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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Investigation of Motion Analysis for Productivity Improvement

This report is submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

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DECLARATION

I hereby, declared this report entitled "Investigation of Motion Analysis for Productivity Improvement" is the result of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:

………………………....................................

(Assoc. Prof. Dr. Mohd Rizal Bin Salleh)

ABSTRAK

Motion adalah salah satu muda yang berlaku di syarikat atau industri yang boleh menyebabkan bahaya kepada pekerja, peralatan, atau produk. Kajian menunjukkan bahawa produktiviti penyaringan dan kawasan penyejukan dipengaruhi oleh pergerakan yang tidak perlu dalam proses tersebut. Objektif projek ini adalah untuk meningkatkan produktiviti di Evert (M) Sdn. Bhd. dengan penghapusan gerakan yang tidak perlu. "Investigation of Motion Analysis for Productivity Improvement" adalah tajuk kajian ini. Kajian ini dijalankan di Universiti Teknikal Malaysia Melaka (UTeM). Asas Lean Manufacturing (LM) menggunakan kaedah untuk penambahbaikan berterusan dengan meningkatkan kos operasi dan menghapuskan pembaziran atau modal tidak bernilai tambah dalam sistem pengeluaran. Optimumkan operasi dengan strategi Lean akan meningkatkan produktiviti sesuatu produk, meningkatkan keuntungan syarikat dan mengurangkan sisa gerakan pekerja. Oleh itu, sangat penting untuk memahami dengan tepat alat perkilangan yang diperlukan untuk meningkatkan produktiviti syarikat. Pengumpulan data diperlukan dalam kajian ini yang menumpukan pada pengukuran kerja melalui kajian masa dan pemerhatian. Sisa gerak yang dikenalpasti di kawasan terpilih dalam syarikat dan mencadangkan penambahbaikan yang ideal dengan menggunakan pengetahuan Pengilangan Lean. Perisian simulasi Tecnomatix Plant dapat mengesahkan hasil peningkatan yang dicadangkan. Dalam projek ini, susun atur kemudahan baru di kawasan penyejukan dan penyaringan meningkatkan produktiviti belon. Sebab utama penambahbaikan adalah pengurangan pergerakan pekerja yang tidak perlu.

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ABSTRACT

Motion is one of the wastes happened in the company or industry which may cause harm to employees, equipment, or product. Study shown that the productivity of screening and cooling area are influenced by unnecessary motion in the process. The objective of this project is to improve the productivity at Evert (M) Sdn. Bhd. by the elimination the unnecessary motion. "Investigation of Motion Analysis for Productivity Improvement" is the title of this study. This study is conducted at Evert (M) Sdn. Bhd.. The fundamentals of Lean Manufacturing (LM) utilize methods for continuous improvement by increasing operating costs and eliminating waste or non-value-added capital within the production system. Optimizing operations with a Lean strategy will improve the productivity of a product, improve the profit of the company, and reduce the motion waste of workers. Therefore, it is very important to understand exactly the needed lean manufacturing's tools in enhance the productivity of company. The data collection is needed in this study which concentrate on work measurement by through time study and observation. The motion waste identified in the selected area in company and suggest the improvement ideal with apply the knowledge of Lean Manufacturing. Tecnomatix Plant Simulation Software can validate the result of the improvement that proposed. In this project, the new facility layout in cooling and screening area increased the productivity of the balloon. The main reason of the improvement is the reduction of the unnecessary motion of workers.

DEDICATION

This project is committed to the affection, caring, motivating and helpful environment of my parents, Pheng Kian Hua and Kua Lee Lee, and other family members. These are qualities that contribute to the aura that is always necessary to achieve a head's goals.

ACKNOWLEDGEMENT

First of all, I would like to thank my PSM supervisor, Prof. Madya Dr. Mohd Rizal bin Salleh, for his kindness, guidance, understanding, inspiration, constructive ideas and spending time dreaming about this mission.

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CHAPTER 1

INTRODUCTION

1.1 Background of The Study

Motion analysis is about analyzing the movement of operator or material handler and others in the industrial and manufacturing's production line. Joseph (2013) state that motion analysis on human body can be classified into three type of parts which are the use of human body, the arrangement of the workplace, design of tools and equipment. Human body motion consists of finger motions, wrist motions, forearm motions, upper arm motions, shoulder motions and others. Workplace motion consists 0f three main motion which are distance of drop delivers, the distance between the tools, materials and controls, the arrangement of the workplace and chair. Combination of multiple tools, handling design and equipment design must suit to workers. Temporary delay of work by operators and machines and the combination of the operation or jobs will affect the motion waste in time conservation.

