

LEAN IMPLEMENTATION OF VALUE STREAM MAPPING
FOR THE REDUCTION OF PRODUCTION TIMES AND
QUALITY DEFECTS IN ELECTRONIC INDUSTRY



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

B051810186

BACHELOR OF MANUFACTURING ENGINEERING (Hons.)

2022 UTeM



اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA



**LEAN IMPLEMENTATION OF VALUE STREAM MAPPING FOR
THE REDUCTION OF PRODUCTION TIME AND QUALITY
DEFECT IN ELECTRONIC INDUSTRY**

Submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Manufacturing Engineering (Hons.)



SYASYA SYAHINDAH BINTI ROSLI

B051810186

980523-01-7626

FACULTY OF MANUFACTURING ENGINEERING

2022

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **LEAN IMPLEMENTATION OF VALUE STREAM MAPPING FOR THE REDUCTION OF PRODUCTION TIMES AND QUALITY DEFECTS IN ELECTRONIC INDUSTRY**

Sesi Pengajian: **2022/2023 Semester 2**

Saya **SYASYA SYAHINDAH BINTI ROSLI**

mengaku membenarkan Laporan Projek Sarjana Muda (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.

- SULIT** (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysiasebagaimana 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:

Syasya

Akramin

Alamat Tetap:
NO 32, JALAN SAGA 6,
TAMAN KSM, SEROM 4,
84410 SUNGAI MATI, JOHOR

Cop Rasmi:

ENCIK NOR AKRAMIN BIN MOHAMAD
NOR AKRAMIN BIN MOHAMAD
Senior Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

Tarikh: 30 JUN 2022

Tarikh: 30 JUN 2022

*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.



FAKULTI KEJURUTERAAN PEMBUATAN

Tel: +606 – 270 2571 / Faks: +606 – 270 1047

Rujukan Kami (Our Ref) : UTeM.
Rujukan Tuan (Your Ref) :

Ketua Pustakawan
2022

29 Jun

Perpustakaan Laman Hikmah,
University Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal
Melaka.

Tuan/Puan,

PENKELASAN LAPORAN PSM SEBAGAI SULIT/TERHAD LAPORAN PROJEK SARJANA MUDA KEJURUTERAAN PEMBUATAN.

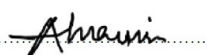
NAMA: SYASYA SYAHINDAH BT ROSLI

Sukacita dimaklumkan bahawa Laporan PSM yang tersebut di atas bertajuk "*Lean Implementation of Value Stream Mapping for The Reduction of Production Time and Quality Defect in Electronic Industry*" mohon dikelaskan sebagai *SULIT / TERHAD untuk tempoh LIMA tahun dari tarikh surat ini.

2. Hal ini adalah kerana ianya merupakan projek yang ditaja sepenuhnya oleh syarikat luar Top Empire Sdn. Bhd dan hasil kajiannya adalah sulit.

Sekian dimaklumkan. Terima kasih.

Yang benar,


Tandatangan dan Cop Penyelia

ENCIK NOR AKRAMIN BIN MOHAMAD
NOR AKRAMIN BIN MOHAMAD
Senior Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

NOTA: BORANG INI HANYA DIISI JIKA DIKLASIFIKASIKAN SEBAGAI SULIT DAN TERHAD. JIKA LAPORAN DIKELASKAN SEBAGAI TIDAK TERHAD, MAKA BORANG INI TIDAK PERLU DISERTAKAN DALAM LAPORAN PSM.

DECLARATION

I hereby, declared this report entitled “Lean Implementation of Value Stream Mapping for The Reduction of Production Times and Quality Defects in Electronic Industry” is the results of my own research except as cited in reference.

Signature :  

Author's name : SYASYA SYAHINDAH BINTI ROSLI
اونيورسي تيكنيكل مليسيا ملاك

Date : 30 JUN 2022
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Hons.). The supervisor as follow:



ABSTRACT

Lean manufacturing is one of the techniques that many major businesses are trying to stay competitive in manufacturing industry and retain their position in the market. The increasing of production time leads to late delivery of products and causes of output demand cannot be met. The concept of lean manufacturing was developed for maximizing the resources utilization through minimization of waste and reduce the production time. In this report presents a study on the problems faced at the electronic production line that contribute to the high production lead time. Bottlenecks and work in progress are some of the problems found that cause an increase in production lead time due to non-value-adding activities. Thus, The aim of this report is to minimize the overall lead time in work process by finding out bottleneck and work in progress (WIP) using the Value Stream Mapping (VSM). Value Stream Mapping (VSM) is used as a suitable lean tool to identify the waste and non-value added activities by using time-frame formula through TAKT time calculation. Current State Map (CSM) is developed to list out all the information in current work process and identify the bottleneck problem by comparing the cycle time with TAKT time using Bar graph and Pareto chart. The identified bottleneck processes are classified into the type of production waste for analysis using a fishbone diagram to determine the three critical causes of the problems. Next, further analysing are made using the 5why analysis in order to determine the countermeasure using lean tool techniques approach for each problems. A Future State Map (FSM) is developed to design a new process flow through the elimination of root cause of waste and indicating the improvement proposal. Both current and future maps are analysed by comparing the result in terms of production lead times and cycle time to evaluate the overall gain achieved by using lean manufacturing techniques. As an expected result after discussing with manager production, it reduced lead time from 326 min to 166 min, which reduced by 50.8%.

