



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

VALUE STREAM MAPPING USING SIMULATION TOWARDS LEAN MANUFACTURING AT MANUFACTURING COMPANY

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

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APPROVAL

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ABSTRAK

Laporan ini telah memberi tumpuan kepada penggunaan Value Stream Mapping (VSM) dalam industri pembuatan. VSM adalah satu cara visual yang mewakili aliran maklumat dan proses dalam pengeluaran produk. VSM membantu pengurusan untuk menggambarkan maklumat untuk melihat hubungan antara maklumat dan aliran material. Ia membantu untuk mengenal pasti berdasarkan tujuh sisa yang berlaku dalam proses pengeluaran. Oleh itu, skop projek ini adalah untuk mewujudkan Negeri semasa Nilai Stream Mapping (CVSM) dan dianalisis menggunakan model simulasi untuk melaksanakan Negeri Masa Depan Nilai Stream Mapping (FVSM) di Pusat Perniagaan A (BCA). Untuk menjalankan projek ini beberapa kaedah yang dirancang kaitan dengan objektif. Data yang diperlukan seperti masa kitaran proses, berubah mengikut masa dan downtime yang dikumpul dan hasil ini berkumpul dan analisis sebelum pernyataan masalah yang dilakukan dan telah dibincangkan. Analisis dilakukan adalah ditentukan oleh peratusan nilai masa ditambah kepada nilai bukan masa tambahan dan menghubungkannya dengan sisa. Daripada analisis di sana untuk menentukan punca sisa digunakan menggunakan sebab dan kesan gambarajah, Pareto dan mengapa analisis. Penemuan ini adalah peluang untuk meningkatkan masa pemrosesan adalah kebanyakannya dari nilai bukan aktiviti dan peningkatan itu menunjukkan berdasarkan sisa dikenal pasti. Selain itu, masa proses mixing 2 juga diperbaiki dengan menggunakan garisimbangan. Dari hasil yang dicadangkan, draf FVSM dilakukan dan simulasi yang dicipta untuk menyokong dapatan. Berdasarkan Perlaksanaan FVSM dan simulasi menunjukkan masa membawa jumlah boleh dikurangkan sehingga 30 peratus iaitu sebanyak 18.46 jam. Akhir sekali, kesimpulan berdasarkan kajian yang telah dilakukan dan cadangan yang telah dinyatakan.

ABSTRACT

This report has focused on the application of Value Stream Mapping (VSM) in the manufacturing industry. VSM is a visual way of representing the flow of information and materials in the production of a product. VSM help management to visualize information and material flow also can see the relationship between information and material flow. It helps to identify the seven wastes that occur in production processes. Hence, the scope of this project is to create Current State Value Stream Mapping (CVSM) and analyze using the simulation model to implement the Future State Value Stream Mapping (FVSM) at Business Centre A (BCA). For conduct this project some methodologies are planned correlate to the objectives. The data required such as process cycle time, change over time and its downtime is collected and the result was gathered and analysis prior to the problem statement are done and was discussed. The analysis done is by determining the percentage of value added time towards non value added time and correlates it with the waste. Then analysis to determine root causes of waste are done by using cause and effect diagram, Pareto and why analysis. The finding is the opportunity to improve lead time is mostly from non value added activity and the improvement was suggested based on the waste identify. Besides, the process of mixing 2 also were improved by using line balancing. From the proposed result, the draft for FVSM is done and the simulation is created to support the finding. Based on the implement of FVSM and in simulation show the total lead time can be reduced up to 30 percent which is about 18.46 hours. Last but not least, the conclusion based on the studies was done and the recommendation was stated.

