Faculty of Mechanical and Manufacturing Engineering Technology

PRODUCTIVITY IMPROVEMENT STUDY USING LEAN TECHNIQUES AT MANUFACTURING COMPANY

Sherilyn Joily

Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

2019

© Universiti Teknikal Malaysia Melaka

PRODUCTIVITY IMPROVEMENT STUDY USING LEAN TECHNIQUES AT MANUFACTURING COMPANY

SHERILYN JOILY

A thesis submitted
in fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2019

© Universiti Teknikal Malaysia Melaka

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: PRODUCTIVITY IMPROVEMENT STUDY USING LEAN TECHNIQUES AT MANUFACTURING COMPANY

Sesi Pengajian: 2019/2020 Semester 1

Saya **Sherilyn Joily** 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 (X)

☐	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	

Yang benar,

.....
Sherilyn Joily

Alamat Tetap:
No 719, Taman Keramat
Jln Tuaran KM4,
Kota Kinabalu, Sabah.

Tarikh:

Disahkan oleh penyelia:

.....
Ts. Dr. Rohana Binti Abdullah

Cop Rasmi Penyelia

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

© Universiti Teknikal Malaysia Melaka

DECLARATION

I hereby, declared this report entitled PRODUCTIVITY IMPROVEMENT STUDY USING LEAN TECHNIQUES AT MANUFACTURING COMPANY is the results of my own research except as cited in references.

Signature: ……

Author : Sherilyn Joily

Date:

© Universiti Teknikal Malaysia Melaka

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor: Ts. Dr. Rohana Binti Abdullah

© Universiti Teknikal Malaysia Melaka

ABSTRACT

Konica Minolta Sdn Bhd (M) is one of the manufacturing company located at Ayer Keroh, Melaka. This company is focusing on manufacture thirteen parts of printer then produce a full set of printers. The aim of this study is to apply the concepts of Value Stream Mapping (VSM) with the approaches of DMAIC tools then propose a Future State VSM in order to reduce the hidden waste occurs in a production line and to increase the productivity for the company. Furthermore, the problem statement indicated where the need to find out the hidden wastes that occurs in the manufacturing system and effect the productivity of the selected product. Next, the method used to solve the problem is by using VSM where it was the main tool used to identify the hidden waste occurs in the production line such as waiting waste, over-production waste, excessive inventory and motion waste in order to increase the productivity and output for the production line. An overview of this thesis is drafted by tittle selection, literature review, research methodology and did the company visit. First step before start with the VSM is to select product family, define the CVSM and developed the FVSM. Moreover, the results from this study clearly shows that the VSM brings out the positive impacts on the imbalance stage process even the result slightly improved from the CVSM. Moreover, lean tools and techniques such as Just-in-Time (JIT), Kaizen, and pull system helps to identify the waste and reduced it. As for the result, according to CVSM the value-added activities are 39.3% and the non-value-added activities is 60.65% and mostly cause by waste of waiting, over-production, excessive inventory and unnecessary motion from the operator in a process. The outcome for this study is the labour-hour productivity improved into 60% and the partial productivity increased to 67%. The new FVSM shows the new techniques proposed to the production line as the improvement that the waste has been reduced.

