



**5S Assessment using Rasch Measurement Model: A Case
Study in Advanced Manufacturing Industry**

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By

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TABLE OF CONTENTS

	PAGE
THESIS DECLARATION	i
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF ABBREVIATIONS	ix
LIST OF SYMBOLS	x
ABSTRAK	xi
ABSTRACT	xii
CHAPTER 1 INTRODUCTION	
1.1 Introduction	1
1.2 Research Background	1
1.3 Problem Statement	3
1.4 Research Objectives	4
1.5 Research Scope	4

1.6 Significance of Study	5
1.7 Thesis Overview	5
1.8 Project Management Timeline	6
1.9 Conclusions	6

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction	7
2.2 Lean Manufacturing	7
2.2.1 History of Lean Manufacturing	8
2.2.2 Definition of Lean Manufacturing	10
2.2.3 Critical Success Factors of Lean Implementation	12
2.2.4 Tools and Techniques in Lean Manufacturing	14
2.3 5S Practices	19
2.4 Lean Assessment	24
2.4.1 Overview of Lean and 5S Assessment and Findings	28
2.5 Conclusions	35

CHAPTER 3 METHODOLOGY

3.1 Introduction	36
3.2 Thesis Flow	36
3.2.1 Scope Formulation	36
3.2.2 Execution Assessment	39
3.2.3 Analysis of Result	43
3.2.4 Improvement Strategies	47
3.3 Conclusion	47

CHAPTER 4 RESULTS AND DISCUSSIONS

4.1 Introduction	49
4.2 Results	49
4.3 Rasch Analysis	50
4.3.1 Pilot Survey (PS)	51
4.3.2 Real Survey (RS)	58
4.4 Observation Based Analysis	66
4.5 Improvement Strategies	72
4.6 Conclusion	79

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction	81
5.2 Research Conclusions	81
5.3 Future Research Recommendation	85

REFERENCES	86
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APPENDIX

Appendix A (Gantt Chart)	92
Appendix B (Sample Pilot Survey Questionnaire)	93
Appendix C (Sample Real Survey Questionnaire)	94

LIST OF TABLES

NO		PAGE
2.1	Seven wastes in Lean Manufacturing	11
2.2	Literature Review Matrix	33
3.1	Ordinal Scale for Pilot Survey	40
3.2	Ordinal Scale for Real Survey	41
3.3	Comparison Between Software	44

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LIST OF FIGURES

NO		PAGE
1.1	Timeline of project	6
2.1	Basic Image of Lean Production	10
2.2	Critical Success Factors of Lean Implementation	13
2.3	Pillars of TPM	18
2.4	Definition of 5S in Japanese and English	21
2.5	Lean Assessment Tool (LAT) Decision Criteria	27
3.1	The Flowchart of the Project	37
3.2	Manufacturing Process in Aerospace Company	38
3.3	Cronbach Alpha	45
3.4	Rating Scale Instrument Quality Criteria	46
4.1	Data collected from Pilot Survey	52
4.2	Summary Statistics for Pilot Survey	53
4.3	Person-Item Distribution Map (PIDM) for Pilot Survey	55
4.4	Data From Real Survey	58
4.5	Summary Statistics (Person)	60
4.6	Summary Statistics (Items)	61
4.7	Person-Item Distribution Map (PIDM)	62
4.8	Differences of Pilot Survey and Real Survey	66
4.9	Workplace area	68
4.10	Items placed at each workstation	68
4.11	Tool box	69
4.12	Label Signs on the Floor	69
4.13	Safety Coats Place	70
4.14	Workboard Organisation Storyboard	71
4.15	Lean Culture Framework	78
4.16	Kaizen Flag	79

LIST OF ABBREVIATIONS

LAT	Lean Assessment Tool
LPI	Lean Production Index
LM	Lean Manufacturing
RWP	Residence Work Plan
RMM	Rasch Measurement Model
PS	Pilot Survey
RS	Real Survey
PIDM	Person-Item Distribution Map
PDCA	Plan-Do-Control-Act

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LIST OF SYMBOLS

e	Base of natural logarithm or Euler's number; 2.7183
β_n	Person's ability
δ_i	Item or task difficulty
α	Cronbach alpha coefficient
r	mean of inter-item correlations the size of alpha
k	number of items considered