DEDICATION

*This thesis is dedicated to my parents,
Sazali Bin Che Amat and Rodziah Bt. Mohamad
For their endless love, support and encouragement*

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TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	v
List of Tables	viii
List of Figures	ix
List of Abbreviations, Symbol and Nomenclature	xi
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 History Background	2
1.3 Problem Statement	3
1.4 Objective	4
1.5 Scope of Study	4
1.6 Layout of Thesis	5
1.7 Conclusion	6
CHAPTER 2: LITERATURE REVIEW	7
2.1 History and Overview of Lean Manufacturing	7
2.2 Leans Principles	9
2.2.1 Identify Value	9
2.2.2 Map the Value Stream	10
2.2.3 Create Flow	10
2.2.4 Establish Pull	11
2.2.5 Seeking Perfection	11
2.3 Lean Manufacturing Tools and Techniques	11
2.3.1 Value Stream Mapping (VSM)	12
2.3.2 Kaizen	17
2.3.3 5S	18

2.3.4	Kanban	20
2.3.5	Time Studies	21
2.4	Waste	22
2.5	Simulation Modeling	23
2.6	Comparison on Previous Case Study	26
2.7	Conclusion	33
CHAPTER 3: METHODOLOGY		34
3.1	Introduction to PSM 1	34
3.1.1	Background Study	37
3.1.2	Define Problem Statement	37
3.1.3	Objective and Scope	37
3.1.4	Literature Review	37
3.1.5	Determine Methodology	38
3.1.6	Create the Gantt chart	38
3.1.7	Data Gathering	41
3.1.8	Data Analysis	41
3.1.9	Current Map Value Stream Mapping	41
3.1.10	Analyze CVSM using Simulation	42
3.1.11	Future map Value Stream Mapping	42
3.1.12	Discussion and Conclusion	42
3.2	Company Background	43
3.2.1	Manufacturing Department	44
3.2.2	Tire Manufacturing Process	45
CHAPTER 4: RESULT AND DISCUSSION		46
4.1	Product Selection	46
4.1.1	Production Flow Process	47
4.1.2	Data Collection	52
4.2	Define Current State Map	62
4.2.1	Cycle Time (C/T)	62
4.2.2	Changeover Time (C/O)	62
4.2.3	Uptime	62

4.3	Current Value Stream Mapping	64
4.3.1	Analysis of Current Value Stream Map	65
4.3.2	Calculation of Takt Time	66
4.4	Root Cause Analysis	68
4.4.1	High Non Value Added Time	68
4.4.2	Identification and Analysis of Waste	73
4.5	Suggestion for Improving Current Value Stream Mapping	75
4.5.1	Overproduction	75
4.5.2	Transportation	76
4.5.3	Inventory	76
4.6	Develop Draft for Future Value Stream Mapping	77
4.6.1	Pull Kanban System	77
4.6.2	FIFO system	78
4.6.3	Standardize Work	78
4.6.4	Improve Mixing 2	79
4.6.5	Proposed draft for FVSM	85
4.7	Simulation Model Using Simul8	86
4.7.1	Verification	86
4.7.2	Model Translation	87
4.7.3	Validation	88
4.7.4	Simulation Analysis	89
	CHAPTER 5: CONCLUSION AND RECOMMENDATION	93
5.1	Conclusion	93
5.2	Recommendation	95
	REFERENCE	96

LIST OF TABLES

1.1	Chapter Organization	5
2.1	The comparison of case study	27
3.1	Gantt chart for PSM 1	39
3.2	Gantt chart for PSM 2	40
4.1	Cycle time data for Mixing 1	53
4.2	Cycle time data for Mixing 2	54
4.3	Cycle time data for Extrusion	55
4.4	Cycle time data for 1 st plies	57
4.5	Cycle time data for 2 nd plies	58
4.6	Cycle time data for cut	59
4.7	Cycle time data for slitter	60
4.8	Average data collection	61
4.9	Causes and its probability index	70
4.10	Why analysis for causes selected in Pareto Diagram	72
4.11	Tyre composition and its weight percentage	80
4.12	The task assignment	83
4.13	The simulation result vs actual value	89
4.14	The trial and the average of simulation output	90
4.15	The average production lead time in simulation	91