© Universiti Teknikal Malaysia Melaka

ABSTRAK

Konica Minolta Sdn Bhd (M) merupakan salah sebuah syarikat pembuatan yang terletak di Ayer Keroh, Melaka. Syarikat ini menumpukan untuk menghasilkan tiga belas bahagian yang terdapat pada mesin pencetak dan seterusnya menghasilkan sebuah mesin pencetak yang siap. Tujuan untuk melakukan kajian ini ialah untuk menggunakan konsep "Value Stream mapping (VSM)" dengan pendekatan alat yang lain iaitu "DMAIC" dan mencadangkan Future State VSM sebagai cara untuk meningkatkan produktiviti syarikat ini. Selain tu, kenyataan masalah menunjukkan keperluan untuk mengetahui sisa-sisa tersembunyi yang berlaku dalam sistem perkilangan dan kesan produktiviti untuk produk terpilih. Seterusnya, kaedah yang digunakan untuk menyelesaikan masalah ini adalah dengan menggunakan VSM di mana ia adalah alat utama yang digunakan untuk mengenal pasti sisa tersembunyi yang berlaku dalam barisan pengeluaran seperti sisa menunggu, sisa pengeluaran yang berlebihan, inventori yang dan sisa pergerakan untuk meningkatkan produktiviti dan pengeluaran dalam barisan pengeluaran. Secara keseluruhan, tesis ini telah disusun yang bermula daripada pemilihan tajuk, kajian kesusasteraan, kaedah penyelidikan, dan lawatan ke syarikat tersebut. Langkah pertama sebelum memulakan VSM adalah memilih keluarga produk, menentukan CVSM dan membina FVSM. Selain itu, hasil dari kajian ini jelas menunjukkan bahawa VSM membawa kesan positif ke atas proses ketidakseimbangan walaupun hasilnya sedikit lebih baik berbanding daripada CVSM yang dibina pada awalnya. Dengan menggunakan teknik dan alat yang lebih dikenali dengan "Lean tool and techniques" yang dapat membantu mengenalpasti sisa seperti "Just-in-Time (JIT)", Kaizen dan sistem tarik atau lebih dikenali "pull system". Menurut CVSM yang telah dilukiskan, "Value-added activities" adalah 39.3% dan "Non-Value-Added activities" adalah 60.65% dan sebahagian besarnya disebabkan oleh sisa menunggu, pengeluaran yang berlebihan, inventori dan pergerakan yang tidak diperlukan dari operator dalam proses. Hasil kajian ini adalah produktiviti jam kerja meningkat menjadi 60% dan produktiviti separa meningkat kepada 67%. FVSM yang baru menunjukkan teknik baru yang dicadangkan kepada barisan pengeluaran sebagai penambahbaikan yang telah berkurang.

© Universiti Teknikal Malaysia Melaka

DEDICATION

I would like to express my deepest appreciation and special thanks to everyone, especially to parents and family who have given their support, encouragement and good advice to me. Not forgetting the classmates and friends at Universiti Teknikal Malaysia Melaka (UTeM) whom helped directly and indirectly in this study report.

Thanks to the staff in Konica Minolta Sdn Bhd who involved in assisting and providing information, advices and giving useful guidance. Not forgetting to the teammates, Lee Hui Kean and Rubasaini A/P Mohandas that going into the same company for getting the data and support while doing the research.

Not forgetting Dr. Rohana Binti Abdullah whom gave moral support, proper guidance, and been an inspiration in completing the project.

© Universiti Teknikal Malaysia Melaka

ACKNOWLEDGEMENTS

I am grateful to God that for the countless blessings and grace that was given to me to complete this project within time given.

Words are very few to express enormous humble obligations to my affectionate family for their prayers and strong determination to enabling me to achieve this project. Thank you for always beside me.

I would like to express my deepest appreciation and thanks to my supervisor, Dr Rohana Binti Abdullah for helping me, served me as my inspiration and strength for guiding and sharing her knowledge from the first day I will never forget the contribution that she gave to me, with support, encouragement, advice, assisting and providing information, and useful guidance to me. She gave me so much inspiration in completing this project. Besides, special thanks for all the employers of Konica Minolta Sdn Bhd for helping to give the information and gaining the knowledge from the real industry.

Lastly, I would like to thanks to all UTeM lecturers, lab assistant and amazing friends who involved direct or indirect who provided their time, efforts and support for this project.

© Universiti Teknikal Malaysia Melaka

TABLE OF CONTENTS

		PAGE
DECLARATION		**i**
APPROVAL		**ii**
ABSTRACT		**iii**
ABSTRAK		**iv**
DEDICATION		**v**
ACKNOWLEDGEMENTS		**vi**
TABLE OF CONTENT		**vii**
LIST OF TABLES		**x**
LIST OF FIGURES		**xi**
LIST OF APPENDICES		**xiii**
LIST OF ABBREVIATIONS		**xiv**
CHAPTER		
1.	**INTRODUCTION**	**1**
1.1	Background	1
1.2	Background of the Study	1
1.3	Problem Statement	2
1.4	Objective of Project	3
1.5	Scope	4
1.6	Study Limitation	4
1.7	Thesis Framework	5
1.8	Summary	7
2.	**LITERATURE REVIEW**	**8**
2.1	Lean Manufacturing/Lean Thinking	8
2.2	History of Lean	9
2.3	Type of waste	10
2.3.1	Transport	11
2.3.2	Inventory	11
2.3.3	Unnecessary Movement	12
2.3.4	Waiting	12
2.3.5	Overproduction	12
2.3.6	Over processing	12