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Penilaian 5S dengan Menggunakan Model Pengukuran Rasch: Satu Kajian di Industri Pembuatan Termaju

ABSTRAK

5S merupakan amalan yang biasa diamalkan dalam sesebuah syarikat dan bertujuan untuk membina kesedaran di kalangan ahli pasukan dan membina tanggungjawab dalam keadaan normal dan tidak normal di kawasan tempat kerja mereka (Brophy, 2013). Elemen 5S adalah Sisih, Susun, Sapu, Seragam dan Sentiasa amal. Kajian ini hanya fokus kepada amalan 5S sahaja kerana proses melapis ini banyak melibatkan aktiviti-aktiviti yang dijalankan secara manual. Ini bermaksud prestasi dan kualiti kerja-kerja adalah bergantung pada kemahiran operator. Kajian ini terdiri daripada dua objektif utama, yang pertamanya ialah untuk menilai amalan 5s semasa dari segi kefahaman, pengetahuan dan amalan sebenar dalam kawasan proses terpilih dengan menggunakan Model Pengukuran Rasch. Tujuan kedua adalah untuk mencadangkan strategi penambahbaikan untuk meningkatkan kualiti amalan 5S berdasarkan keputusan Model Pengukuran Rasch. Untuk menilai keadaan semasa amalan 5S, kaedah kuantitatif telah digunakan. Sebelum kajian sebenar dijalankan, kajian rintis telah dibangunkan untuk menguji kebolehpercayaan orang dan item dan ia juga bertindak sebagai percubaan untuk membangunkan struktur soal selidik yang lebih baik untuk digunakan dalam kajian sebenar. Kemudian, kajian sebenar dibangunkan untuk menganalisis pengetahuan, pemahaman dan amalan setiap elemen 5S. Dapatan analisis menunjukkan kebanyakan responden mempunyai pengetahuan yang baik, memahami dan mengamalkan elemen-elemen 5S dalam kerja-kerja rutin mereka. Seterusnya untuk menganalisis sama ada responden mengamalkan amalan 5S dalam aktiviti kerja mereka, analisis berdasarkan pemerhatian telah dilakukan. Daripada analisis berdasarkan pemerhatian yang dibuat, ia telah membuktikan bahawa apa yang responden menjawab adalah selari dengan apa yang mereka lakukan dalam kerja-kerja rutin mereka. Akhir sekali, beberapa strategi penambahbaikan turut dicadangkan seperti latihan, menerbitkan dan mempamerkan Rancangan Kerja, memberi hadiah atau pujian dan hukuman dan juga PDCA (Pelan, Lakukan, Kawal dan Tindakan).

5S Assessment using Rasch Measurement Model (RMM): A Case Study in Advanced Manufacturing Industry

ABSTRACT

5S practices a common practice in the company and purposely to develop awareness among the team member and build responsibility of normal and abnormal conditions in their workplace area (Brophy, 2013). The 5S element are Sort, Set in Order, Shine, Standardize and Sustain. The study is only focus on 5S practices because in the Laying Up process, most of the activities are manually conducted which means the performance and quality of works depends on the operators' skills. The study was composed with two main objectives which are; firstly is to assess the current 5S practices in term of understanding, knowledge and actual practices in Lay Up process area using questionnaire-based survey and observation methods and analysed in Rasch Measurement Model (RMM) and secondly is to recommend the improvement strategies to improve the 5S practices based on analysis results of Rasch Measurement Model (RMM). In evaluating the current state 5S practices, the quantitative method which is survey had been created. Before the real survey had been launched, the pilot survey had been distributed to test the reliability of person and items and also act as trial to make better questionnaire's structure for real survey. Then, the real survey had created to analyse their knowledge, understanding and practices of every elements of 5S practices; sort, set in order, shine, standardize and sustain. The analysis showed that, most of the respondents have good knowledge, understanding and practice these 5S elements in their routine works. Next to analyse either these respondents applied or practiced the 5S practices in their work activities, observation based analysis had been done. From the observation based analysis made, it had proved that what are the respondents answered is parallel to what are they doing in their routine works. Lastly, some improvement strategies are also suggested such as training, publish the RWP (Residence Work Plan), complimentary and punishment and Deming's PDCA (Plan-Do-Control-Act).