LIST OF FIGURES

2.1	The five key principles of lean thinking	9
2.2	Example of CVSM	14
2.3	Example of FVSM	15
2.4	Basic icon in VSM	17
3.1	Overall project flow chart	35
3.2	Overall report planning flow chart	36
3.3	BCA process and machine involved	44
3.4	Tire manufacturing process	45
4.1	Process flowchart for WBR radial	47
4.2	Raw material is waiting to be mixed	48
4.3	Non productive compound before mixing 2	48
4.4	Productive compound is inserted	49
4.5	Fabric is stretched	50
4.6	Process applies coating into fabric	50
4.7	The treatment that been cut	51
4.8	Process to slitter into the overlay	52
4.9	Current value stream map	64
4.10	Inventory time and processing time	65
4.11	Graph cycle time vs takt time	66
4.12	Cause and effect diagram for high WIP time	69
4.13	Pareto diagram plotted	71
4.14	Overproduction happen in BCA	74

4.15	Queuing time for inventory at mixing 2	75
4.16	Pull Kanban system at BCA	78
4.17	The sub processes of mixing 2	80
4.18	Time loss during sub process of mixing 2	81
4.19	The workstation separation in line balancing	83
4.20	Draft suggestion for FVSM	85
4.21	The running snapshot of simulation model	87

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

VSM	-	Value Stream Mapping
CVSM	-	Current State Value Stream Mapping
FVSM	-	Future State Value Stream Mapping
PSM	-	Projek Sarjana Muda
JIT	-	Just In Time
WIP	-	Work In Progress
MRP	-	Material Requirement Planning
NUMMI	-	New United Motor Manufacturing Inc
FPV	-	Final Value Plant
AOP	-	Annual Operating Plan
MTD	-	Month to Date
WBR	-	Wire breaker radial
FIFO	-	First in first out
BCA	-	Business Centre A
SOP	-	Standard of procedure

CHAPTER 1

INTRODUCTION

Overview

This introductory chapter has provided some background to the research and also explain the objective or purpose of this research based on the problem statement. Then it also gives an overview and structure of this report and lastly conclusion from the content.

1.1 Background

Currently, manufacturing industry has become tougher and a competitive market ever since. Most of the company is trying hard to make sure that their business can sustain in this situation. To sustain their business, the company used many methods to keep them competitive and one of the methods is lean manufacturing. According to Womack *et al* (1996), the lean manufacturing is a philosophy that used to improve the manufacturing system by eliminating waste or non added value activity along the process flow.

One of the lean tools is value stream mapping (VSM) which is a tool that drawn in order to evaluate process flow and identify the value added and non value added activities. Then based on the current VSM, the improvement to eliminate the non value added activity is done and future VSM is drawn based on improvement. Although in recent years, the VSM has been used widely due to its simplicity that ease in determining the

loophole in the process flow, however the VSM also has the limitation which will not be reliable due to the complexity of process on the system.

That is why the researcher has included the use of simulation in enhancing the VSM ability. This computer simulation is basically a tool that can help companies in finding the best possible outcome based on changes done. The result of simulation can be a tool that predicts prior the changes are implemented. By using the VSM that enhance with simulation tool, ideal process flow of product can be achieved and thus will place the manufacturing company keeps the competence to survive in the industry.

1.2 History Background

The history of tire industry started with metal tires and after the discovery of rubber has led to vulcanization process by Charles Goodyear on 1839. Later begin the use of rubber as the pneumatic bicycle tire by Robert William Thompson in 1846 and in the automobile industry by the Michelin brothers in 1895 (Charles *et al*, 2011). Since that era, the tire industry has grown tremendously ever since and estimated the tire industry encompasses around 400 factories worldwide producing more than 1 billion profit annually.

Basically, the tire industry is divided into two markets which is the original equipment manufacturer (OEM) market and also the replacement market. The OEM's tires are supplied to auto makers for the new vehicle production meanwhile the replacement market is supplied to the tire retailer in the country. Based on the article of "Tire Trade News" (2009), it said that despite the market volumes growing for OEM and replacement tire are 2.3% over the seven years from 2003-2008, but it has only affected in financial growth for just 2.1%. This situation has made the tire manufacturer are trying to find an efficient ways to cut cost and increase efficiency by reducing waste to survive.