ABSTRAK

Pembuatan lean adalah salah satu teknik yang banyak dicuba oleh perniagaan besar untuk kekal berdaya saing dalam industri pembuatan dan mengekalkan kedudukan mereka didalam pasaran. Peningkatan masa pengeluaran menyebabkan penghantaran produk menjadi lewat dan permintaan pengeluaran tidak dapat dipenuhi. Oleh itu, konsep pembuatan lean telah dibangunkan untuk memaksimumkan penggunaan sumber melalui meminimumkan sisa dan mengurangkan masa pengeluaran. Laporan ini membentangkan kajian tentang masalah yang berlaku dalam barisan pengeluaran kilang elektronik yang menyumbang kepada masa utama pengeluaran yang tinggi. Kesesakan dan kerja dalam proses adalah beberapa masalah yang menyebabkan peningkatan dalam masa utama pengeluaran disebabkan oleh aktiviti tidak menambah nilai. Objektif laporan ini adalah untuk meminimumkan keseluruhan masa utama dalam proses kerja dengan mengetahui kesesakan dan *work in progress* (WIP) menggunakan *Value Stream Mapping* (VSM). VSM digunakan sebagai alat lean untuk mengenal pasti sisa dan aktiviti bukan nilai tambah dengan menggunakan formula jangka masa melalui pengiraan masa TAKT. *Current State Map* (CSM) dibangunkan untuk menyenaraikan semua maklumat dalam proses kerja semasa dan mengenal pasti masalah kesesakan dengan membandingkan masa kitaran dengan masa TAKT menggunakan graf bar dan carta pareto. Proses kesesakan yang dikenal pasti dikelaskan kepada jenis sisa pengeluaran untuk dianalisis menggunakan teknik *fishbone* untuk menentukan tiga punca kritikal masalah. Kemudian analisis lanjut dibuat menggunakan *5Whys* analisis bagi menentukan langkah balas menggunakan pendekatan teknik alat lean bagi setiap masalah. *Future State Map* (FSM) dicipta untuk mereka bentuk aliran proses baru melalui penghapusan punca pembaziran dan menunjukkan cadangan penambahbaikan. Kedua-dua peta semasa dan masa hadapan dianalisis dengan membandingkan keputusan dari segi masa utama pengeluaran dan masa kitaran untuk menilai faedah keseluruhan yang dicapai dengan menggunakan teknik pembuatan lean. Sebagai hasil yang dijangka selepas berbincang dengan pengurus pengeluaran, ia mengurangkan masa utama pengeluaran daripada 326 min kepada 166 min, iaitu berkurangan sebanyak 50.8%.

DEDICATION

This report is dedicated to
my beloved parents, brothers, and friends
for giving me moral support, cooperation, encouragement also understanding.



ACKNOWLEDGEMENT

Alhamdulillah, all praises to Allah for His blessing that accompany us along completing this report. This report would not be possible without His love and guidance in giving us grace, patience and strength. First and foremost, my deepest gratitude goes to my supervisor, sir Akramin Bin Mohamad for all his support, advice, inspiration and suggestions were really useful in writing my report. His unwavering patience in mentoring and imparting invaluable knowledge will be remembered for the rest of my life.

In addition, this report was successfully conducted with his continual supervision and guidance, as well as providing relevant report information. Thank you for guiding me so well through the completion of my report.

Last but not least, I would like to express my gratitude towards my parents, Rosli Bin Ibrahim and Hamidah Binti Ahmad also my siblings for their moral support and motivation in completing this report and lastly special thanks to all my fellow friends who directly and indirectly provided their time, effort and support for this report.