CHAPTER 1

INTRODUCTION

1.1 Introduction

The first chapter of this thesis is divided into seven parts. The first part is research background, the second part is about the problem statement of this research, the third part presents the objectives of this research, fourth is the scope of the research, next part is describing the significance of this research, the sixth part is an overview of this thesis and lastly is timeline for this research.

1.2 Research Background

Lean is like a journey which does not have the ending. Currently, in business world there is no boundary and challenging and lean manufacturing had give many changes in management practices in order to enhance the customer satisfaction and also their effectiveness (Azuan & Ahmad, 2013). Lean implementation should not be stopped after implemented, it needs to be controlled and improved from time to time.

Eventhough the company have knowledge about the lean, there are some challenges they might face. There are nine key area of challenges in lean manufacturing that commonly encountered by a well known E&E organization operating in Malaysia (Chong,

Cheah, Wong, & Deng, 2012). These authors had categorised all these nine challenges into three levels by using hierarchical relationship model (HRM).

Those nine challenges are projects implementation, effective communication, training, pressure from top management, uncertainties in demand, pressure from customer, non effective method, lack of common vision and non lean behaviour. Some of them had give attention which is related to what is going to be studied in this study. Among of the challenges highlighted by them are related to 5S practices. Those challenges are non effective method which means the problem with the inventory management and knowledge and information transfer which means the effective communication and also the training which means inappropriate training had given to the workers. These challenges might fail their attempt or plan to implement lean manufacturing.

Therefore, to compete with other same field companies currently, there are several factors that should be considered in marketing performance which are manufacturing control, staff skill and knowledge management. Likewise neither application of technology nor type of process was the critical affect to market performance. The 5S practices is one of the technique that can be used to control the manufacturing production.

5S practices is a fundamental technique can be used in implementing lean. The 5S practices is stands for Sort, Set in order, Shine, Standardize and Sustain. These elements are practised in the daily work, routines and maintain the organisation and orderliness which is also important to ensure a smooth and efficient flow of activities (Deros, Jun, & Rahman, 2012). Besides that, it is a technique that used to improve the performance as well as organize whole the system (Ghodrati & Zulkifli, 2013).

1.3 Problem Statement

Lean Manufacturing had been applied in this company which is one of the advanced manufacturing industry for some time, but the company must consider some factors such as leadership and management, finance, skills and culture which all of these can influence to the successful of implementing the lean manufacturing. Lean assessment is important to be carried out and it also can be considered as an appropriate tool as it can be used for both self assessment and comparison (Gurumurthy & Kodali, 2009).

But the issue is many researcher had done the study on lean assessment which is the study had be done to the whole system of company, and fewer study is about the assessment that only focus on 5S practices. Therefore, this study is necessary in order to add more knowledge about the 5S practices especially in Malaysia's industries.

As mentioned in previous section, one of the basic lean manufacturing that applied in the company is 5S practices which is including five elements; Sort, Set in order, Shine, Standardize and Sustain. 5S practices is an effective method which can improve housekeeping, environmental performance and also safety standards in a systematic way (Rahman, Khamis, Zain, Deros, & Mahmood, 2010).

Besides that, 5S practices is also known as the fundamental of an organisation. These had been showed how much important of an effective 5S practices. A good practice of 5S can build a strong organisation which is have an effective practices. The company studied need to have a good understanding, knowledge and practices of 5S in order to have the right training in the right time to the right person.

1.4 Research Objectives

This study is consists of two objectives which are:

1. To assess the current 5S practices in term of understanding, knowledge and actual practices in Lay Up process area using questionnaire-based survey and observation methods and analysed in Rasch Measurement Model (RMM).
2. To recommend the improvement strategies to improve the 5S practices based on analysis results of Rasch Measurement Model (RMM).

1.5 Research Scope

The objective is to assess the 5S practices in an advanced manufacturing company and analysed by using Rasch Measurement Model (RMM). Therefore, the most crucial process in this industry had been selected; Lay Up process. The Lay Up process almost included manual work by operators. In this process, there are many type of products had been manufactured, so that only one had been selected and known as product A. This type of product has highest cost among all the products. The results obtained will be based on data collected from the questionnaire and observation-based within selected area. Besides that, this study includes only the current level of 5S practices in selected area and recommends ways to improve the practices. The improvement implementation of the current practices will not be included in this study.