In this situation, this project is done based on XYZ tire manufacturing company. Like every other big organization, the XYZ tire manufacture company has realized that the

world manufacturing has become tougher and challenging. That's why the XYZ tire manufacture always looking for process improvement that will reduce their operating cost but still produce a good quality product.

1.3 Problem Statement

As mentioned before, the automotive industry is a challenging industry since this sector keeps on radically changes due to customer requirement for the automotive product. Day by day new automotive product and rumours about the product are coming out. This scenario has dragged along the XYZ tire manufacture as original equipment manufacturer (OEM) for the automotive industry and replacement tire to become more competent to keep competing with others tire manufacture. This situation has brought the importance of lean manufacturing to increase production and in mean time reducing the cost of producing a high quality tire.

The problem faced by the XYZ tire manufacturing centre is in the beginning process, the beginning process is an important step before proceeding to another process. This is because the raw materials are changes to product part that will assemble in becoming radial tire. There are lots of wastes happen in the early stage of production that can reduce the quality of assembly product before curing. Making thing worse, after curing the final product of radial tire are scrapped because of unfamiliarities that occurs in the early process lead to product defect.

The scenario of this problem can be eliminated by implementing the lean tool which can eliminate the waste happen in the early process. The value stream mapping is the ideal tool to have an overview of the process, the add value refer for process that create value for money and the non value added that related to waste. Thus non value added need to eliminate by having lean improvement in the system.

But the implementation of lean improvement such as Kaizen in manufacturing centre can direct to high risk and make managers afraid to make changes. This situation has brought the need of using simulation of discrete event package to analyze for future improvement. Although by creating of current and proposed for future value stream mapping may seem enough. But the simulation may give more understanding and visualization towards the after implementing lean and directly lead to confidence in positive improvement for production line.

1.4 Objective

The purpose of this study is to reduce waste in the production line by having a lean manufacturing apply toward the process line. In order to so, the things need to be done is:

1. To establish current state Value Stream Mapping (VSM) at Business Centre A.
2. To identify waste and analyze the VSM and opportunities for Kaizen Proposal
3. To suggest on the future state VSM and perform a simulation.

1.5 Scope of study

Basically the scope of this study is focused on the early process which is at Business Centre A (BCA) production line. The value stream mapping will be done at BCA and with analyzing its current value stream mapping state (CVSM) to find the non-value added activities and waste along the process flow. Then to perform data collection that possible and relate to be stimulated and experiment by using discrete event simulation package. The subsequent from the result of experiment in simulation will lead to proposal to the lean techniques to reduce waste and finally perform the future state of value stream mapping based on the proposed improvement.

1.6 Layout of Thesis

This chapter shows the organizational layout of this report that need to be completed. Basically this final year project is separate into two phases which is Projek Sarjana Muda 1 (PSM 1) and also Projek Sarjana Muda 2 (PSM 2). In the PSM1 contain the early stage of this project necessarily need to be done to find out what direction of this project. Basically the PSM 1 is the defining stages where all initial ideas regarding this research. Meanwhile the PSM 2 consists of current and future state VSM based on simulation analysis. The table below will show the organization of both PSM 1 and also PSM 2.

Table 1.1: Chapter Organization

Chapter	Content	Division
Chapter 1	Introduction	PSM 1
	<ul style="list-style-type: none"> This chapter contains the initial information regarding the project which is background including historical background. It also contains objective based on the problem statement and also the scope of this research that act as boundaries of the project. 	
Chapter 2	Literature Review	
	<ul style="list-style-type: none"> This chapter contains the information need to have for the research. The information from various kinds of source such as paper research and case studies on topic relate to lean manufacturing, VSM and also discrete event simulation. It also contains comparison on the case studies based on their method and result. So based on the comparison and also information on the paper research, the methodology for this project can be developed. 	
Chapter	Methodology	PSM 1