TABLE OF CONTENT

Abstract	i
Abstrak	ii
Dedication	iii
Acknowledgement	iv
List of tables	x
List of figures	xii
List of equation	xiv
List of abbreviation	xv
List of symbols	xvi
CHAPTER 1: INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statements	3
1.3 Objectives of Study	4
1.4 Scopes of Study	4
1.5 Importance of Study	5
1.6 Organization of Report	5
CHAPTER 2: LITERITURE REVIEW	
2.1 Manufacturing Industry	7
2.1.1 Research problem in industry	8
2.2 Production Time	10
2.2.1 Lead time	10

2.2.2	Cycle time	11
2.2.3	Takt time	12
2.2.4	Effect of bottleneck in production time	13
2.3	Lean Manufacturing	14
2.3.1	Type of lean waste	14
2.3.1.1	Transportation	15
2.3.1.2	Inventory	15
2.3.1.3	Motion	16
2.3.1.4	Overproduction	17
2.3.1.5	Over-processing	17
2.3.1.6	Defect	18
2.3.1.7	Waiting	18
2.4	Lean Techniques	19
2.5	Value Stream Mapping (VSM)	21
2.5.1	Current state VSM	22
2.5.2	Future state Value Stream Mapping	23
2.6	Lean Manufacturing Implementation in Various Industry	24
2.7	Summary	26

CHAPTER 3: METHODOLOGY

3.1	Flowchart of Study	28
3.2	Problem Statement and Objective	29
3.3	Methodology	29
3.3.1	Observation	30
3.3.2	Data collection	30
3.3.3	VSM: Current State Map (CSM)	31
3.3.4	Takt time calculation	35

3.3.5	Analyse the type of waste and problem identification	37
3.3.7	Propose suitable lean tools	38
3.3.8	Improve	40
3.3.9	VSM: Designing Future State Map (FSM)	40
3.3.10	Discussion and conclusion	41

CHAPTER 4: RESULT AND DISCUSSION

4.1	Introduction	42
4.2	Project Charter	43
4.3	Observation	44
4.3.1	Flowchart of main departments	45
4.3.2	Auto insert process	46
4.3.2.1	Process 1- Eyelet process	47
4.3.2.2	Process 2- Axial process	47
4.3.2.3	Process 3 - Radial process	48
4.3.3	Surface Mount Technology process	49
4.3.3.1	Process 4 - Bond process	49
4.3.4	Process 5 - Manual insert	50
4.4	Data Collection	52
4.4.1	Cycle time (C/T)	53
4.4.1.1	Process 1 - Eyelet process	53
4.4.1.2	Process 2 - Axial process	54
4.4.1.3	Process 3 - Radial process	55
4.4.1.4	Process 4 - Bond process	56
4.4.1.5	Process 5 - Manual insert (MI)	57
4.4.2	Uptime (U/T)	59
4.4.3	Inventory	60

4.5	Current State Map (CSM)	62
4.5.1	Summary of data collection	63
4.5.2	Pareto Chart of Process Cycle Time	64
4.5.3	Pareto Chart of Longest Process Element	65
4.6	TAKT Time	66
4.6.1	Identifying the bottleneck along production process	67
4.7	Classification type of production waste	68
4.8	Analysis of root-cause	69
4.8.1	Ishikawa diagram critical longest cycle time in process element 1	69
4.8.2	Ishikawa diagram critical longest cycle time in process element 3	70
4.8.3	Ishikawa diagram critical longest cycle time in Process element 5	70
4.9	Analysing the Root Cause Using 5 why Technique	71
4.10	Propose Solution Improvement	72
4.10.1	Proposed 5S techniques for process element 1	73
4.10.1.1	Sort	74
4.10.1.2	Set in order	74
4.10.1.3	Shine	75
4.10.1.4	Standardize	75
4.10.1.5	Sustain	76
4.10.1.6	Expected Result of Proposed 5S Technique	77
4.10.2	Proposed Kanban Method for Process element 1	77
4.10.2.1	Expected Result of Proposed Kanban Technique	78
4.10.3	Proposed Poka Yoke techniques for process element 2	78
4.10.3.1	Expected result of proposed Poka Yoke technique	80
4.10.4	Proposed Total Quality Management techniques for process element 3	80
4.10.4.1	Expected Result of Proposed Total Quality Management technique	82
4.11	Future State Map (FSM)	83

4.12	The Comparison Between of CSM and FSM Results	84
------	---	----

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1	Conclusion	85
5.2	Recommendation	87
5.3	Limitation of the study	87
5.4	Sustainable Design and Development	88
5.5	Complexity	89
5.6	Life Long Learning	89

REFERENCES		90
-------------------	--	----

APPENDICES		96
-------------------	--	----

A	The verification form of proposed lean tools techniques	96
B	A Gantt Chart for PSM 2	96