1.6 Significance of Study

This study may help the industry to improve their business specifically in manufacturing or production operations and also maximize the benefits from lean implementation in the company. From this project, the company can apply this technique; 5S assessment on their own and can assess the 5S practices among their workers in anytime without having to hire someone to assess the 5S practices. This assessment can be used even if their workers stop working in anytime. It means that this assessment is not tied up to the workers but the practices of 5S. Besides that, this project can also be reference to other researcher or company to implement the 5S assessment especially in manual activities.

1.7 Thesis Overview

The thesis is organized as follows. In Chapter Two, literature study is regarding lean manufacturing issues and its application industry is presented. Then, Literature Review also had discussed about the Lean assessment, the key areas or scope and the method used to conduct by other researchers. In Chapter Three, the framework or methodology that used in this study is discussed. After that, in Chapter Four the results from the assessment is discussed and also some solution or improvement will be proposed. Last chapter presents the conclusion made from this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This second chapter presents an overview of lean manufacturing issues and then the focus is given on the topic of 5S practices in industries. It follows by reviewing the articles related to the discussed topic.

2.2 Lean Manufacturing

“Lean manufacturing is all about observing at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value added wastes” (Ohno, 1988). By using the lean manufacturing, the wastes can be reduced or eliminated and at the same time customer’s satisfaction also can be improved. Customer only wants to pay the value added activities which is activities that transform materials and information into products and services as what customer wants. While non value added activities can be defined as activities that have resources, but do not directly contribute to product or service.

2.2.1 History of Lean Manufacturing

The Lean approach in manufacturing application (thus the term known as lean manufacturing) had been started at Toyota with different names such as 'just-in-time' manufacturing or 'Toyota production system' (T.Earley, 2015). The origin of Lean manufacturing is after World War II, when Japanese manufacturers had faced with the dilemma of losses many resources such as workers, material and also financial (Ohno, 1988).

Henry Ford had created the Model T in 1908 and have 2 objectives; a car that was designed for manufacture and was user-friendly which means almost anyone can drive and repair the car. Basically, the mass production was not the continuously moving assembly line but it is the interchange-ability of parts and the simplicity of attaching the parts to each other.

Then, a young Japanese engineer named Eiji Toyoda had visited Ford's vast Rouge plant in Detroit in the spring of 1950 to study (Womack JP & Jones DT, 1990) . Eiji and his production genius, Taiichi Ohno had discussed and they had concluded that mass production which is implemented by Ford would never work in Japan. From this events, the Toyota Production System (TPS) was born.

For decades, America had cut costs by mass which is producing fewer types of cars. But the problem they faced was how to cut costs while producing small numbers of many types of cars. In Japan, Toyota had faced problems such as the tiny of domestic market and demanded a wide range of vehicles from luxury cars for executives, to large and small

trucks for farmers and factories, and small cars for the crowded cities and high energy prices.

Ford's original thinking are revisited by them and a new, disciplined, process-oriented system which is known as the Toyota Production System (TPS) is devised. By the experimentations, the TPS was developed and refined between 1945 and 1970 and is still growing today. The basic idea of this system is to minimize the consumption of resources that non value added to a production.

After decided not to use mass production, Ohno had started the changes on the process of stamping of sheet metal. Until now, the stamping process included a million or more of a given part in a year. Unfortunately, Toyota's production was to be a few thousand vehicles per year. Therefore, Ohno had concluded that instead of dedicating whole set of presses to a specific part and stamping these parts for months or years without changing dies, he developed simple die change techniques and change dies frequently by using rollers to move dies in and out of position. By this way, he would need only small amount of presses and at the same time he found that in this way it is cheaper to produce smaller number of parts and not have to inventory them.

It can be concluded that, Ohno's techniques can save the cost of inventory and the mistakes can be found earlier in the process. He also decided that the production workers should perform the die changes instead of hiring specialist to perform these tasks. He also realized that in order to achieve success in his new ideas, the workers would need to be motivated to look for and correct the mistakes and to be extremely skilled in their work at

the same time. Then, Ohno start to tackle the other process such as assembly process and supply chain process in order to improve the whole system of production.