Motion analysis is general approach with a wide field of application, such as medicine, sports, security, and safety monitoring. In medicine field, Kanjanapas & Masayoshi (2013) stated that walking plays a critical role in human locomotion. In this study, the correct motion enhances the health care accessibility and performance.

In industry, motion classified as motion generate by human during working or transportation. Reaching, walking, and stretching motion to take a parts or product on the workbench when the things could be placed more efficiency of use as wasted motion. During those motion, they will have unnecessary time conservation compared to the simple motion. The product travels for a certain period before it actual handling by machine or starts moving is consider as a transportation. During working, there will always have an excessive movement and unnecessary movements within the workspace.

In this study, the focus will be given on motion analysis within the workers. The human motion can be divided into several categories of motion such as simple motion and more complex motion. Simple motion can be represented by certain part of the body movement like arm or leg movements. Simple movement like a walking represented the more complex motion which consists of a sequence of simple motion. In manufacturing section, more complex motion will be studied in term of distance of walking and the manually transportation by workers. According to Christina (2016), waste of motion also caused by poor production planning, poor process design, shared equipment and machines, siloed operations, lack of production standards. As an efficient system map is created, with well plan and recorded standard work, proper use of space can be captured.

In this study, there is a squeezing got to be able to precisely screen body pose and body developments over time and in a wide assortment of settings. Body checking frameworks are required in both the research facility and real-world settings. They ought to be able to precisely track both unobtrusive as well as more pronounced developments. They should be usable for distinctive populaces and in errands that run from a few of minutes to a few hours. Creating frameworks that fulfill these wide-ranging imperatives isn't easy in obtain accuracy result. As a result, numerous frameworks have been created, each focusing on distinctive needs based on the necessities of distinctive inquire about plans. These frameworks can be classified as contact sensors, non-contact sensors, blended frameworks, or manual approaches, and are briefly talked about underneath.

The method used in this research is non-contact approach for human motion analysis. A method is proposed to record upper working motion information from a workstation to other workstation without contact with human skin, compensating. Non-contact approach will usually use camera in capture the movement of the workers. This approach will record the fixed variables like the quantity of the product and the workstation type. These approaches allow capture the human motion in a complete three-dimensional kinematics of full body motion. In this research, time is the most importance parameter for the analysis which is the required measurements.

The importance of the motion analysis is to capture and record the time taken on a movement between two selected places. This time taken helps engineer to figure out the

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problem or the non-value added during the processes. Without eliminating or reducing the waste motion, the manufacturing productivity will be affected on its profitability, flexibility, and productivity. Employee efficiency and effortlessness of the process will be reducing with the impact of excessive motion towards productivity. This non-value added in activities or small motion will increase the impact in high volume work areas. Besides, benefits of lean implementation is enhancing three major stages which are preparation stage, design stage and implementation stage.

In the nutshell, this study proposes an ideal means in enhancing the motion of the workplace and workers. Such ideal can provide the good information that is particularly useful for the manufacturing production. This approach requires various proper human model with fixed distance and fixed quantity and size of production. This helps the data collection have an accurate data analysis with the only one manipulated variable by fixed the other variables.

1.2   Problem Statement

Everts (M) Sdn. Bhd. is a balloon production industry. Everts is continuously implementing and encouraging the adoption of improvement activities in its production line. This study is investigating one selected section in Everts (M) Sdn. Bhd. which is manual quality screening area. This section consists cooling balloon and screening area. This area is a cooling process for finished balloon and quality management workspace that screening the defect balloon for whole production. The workers need to collect the product from the production and distribute it to each of cooling box or cooling machine. The cooling boxes or cooling machines are arranged in a line which the workers need to collect each of the finished cooling tray from left to right. The existing distance of moving the tray of balloon to the others cooling box will take quite some time and inconsistent time conservation to complete the tasks in Table 1.1 and Figure 1.2. Table 1 data obtained on every Monday in November 2020. After completing the cooling process, each worker will be taking turn in finishing their screening process of the balloon from cooling area. There are 8 workers at the screening area to perform the quality control process daily. The production of the finished balloon is faster compared to the time taken in screening process. Therefore, more manpower

