background of study, problem statement, objectives and the scope of the study which acts as the core to the entire research and study.

Chapter 2: Literature Review

This chapter covers on the literature review conducted to ease the understanding of relevant topics for this study through research of all types of published work.

Chapter 3: Methodology

It describes the basic study method and describes the method chosen to carry out this study. It consists of fundamental approach to be taken to achieve the objectives.