3	<ul style="list-style-type: none"> • This chapter is the methodology that is done based on the finding in the literature review. The methodology is for the procedure guideline that needs to be done during the PSM 2 later. It also contains the company background and information regarding the manufacturing flow in the study area. 	
Chapter 4	Result and Discussion	PSM 2
	<ul style="list-style-type: none"> • This chapter contains all the data collection that is needed, it is conducted during the conducted research in the XYZ tire manufacture. This chapter also will contain the current value stream mapping (CVSM) at the research target area. • This section contains the result and explanation regarding data analysis and the analysis done to achieve the objective of the research. It includes the simulation and also the future state of value stream mapping (FVSM). 	
Chapter 5	Conclusion and Recommendation	
	<ul style="list-style-type: none"> • This section consists of overall concluding comment on the study in term of approach and also result. The shortcoming or finding of the research will also be addressed as well as the recommendation for the improvement. 	

1.7 Conclusion

This chapter concludes the overview of this study by stating the objective, scope of the study, and methodology. The objective has addressed the direction of the study while from the scope of study and the critical parameter was specified. Lastly the arrangement of the study was briefly explained that also act as guideline for the study done.

CHAPTER 2

LITERATURE REVIEW

Overview

This chapter is made based on reviews of the existing research that related to project title such as lean manufacturing, value stream mapping, simulation and others important factor that correlate to project title. Besides, in this chapter also contain information and discussion that were relevant and need to consider before beginning the project.

2.1 History and Overview of Lean Manufacturing

The lean manufacturing begins when the westerner has realized the potential of Japanese car maker in producing a car with a mass production of high quality product at a lower cost. Lean is derived from the Toyota Production System and been adapted by the western in their work culture called lean manufacturing and was famously studied with them for that. The produce of the book relates to lean by to Womack *et al* (1991) title “The machine that changed the world, the story of lean production” that has made the mindset of US manufacturer to change.

Previously, there is a huge gap between Japanese and Western automotive industry. But the study based on Toyota great success at NUMMI (New United Motor Manufacturing Inc.) That made a Western automotive industry gap with the Japanese to become closed.

It is important because the Japanese companies have already developed their manufacturing system to a level of production at less human effort, less capital investment, less flooring space, tool, material and time that conclude to a less overall expense (Womack *et al*, 1991).

The meaning of lean represents a whole system that makes use of fewer inputs in order to create the same output compared to those created by the traditional mass production system. Meanwhile Marchwinski *et al* (2004) clarifies that lean is a production system for managing and organizing the product development, operations, suppliers and customer related by reducing the 7 waste. When compared to the previous system of mass production, then lean in manufacturing will make products with fewer defects that achieved the demand require.

The usage of this lean philosophy can be done with focus on reducing waste in manufacturing by operation management control. The 7 types of waste that need to be eliminated is transportation, inappropriate process, motion, waiting, over processing, unnecessary inventory and also defect. Lean also can be understood to a concept of value which refers value in customer perspective that differs from the traditional production point of view (Carreira, 2005).

In explanation, the value is divided into two which is value added and non value added. Activity that customer willing to pay is referred as value added where the product or service undergo a process which transform them into a more complex state towards finish product. Meanwhile the non value added literally activity that the customer does not want to pay because the activity does not change the product or service into another thing but remain same for example inventory stage. To understand better on lean manufacturing, first one need to be acquainted with the basic principle and techniques as listed below.

2.2 Lean Principle

Lean is a philosophy that began with five principles are also known as lean thinking. In within the manufacturing environment, by understand the principle is basically a basic step before knowing deeper in lean and to improve it. Below as shown in figure 2.1 is the step of lean principle that follows:



Figure 2.1: The five key principles of lean thinking (Womack *et al*, 1996)

2.2.1 Identify Value

The critical starting point for lean principle is identifying value which entirely referred to customer perspectives. The information of product that a customer willing to pay for and only are defined by the customer to is the value of significance (Womack *et al*, 1996). The producer exists because of the value comes from customer point of view and was created by producer (Womack *et al*, 1996). Usually producer tends to make what they already make and the customer can only settle for what they offered. The situation shows that the producer does not see what customer really want and when customer no