5S AND AUTONOMOUS MAINTENANCE FOR LEAN PRACTITIONER AT AN AEROSPACE MANUFACTURING: A CASE STUDY

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

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Sekian dimaklumkan. Terima kasih.

Yang benar,

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DECLARATION

I hereby, declared this report entitled “5S and Autonomous Maintenance for Lean Practitioner at an Aerospace Manufacturing: A Case Study” is the results of my own research except as cited in reference.

Signature : 

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Date : 13 JULY 2022

APPROVAL

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

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ABSTRAK

Sisa merupakan masalah utama yang sering berlaku di alam sekitar. Dalam banyak kes, kualiti ini tidak berjaya dikenal pasti, tetapi elemen penyelenggaraan penting, seperti penggantian komponen dalaman dan bahagian berputar sistem automatik, telah hilang. Apabila melakukan pembuatan yang kurang, kaedah 5S dan AM sering digunakan. Banyak syarikat, terutamanya syarikat multinasional (MNC), sudah menggunakan kedua-dua strategi ramping ini untuk mengurangkan pembaziran. Untuk membina sebuah syarikat yang menguntungkan, pengurusan mesti menghapuskan bukan nilai tambah (NVA) pada setiap peringkat pekerjaan. Pesanan yang tidak teratur adalah salah satu masalah yang paling biasa, menyebabkan pengendali menghabiskan terlalu banyak masa mencari peralatan mereka dan pekerja bergerak terlalu lama. Jika senarai standard tidak disediakan, pengeluaran mesin akan menjadi kurang produktif dan pekerja akan tidak pasti bagaimana untuk mengelakkan peralatan daripada gagal. Tujuan kajian ini adalah untuk menunjukkan perkaitan proses penyelenggaraan 5S dan autonomi dalam talian laminasi. Penyelidikan ditakrifkan oleh lima proses utama: memilih dan mentakrifkan masalah, menyatakan metodologi penyelidikan melalui kaedah penyelidikan, mengumpul dan menganalisis data, menjalankan aktiviti penambahbaikan, mentafsir keputusan kajian kes, dan menjalankan kajian literatur sepanjang proses penyelidikan. Ia adalah perlu untuk mengenalpasti punca penting dan menyediakan penyelesaian baharu selepas meneliti proses dan menganalisis data melalui carta “Ishikawa” dan "5Whys". Kemudian, sediakan konsep baharu untuk kaedah 5S dan AM, sediakan tugas untuk mengguna pakai alat ramping, dan kakitangan HMS CTRM akan memberikan maklum balas untuk menunjukkan bahawa cadangan itu boleh dilaksanakan. Oleh itu, dengan menggunakan penyelenggaraan autonomi dan alat 5S sebagai garis dasar, ruang dan kawasan mesin boleh dilaraskan untuk memastikan budaya garisan hidup dan sihat.

ABSTRACT

Waste is a major issue that constantly occurs in environmental contexts. In many cases, these qualities were not successfully identified, but significant maintenance elements such as changing inner components of automated systems and spinning parts are lacking. The 5S and AM approaches are commonly employed while implementing lean manufacturing. Many businesses, especially multinational companies (MNCs), have used these two lean strategies to reduce waste. To establish a profitable firm, management must eliminate non-value added (NVA) on each work floor. A disorganized arrangement is one of the most typical concerns, causing the operator to spend time hunting for their equipment and the worker's motion to take too long. If there is no standard checklist in place, the machine's production will be less productive, and the worker will be unsure of how to maintain the equipment from breaking down. The objective of this study is to demonstrate how 5S and Autonomous Maintenance processes are related in the lay-up manufacturing line. This study was defined by five major processes: selecting and defining the problem, describing the study methodology through research methodology, collecting and analyzing data, conducting improvement activities, and interpreting the case study results, with a literature review taking place throughout the study. It is necessary to identify the essential root cause and provide a new solution after examining the process and analyzing the data with the ishikawa diagram and 5Why. Then, offer a new concept for a 5S and AM approach, assign a task for adopting a lean tool, and HMS's CTRM personnel will provide feedback as proof that the proposal can be used. As a consequence, by utilizing the autonomous maintenance and 5S tool as a baseline, the space area and machine may be adjusted in order to maintain the production line culture alive and well.

DEDICATION

To my beloved parent,

My supervisor,
Professor Ts. Dr. Effendi bin Mohamad

My friends that involve in this study,
for giving me moral support, money, encouragement, and understandings
Thank you so much and may God bless all of you

ACKNOWLEDGEMENT

First and foremost, all praises and thanks to God, the Almighty as for His mercy and grace, that had given me strength and perseverance, I was able to complete the throughout my Final Year Project successfully.

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To my family, I am extremely grateful for their love, support, prayers, understanding, and sacrifices for educating and preparing me for my future. Finally, thank you for all my friends and colleagues for their continuous moral support, and encouragement to complete this final year project.