© Universiti Teknikal Malaysia Melaka

2.3.7 Defects 13
2.4 Tools and Techniques 13
2.4.1 Kanban 14
2.4.2 5 S's 14
2.4.3 Poke yoke 15
2.4.4 Single Minute Exchange of Dies (SMED) 15
2.4.5 Visual Stream Mapping (VSM) 16
2.4.6 Total Quality Management (TQM) 16
2.4.7 Six Sigma 16
2.4.8 Just in Time (JIT) 17
2.4.9 Total Preventive Maintenance (TPM) 17
2.5 Principles of Lean 18
2.6 Advantages of using Lean Techniques 20
2.7 Disadvantages of using Lean Tools and Techniques 21
2.7.1 Equipment Failure 21
2.7.2 Delivery Inconsistencies 22
2.7.3 Stock Problems 22
2.7.4 High Cost of Implementation 22
2.7.5 Lack of Acceptance by Employees 22
2.7.6 Customer Dissatisfaction Problems 23
2.8 Applications: Case Studies 24
2.9 Summary 29

3. METHODOLOGY 30
3.1 Planning of Study 30
3.2 Gantt Chart 33
3.3 Title Selection 36
3.4 Literature Review 36
3.5 Research of Methodology 36
3.5.1 Value Stream Mapping (VSM) 37
3.5.2 DMAIC Tool 39
3.6 Company Visits 40
3.7 Gathering Results 40
3.7.1 Selecting Product Family 41
3.7.2 Define the Current State Map 41
3.7.3 Waste Identification 43
3.8 Develop Future State Map 43

© Universiti Teknikal Malaysia Melaka

3.9 Report Writing 43
3.10 Summary 44

4. RESULT AND DISCUSSION 45
4.1 Product Family Selection 45
4.1.1 Product Quality Analysis (PQA) 46
4.1.2 Sub-Product Selection 47
4.2 Current State Mapping 49
4.2.1 The selected part A7U4340003 49
4.2.2 Customers Requirement 50
4.2.3 Production Process 50
4.2.4 Production System 51
4.2.5 Data Collection 52
4.2.6 Process Attributes 53
4.2.7 Time Standards Attributes 54
4.2.8 Shipping Department 55
4.3 Development of Current Visual Stream Mapping 55
4.4 Analysis of The Current State of Map 57
4.4.1 Identification and Waste Analysis 60
4.5 Cycle Time vs Stage Process 62
4.5.1 Capacity Per Week 63
4.6 Actual Capacity 64
4.7 Current Efficiency 65
4.8 Future State of Maps 67
4.8.1 Future Cycle Time vs Stage Process 70
4.9 The Difference Between The Two Type of VSM. 71
4.10 Productivity Improvement 72
4.11 Summary 74

5. CONCLUSION AND RECOMMENDATION 75
5.1 Conclusions 75
5.2 Recommendation 77

REFERENCES 78
APPENDIX 81

© Universiti Teknikal Malaysia Melaka

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1.1: Thesis Frame for Final Year Project (FYP 1)		6
Table 2.1: The Principles of Lean (Abdulmalek & Rajgopal, 2007)		19
Table 3.1: Planning Gantt Chart for FYP 1		34
Table 3.2: Planning Gantt Chart for FYP 2		35
Table 4.1: Volume Produced (3 months)		46
Table 4.2: Process/Machine/Number of workstations and Operator		51
Table 4.3: The Process Attributes		53
Table 4.4: The Time Standard Attributes		54
Table 4.5: ILO Fix allowance		54
Table 4.6: Data for Cycle Time vs Stage Process		62
Table 4.7: Calculation for Capacity per Week		63
Table 4.8: Actual Capacity for Stage Process		64
Table 4.9: The Difference Between the Two Type of VSM		71
Table 4.10: Productivity between CVSM and FVSM		72

© Universiti Teknikal Malaysia Melaka

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1:	The 4P's (Knol et al., 2018) p	10
Figure 2.2:	The Seven Types of Wastes (Melton, 2005)	11
Figure 2.3:	Lean tools (Chiarini, 2014)	13
Figure 2.4:	Pull production using Kanban (Melton, 2005)	14
Figure 2.5:	The 5S's (Omogbai & Salonitis, 2017)	15
Figure 2.6:	The SMED (Knol et al., 2018)	15
Figure 2.7:	Flow of Value to the Customer (Melton, 2005)	16
Figure 2.8:	The Six Sigma (Andersson et al., 2006)	17
Figure 2.9:	The TPM table (Musa et al., 2015)	17
Figure 2.10:	House of Toyota Production System (Wagner et al., 2017)	20
Figure 2.11:	The typical benefits (Melton, 2005)	21
Figure 3.1:	General Flow Chart	32
Figure 3.2:	Value Stream Mapping Steps (Damle et al., 2016)	38
Figure 3.3:	Flow chart by using DMAIC (Buesa, 2009)	39
Figure 4.1:	Pareto Chart – Volume Produced (3 months)	46
Figure 4.2:	Product selection	47
Figure 4.3:	Sample of A7U4340003 part	49
Figure 4.4:	Overall production flow	50