LIST OF TABLES

1.1	The list of problems in the production process	4
2.1	Time measurement at the PCB assembly line	9
2.2	Tools and techniques used in lean manufacturing by previous case studies	20
2.3	VSM implementation by previous case studies	24
2.4	Lean manufacturing implementation in various industry	25
3.1	Type of process data	34
3.2	The working schedule	36
4.1	The Project Charter	43
4.2	The data collection of eyelet process	53
4.3	The data collection of axial process	54
4.4	The data collection of radial process	55
4.5	The data collection of bond	56
4.6	The data collection of manual insert	58
4.7	The working schedule	59
4.8	The summary of data cycle time	63
4.9	The working schedule	66
4.10	The classification type of waste	68
4.11	The summary of critical root causes	71
4.12	The 5Whys analysis	72



LIST OF FIGURES

2.1	Example of work in progress (Rahani and al-Ashraf, 2012).	10
2.3	Example of current state value stream mapping (Zahraee et al., 2020)	22
2.4	Example Future State Value Stream Mapping (Zahraee et al., 2020)	23
3.1	Flow chart of study	28
3.2	Data box	31
3.3	Symbol of VSM (Langstrand, 2016)	32
3.4	The first step of CSM	32
3.5	The second step of CSM (Langstrand, 2016)	33
3.6	The third step of CSM (Langstrand, 2016)	34
3.7	The final step of CSM (Langstrand, 2016)	35
3.8	Waste audit worksheet	37
3.9	Fishbone diagram	38
3.10	Lean manufacturing tools	39
3.11	Verification form	39
4.1	Main department process	45
4.2	The process flow at the AI department	46
4.3	The works element of eyelet process	47
4.4	The works element of axial process	48

4.5	The works element of radial process	49
4.6	The works element of bond process	50
4.7	The works element of manual insert process	51
4.8	The work in progress of PCB	60
4.9	The work in progress of PCB	61
4.10	The current state map process flow	62
4.11	The Pareto Chart of process	64
4.12	The Pareto Chart of process element	65
4.13	The line bar graph of TAKT time	67
4.14	Ishikawa diagram of process element 1	69
4.15	Ishikawa diagram of process element 3	70
4.16	Ishikawa diagram of process element 5	70
4.17	Current situation shelf at store	73
4.18	Current situation shelf at store	74
4.19	Drawing of the box divider using Solidwork	75
4.21	The work in progress of PCB	79
4.22	Manual jig for inspection	79
4.23	Process certification card	82
4.24	The Future state map process flow	83
4.25	The comparison of before and after improvements	84

LIST OF EQUATION

Equation 1	Calculation of lead time.....	11
Equation 2	Takt time calculation.....	13
Equation 3	Up time calculation	



LIST OF ABBREVIATION

UTeM	-	Universiti Teknikal Malaysia Melaka
WIP	-	Work in progress
TPS	-	Toyota Production System
VSM	-	Value Stream Mapping
JIT	-	Just in Time
SMED	-	Single minute exchange of dies
NVA	-	Non-value added activity
VA	-	Value added activity
CSM	-	Current State Map
FSM	-	Future State Map
SME	-	Small-Medium Enterprise
PCB	-	Printed circuit board
LM	-	Lean manufacturing
TPM	-	Total productive maintenance
VSD	-	Value stream design
C/T	-	Cycle Time
C/O	-	Changeover Time
U/T	-	Uptime
L/T	-	Lead time
AI	-	Auto Insert
SMT	-	Surface Mount Technology
MI	-	Manual Insert

LIST OF SYMBOLS

%	-	Percentage
€	-	No of worker
s	-	Seconds
min	-	Minutes



CHAPTER 1

INTRODUCTION

1.1 Background of Study

Due to the high competitiveness of the manufacturing industry today, most industries will be competitive with each other to fulfill their customer needs to maintain their position in the market (S. Nallusamy, 2020). Companies implement lean manufacturing to keep their competitiveness over their competitors by improving the manufacturing system's productivity and quality enhancement of the product (Palange & Dhattrak, 2021). Competitiveness and efficiency are key challenges that drive manufacturing companies to adopt and continuously update their management strategies to strengthen their position and remain a leading pioneer of product production in today's global market. According to Zahraee et al. (2020), the most critical issue faced by manufacturers today, they need to think consistently about the most effective way to deliver their products or services to customers in a shortest time, low cost and most importantly with the best quality.

Lead time plays a vital role to improve manufacturing industry in the global competitive market. Generally, lead time is time required to complete the manufacturing process from start to finish product. In challenges, high lead times in production lines, delays in work in progress (WIP) and increased idle manufacturing times are some of the main reasons for customer dissatisfaction as the company not being able to deliver the product on time. Bottleneck that occurs in the production process from industry also can increased the cycle time and TAKT time (Barot et al., 2020). Essentially, the time required to complete one process cycle is known