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LIST OF ABBREVIATION

PSM	-	Final Year Project
CTRM	-	Composite Technology Research Malaysia
LM	-	Lean Manufacturing
SME	-	Small and Medium sized Enterprises
TPS	-	Toyota production system
NVA	-	Non-Value Added Activity
VA	-	Value Added Activity
SFM	-	Shop Floor Management
TPM	-	Total Productive Maintenance
JIT	-	Just in Time
PDCA	-	Plan, Do, Check, Act
CI	-	Continuous Improvement
OPE	-	Overall Production Effectiveness
KPI	-	Key Performance Indicator
SOP	-	Standard Operation Procedure
JOS	-	Job Observation Sheet
COIN	-	Cost Optimisation Initiative
FPY	-	First Pass Yield
SW	-	Standardized Work
AM	-	Autonomous Maintenance
NDA	-	Non-Disclosure Agreement
HMS	-	HICOM Management system
OE	-	Operational Excellent

CHAPTER 1
INTRODUCTION

This chapter explains about background of the study, problem statement, objectives, scope, and importance of the study. To complete a bachelor's degree Project (PSM) in Faculty of Manufacturing Engineering (Bachelor of Manufacturing Engineering), researcher chooses to investigate on how to be applying lean in aerospace manufacturing.

1.1 Background of Study

In Japanese industrial definitions, morale and motivation, competitiveness, and adequate workplace culture circumstances are indeed the three key factors that determine the working conditions (Monden, 2011). To remove a facility's six major losses, employee morale and behaviours must be improved, skills must be elevated in order to provide a level playing field for fairness, and a proper and secure atmosphere must be developed to facilitate TPM implementation efforts. Creating a safe and acceptable environment, of course, involves the use of 5S principals. From several situations, these factors were not well recognised, thus they are simply depicted as symbolic acts on the shop floor and on the body of equipment, but significant maintaining aspects such as repairing interior portions of automated systems and spinning elements are absent (Pomorski, 2004). As a result, TPM implementation might be established on the basis of precise and successful 5S. The very first two principles of 5S emphasise removing undesired and unneeded objects from the workplace and concentrate on arranging required items.

The proactive participation of employees in 5S-related activities is a key determinant in their effectiveness. In other words, the performance of 5S is based on worker accountability and dedication to the system. Top executives must reconfirm their pledge to

5S and continuous improvement ahead of a rest of the employees in order to generate a commitment between all rest of the staff. Additionally, people must be taught to accurately grasp 5S and its value, to routinely and methodically analyse 5S implementation, and to optimise any inefficiency in order to ensure the system's longevity. The successful adoption of 5S in the workplace will pave the way for completing tasks that need teamwork. Employees will be willing to make beneficial organizational changes (Moradi et al., 2011).

Autonomous maintenance necessitates the involvement of production line people in routine maintenance. Workers on the production floor should be treated as if they were the proprietors of manufacturing equipment. Consequently, they will make every effort to resolve any issues that arise in order to ensure suitable operating circumstances.

Production quality inside this aerospace industry traditionally implies development of new products; however, even as benefits of incremental innovation grow, intelligent manufacturers are aiming to innovate the production line altogether. Introducing digitalization into another manufacturing process is critical to maintaining a competitive edge, but it may work as a catalyst for innovation at all levels of a company (Jonathan Gray, 2016). The advantages toward a sector in which even minor improvements in quality specifications may result in massive of pounds in savings. Therefore, they examined crucial features of 5S implementation in this research study, which was accompanied by an overview to topics related to 5S. Finally, the consequences of implementing 5S in the lay up production line have been explored, as well as the implications among this implementation on the establishment of TPM in the CTRM aerospace industry

1.2 Problem Statement

The current research was conducted in a pilot area at CTRM Aerospace Composite Industry's Layup 4 where 5S and Autonomous Maintenance were used as a lean technique in this case study. Composites Technology Research Malaysia (CTRM) has completed a large project involving kaizen activity inside the organisation. In order to enhance the company's foundation. The company has its own distinct elements, such as 5S and AM.

Although LM is typically regarded as the easiest instrument to implement, not every firm has been successful in implementing the idea. Furthermore, the 5S and AM is usually

used for physical improvements, such as organising the layup production line space and determining the maximum and minimum equipment and tools that may be used inside the area.

To begin with, one of the issues that must be addressed is the lack of a distinct location for the assistance tool. The corporation instantly recognises that there is widespread disorganisation, as indicated in Figure 1.1 below, and this is almost certainly the first impression that everyone passing by the location has. Aside from that, no defined area for support equipment, a layup table, or a fillet cradle is available.