© Universiti Teknikal Malaysia Melaka

Figure 4.5: CVSM for A7U4340003 part 56

Figure 4.6: Value Added vs Non-Value-Added based on the Current Map 59

Figure 4.7: Cycle time for every stage process 62

Figure 4.8: Capacity unit per week 63

Figure 4.9: Waste Identification Process Flow for A7U4340003 Part 68

Figure 4.10: Future Value Stream Mapping for A7U4340003 part 69

Figure 4.11: Future Cycle Time vs Stage Process 70

Figure 4.12: Labour-Hour Productivity (unit/hour) 73

Figure 4.13: Partial Productivity (unit/RM) 73

© Universiti Teknikal Malaysia Melaka

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1: VSM Process Symbols		81
Appendix 2: VSM Material Symbols		81
Appendix 3: VSM Information Tools		82
Appendix 4: VSM General Symbols		82
Appendix 5: The ILO Personal and Fatigue Allowances		83
Appendix 6: Assignment of Relaxation and Fatigue Allowance		84
Appendix 7: Development of Work Standard		85
Appendix 8: Moulding Department		86
Appendix 9: Receiving Raw Material Area		86
Appendix 10: Shipment Area		87
Appendix 11: The Layout of 2 Building		87
Appendix 12: Delivery Sheet		88
Appendix 13: Turnitin for Whole Report		89

© Universiti Teknikal Malaysia Melaka

LIST OF ABBREVIATIONS

C/O	Changeover
CT	Cycle Time
CVSM	Current Value Stream Map
DMAIC	Define, Measure, Analyse, Improve, Control
FVSM	Future Value Stream Map
FYP	Final Year Project
NVA	Non-Value-Added
STD	Standard Time
TPS	Toyota Production System
UP	Up Time
VA	Value Added
VSM	Value Stream Mapping

© Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

Chapter 1 will brief about the background of the study, the problem statement, the objectives, the scope of study, the project framework and the outline of the report.

1.1 Background

Company selected is Konica Minolta, located at Ayer Keroh, Melaka. Konica Minolta Business Solutions (M) Sdn Bhd has come a long way since the incorporation of City Marketing Sdn Bhd (CMSB) in 1981 as the trading arm of Konica Minolta Business Solutions (S) Pte Ltd or known as Minolta Singapore. CMSB was originally set up to take over control of Minolta Camera business in Malaysia. In August 1988, CMSB decide to change the name into Minolta Marketing (M) Sdn Bhd.

Moreover, there is 13 parts that being produce in this company, which is Helios PH, Zeus PH, Citrine PH, toner holder, DR housing and other with different name and then directly produce a printer machine. Next, for this company they only produce 3 type of models bizhub C759/C659, bizhub C658/C558/C458 and bizhub C368/C308/C258.

1.2 Background of the Study

This study explores the application of current state Value Stream Mapping (VSM), DMAIC and propose a future state VSM. It also identifies the lean tools and techniques that are used in the manufacturing company in the process of VSM and DMAIC implementation. The VSM is a famous lean tools and technique which can investigate and design the flow

© Universiti Teknikal Malaysia Melaka

sequences of materials and information that is needed for customer to receive the product or services. DMAIC is a strategic tool to enhance processes and is an integral part of the company's Six Sigma Quality Initiative.

The VSM technique originated from Toyota Production System (TPS) as part of their Lean Management tool. VSM is usually used to detect waste in the production line. The function is to document, analyze and improve the flow of materials or information needed to produce a product or service. Next, Mikel Harry and Bill Smith, Motorola develop DMAIC. Motorola was among the first recipients of the Malcolm Baldrige Award (Saleeshya & Bhadran, 2015). Next, in DMAIC it presents of five phases to solve the problem where it is a define the problem, measure process performance, analyze the process that root causes, improve the process by eliminate or reduce and control plan that required to do so all activities that may occurs are still in control.