2.2.2 Definition of Lean Manufacturing

Lean manufacturing can be defined as a systematic approach to identify and eliminate or reduce the wastes to achieve a totally waste free operation by using continuous improvement. The House of Lean Production is the basic image of lean production (Dennis, 2002). The Figure 2.1 shows the basic image of Lean Production.

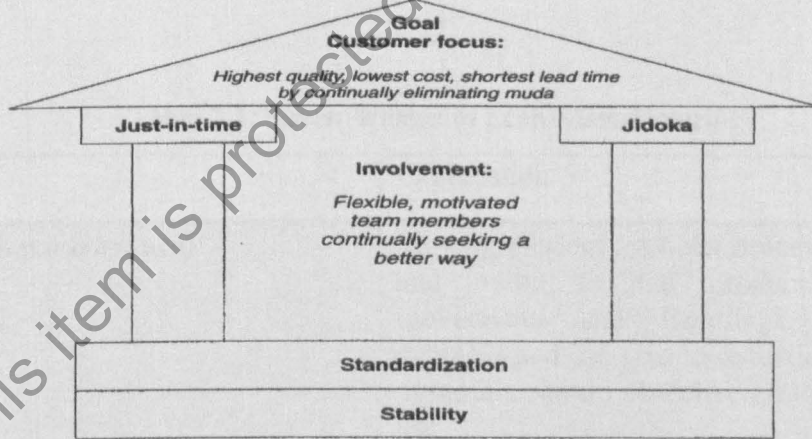


Figure 2.1 : Basic Image of Lean Production (Dennis, 2002)

The basis of the lean system is stability and standardization. The walls are just-in-time delivery of parts of products and jidoka, or automation with a human idea. The goal or the roof of the system is customer focus; to deliver the highest quality to the customer, at

the lowest cost, in the shortest lead time. The heart of the system is involvement; flexible motivated team members continually seeking a better way (Dennis, 2002). Based on the goal of the Lean Production is to provide highest quality at the lowest cost in the shortest time by continually eliminating muda or waste.

The Lean manufacturing implementation is purposely to make a lean production system in sustainable state. When there is no lean system, the lean production implementations will sometime fails, often falter and also virtually never deliver up to the long run promises. One of the author mentioned about the three categories of waste which is also non value added activities are unevenness or fluctuation in work (Mura), overburden (Muri) and opposite to the value or waste (Muda) (Dennis, 2002). In the Muda or waste, there are seven types of wastes and showed in Table 2.1:

Table 2.1: Seven Wastes in Lean Manufacturing

Wastes	Explanation
Transportation (conveyance)	Moving product between processes does not add value to the product. Excessive movements and handlings can cause damages and can lead to reduction in quality. Materials should be delivered to its point of use
Inventory	The waste in inventory means to keep unnecessary raw materials, parts, and WIP. These conditions result when flow is constricted in a plant and when production is not linked to the drumbeat of the market (pull system).
Motion	Wasted in motion involve both human and machine element. Wasted human motion is related to workplace ergonomics. Poor ergonomic design negatively affects productivity and quality as well as safety.

	Productivity suffers when there is unnecessary walking, reaching or twisting. Quality suffers when the worker has to strain to process or check the workpiece because of reaching, twisting or poor environmental conditions.
Waiting	Waste in waiting can be occurred when the people or product is not moving. The delays can increase the lead time; that is the time between the customers placing and receiving his or her order.
Overproduction	Overproduction means making things over than what customer wants. Some of the related costs to this waste of overproduction are: <ul style="list-style-type: none"> 1. Building and maintenance of large warehouse 2. Extra workers and machines 3. Extra parts and materials
Overprocessing	Do the unneeded steps to process the parts. This is due to poor layout, poor tools and poor product design, causing unneeded motion and producing defects.
Defects	Defects can be either production defects or service errors. Having a defect results a large cost to organizations.

2.2.3 Critical Success Factors of Lean Implementation

Despite of these type of wastes, the users of this lean should understand more about the lean and know what is the critical success factors (CFCs). When the CFCs known, the users will more alert and careful in implementation of lean. In some author's studies, there are a lot of factors lead to successful of implementing lean. Those CFCs had been summarized as below (Achanga, Shehab, Roy, & Nelder, 2006; Punnakitikashem & Chen, 2013):