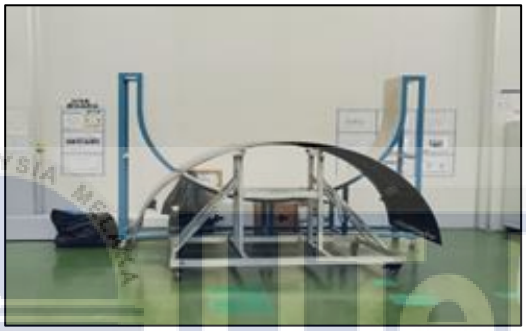

Figure 1. 1 No dedicated area for support tools, layup table and cradle for fillet

Additionally, there were no floor markings to distinguish the production and walkway areas, such as equipment, the route for tying large parts of the aerospace body, the sharpness of the aerostructure parts, and figure 1.2 illustrates this passing persons was severely compromised, there were various obstructions, and it was almost certain that accidents would occur. Aside from that, all work and infrastructures were lacking, making it dangerous if a sharp object falls to the ground, perhaps leads to severe unauthorized events on the production line.

The workplace seemed messy and filthy. Besides producing a massive amount of sharp aerospace components and the designing tool as a result of the cut of pieces, the method itself, due to high safety line, discharges an important amount of space onto the land surrounding the aerospace component. Not only does this make a bad first impression, but it also puts operators in danger.

Figure 1. 2 No floor marking

Apart from that, it is well known that autonomous maintenance is a significant aspect in TPM that can boost work is completed on time, but it is only well understood by the higher management, therefore the primary issue here is to improve the operators' mindset, habit, and cultural. There is indeed a problem with operators who do not fully commit to the task at hand. Next, despite the minor maintenance, there is a lot of downtime in the manufacturing line. This signified that the difficulty on the production floor was caused by a basic issue. Lacking the AM standard form, it will be difficult for the operator to identify and take corrective action in the next event for CNC machine cleaning and inspection. It is critical that we maintain the machinery so that it lasts longer and does not malfunction during working hours.

1.3 Objective

The objectives of this research study are stated as below:

i. To study the current work flow and process at Lay-up production line.
ii. To analyse the problems at Lay-up production line.
iii. To propose the idea of 5S and Autonomous Maintenance techniques at Lay-up production line.

1.4 Scope of Study

This case study is about how to improve of shop floor management, reduce waste by implementing the 5S and autonomous maintenance in order to involve the lean manufacturing toward the digital lean of shop floor management.

This research will be conduct in lay-up production line which in CTRM Aerospace composite industry and guideline is based on the book which the title "New Shop Floor Management Empowering People for Continuous Improvement by Kiyoshi" to implement the lean in a shop floor. Within the company, data gathering was limited to the lay up production line department and therefore to personnel and interactions within this department. Further, the interviews conducted were centred on overall operation member, while observations were conducted at the lay up production line. Furthermore, implementation of 5S and autonomous maintenance needs to include some sort of techniques to optimize the space area.

Figure 1. 3 Lay-up production line

1.5 Significant of Study

In this study, there are some benefit that can be gained by the company after the completion of this study. The improvement rearranges the layout and provide the education manual for operators are standardized inside the lay-up production line in the CTRM aerospace composite industry will be based on the lean method that are using in order to optimize utilization of the available resources. The organizational growth inside the production line will remain sustain, improve the company culture, employee mindset and skill of operator for efficient work.

1.6 Organization of Report

In the PSM 1, this report will be divided into three chapter which is introduction, literature review and methodologies. The contents of each chapter are:

Chapter 1: Elaborate the background, problem statement, objectives, define the scope and significant of study throughout the entire study.

Chapter 2: Explain the relevant theoretical concepts, including the journal, book, use case diagram, website theory, and the chosen implementation platform.

Chapter 3: It describes the basic study method and describes the method chosen to carry out this study and consists of fundamental approach to be taken to achieve the objectives.

Chapter 4: Where the data collected is analysed and explained the idea of implementing the 5S and Autonomous maintenance techniques at Layup production line as a lean practitioner.

Chapter 5: All the study about the case study is conclude. This chapter also explain about the recommendation, sustainability, lifelong learning and complexity for the future to study further about this topic

1.7 Summary

Throughout this chapter, the student has discussed the background of the study, problem statements, objectives, scope of the study, significance of the study, and report organization.

CHAPTER 2
LITERATURE REVIEW

In this chapter, this should discuss relevant work in the fields of manufacturing improved performance, such as total productive maintenance, lean manufacturing, and their potential uses manufacturers, like automotive, devices, resins materials, and others, for several small and medium-sized manufacturers enterprise, particularly older industries organised. Moreover, it will also review about what specific tool of lean that have been using in the aerospace manufacturing.

2.1 Overview of Lean Manufacturing

Toyota production system (TPS) was the one to utilise lean principles after the idea of lean manufacturing was established in Japan (Monden, 2011). Lean manufacturing improves workflows while also increasing worker fulfilment (Singh et al., 2010). Over several small and medium-sized businesses, lean manufacturing (LM) introduces a different management paradigm. In order to ensure quality, production time, and efficiency, the benefits could become considerable. It seems like an application of techniques and procedures, and several industrial businesses have embraced it (Bharadwaj et al., 2015). These criteria were identified in the aerospace industry and attempts to incorporate Lean methods are already well underway. The automobile industry was the first to use lean production. Though lean manufacturing was established only for automobile sector, aerospace manufacturers has discovered that same concepts relate towards this greater industry to enhance performance dramatically.