Every production line normally will produce a waste which is from value added (VA) activity or non-value-added activity. Firstly, the waste must be reduced or eliminate in order to improve the productivity and do the continuous improvement so that it will keep the product in a good way until reach to customer. Next, the goal is to satisfy the customer with the real product, best quality, quantity required and the reasonable price in a very short time. Ultimately, each line must consist of effective and efficient processes implemented by the company in order to achieve the goal.

1.3 Problem Statement

Konica Minolta Business Solutions (M) Sdn Bhd (KMBS) is one of manufacturing company that operating in Ayer Keroh, Melaka. It is committed to continually improve their productivity as in the technology solutions that work for all, they are shaping new standards, find the way to manage the production better every day, seeking ways of creating and

© Universiti Teknikal Malaysia Melaka

implementing effective and efficient processes in each production line in an ever-changing workplace environment. In this manufacturing company they are usually produce an office printing, production printing, industrial printing, innovative technologies and as the supplier.

Based on the company visit, the problem indicated where they need to find out the hidden wastes that occurs in the production line and effect the productivity of the selected product. Thus, coordination and in-process materials are common sources of significant loss in this company.

This study focusing on to propose the future state of VSM and recognizing the lean tools and techniques used in this manufacturing company in the implementation of VSM. Next, in the implementation of VSM, the company can refer and consider another concept. The decision was made to visualize and analyze the process flow on production line and then propose improvement model using lean manufacturing methodology, particularly mapping tools that have proven to be powerful tool for identifying waste, improving and standardizing the workflow.

1.4 Objective of Project

The objective of this study is:

i. To develop the current state VSM in the Konica Minolta Sdn Bhd.
ii. To analyse a current State VSM and identify the hidden waste in the production line.
iii. To propose improvements opportunities using suitable lean tools and techniques and develop Future State VSM.

© Universiti Teknikal Malaysia Melaka

1.5 Scope

The scopes of this study are to identify and to reduce or eliminate the hidden wastes found in the production line of the manufacturing company. The processes involve in this study is to define the current state and develop the future state in a visual mapping with the help of the DMAIC project management tool as a systematic approach in conducting this study. Moreover, the proposal can be applied in this manufacturing company in order to increase their production goals by using the suitable Lean Manufacturing tools and availability too. Furthermore, the main purpose is to define the hidden waste and suggest improvement opportunity to fulfil the time given by customer to finish the product and reduce the production lead time.

1.6 Study Limitation

To solve the problems in this study, the scope of the research needs to be defined so that this study is on the right track, more focus and not too wide.

The limitation of this study is:

i. The value stream map is proposed to help identify areas of improvement that are limited to one selected product family based on the criteria of the value stream mapping product group.

ii. This study only has limited focus on the manufacturing process and production scheduling activity but does not discuss about the financial aspect.

iii. The researcher only can propose but the improvement is subject to agreement by the manufacturing company.

© Universiti Teknikal Malaysia Melaka

1.7 Thesis Framework

This study is conducted to fulfil the requirement of final year project (FYP). To demonstrate the flow of the report and the summary of the chapter available in the study. Refer to the table 1.1 below.

© Universiti Teknikal Malaysia Melaka

Table 1.1: Thesis Frame for Final Year Project (FYP 1)

CHAPTER	TOPIC	DESCRIPTION
Chapter 1	Background of the study	Explain overall background in this study.
	Problem statement	The problem that face and need to solve it by using the suitable tools and techniques.
	Objective of the project	Describing the main purpose of this study.
	Scope	Define the tools and techniques apply to this study.
	Study limitation	Explain about the restriction face from this study.
Chapter 2	Literature review	To review from previous study and get a new idea from the readings.
Chapter 3	Methodology	Discuss the methodology in a correct flow sequence.
Chapter 4	Results and Discussion	Prepare the data results based on company visit. Discuss the type of waste occurs and state the way to reduce or eliminate.
Chapter 5	Conclusion and Recommendation	Conclude overall based on the case study and propose a suitable recommendation of applying VSM.

© Universiti Teknikal Malaysia Melaka

1.8 Summary

In summary, this study explains the use of Six Sigma DMAIC project management methodology in the development of the Current state (VSM) to identify the wastes. Next, this chapter also explains the use of suitable Lean tools and techniques to eventually propose a Future State (VSM) with the aim to achieve an improvement in the manufacturing performances such as the product delivery and cycle time. Therefore, proper problem statement and clear objectives are necessary to be defined in this chapter. Further, the scope of work explains the tools and techniques used in order to avoid being out of track. Lastly, the outline of the report is explained in order to guide the reader throughout this report.

© Universiti Teknikal Malaysia Melaka