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required for the cooling space and screening process. They have very limited workspace to place all the final products in the trays during cooling and screening process shown as Figure 1.1. There are also many excessive movements happened during the transportation of each tray from cooling area to screening area.
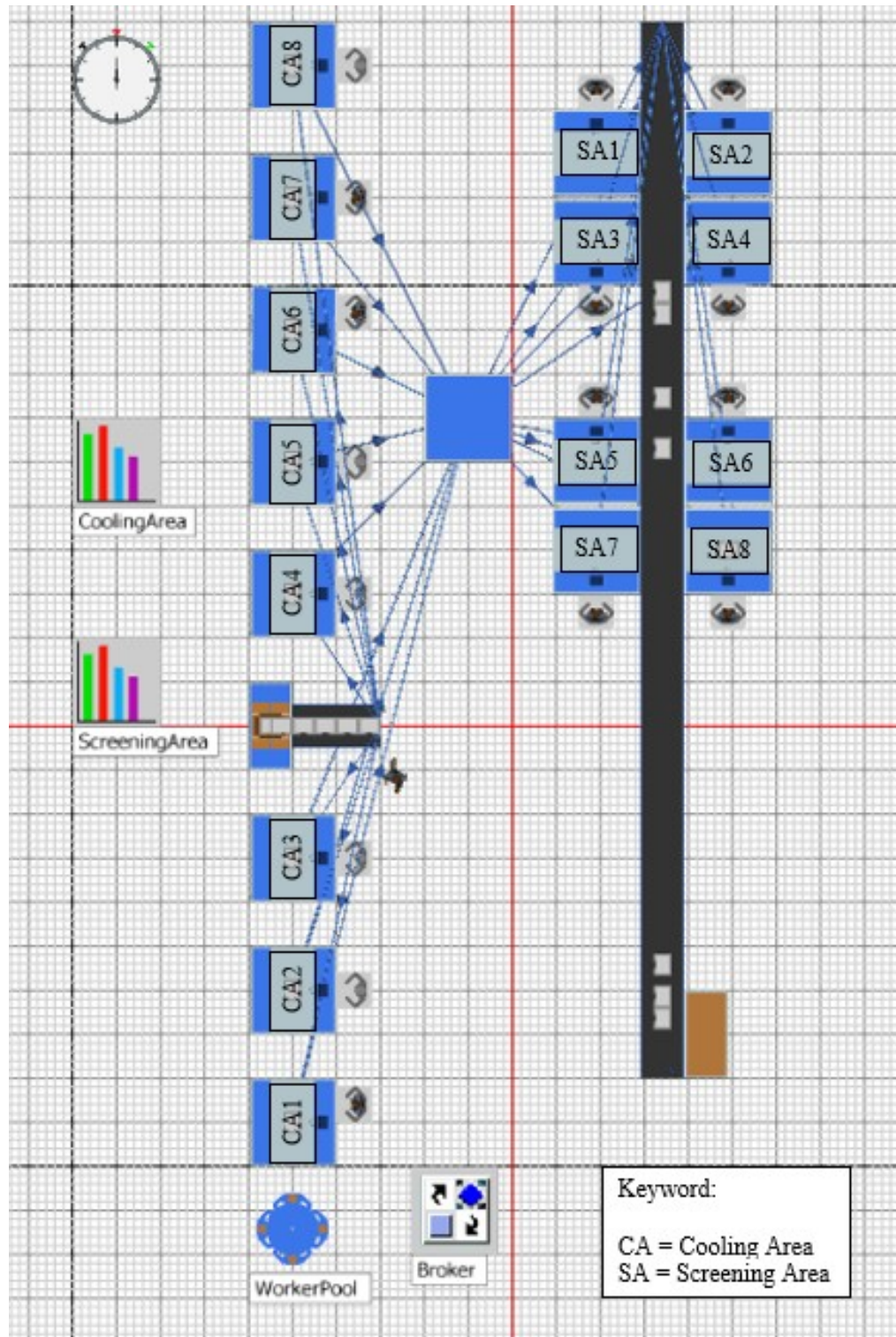
Figure 1.1: The current layout of screening area and cooling area in Everts (M) Sdn. Bhd.

Table 1.1: Time taken of the human motion in screening area.

Screening Area No	Time taken on transport the balloon after cooling process to screening area, secs		Time taken on transport the balloon after screening area to conveyer, secs		Time taken during screening area, min	
	1	2	1	2	1	2
SA1	4	4	6	8	33.38	29.19
SA2	8	9	9	7	14.18	16.51
SA3	3	4	11	13	27.54	26.51
SA4	11	13	12	11	8.01	7.58
SA5	4	4	13	17	28.38	34.31
SA6	13	12	15	17	21.35	18.56
SA7	5	4	17	16	25.45	27.03
SA8	14	15	16	18	17.31	13.16

Figure 1.2: Time taken of the human motion in screening area.

1.3 Objective

The objectives of the study are:

1. To investigate the problem faced based on human motion in cooling and screening area in Everts (M) Sdn. Bhd., Melaka.

2. To propose the new layout by adopting lean concept of the cooling and screening area.

3. To validate the propose layout using simulation tools.

1.4 Scope of Study

This study is introducing the improvement ideas on human motion in an industry. These introduced ideas need to consider 5 factors which are environment, metho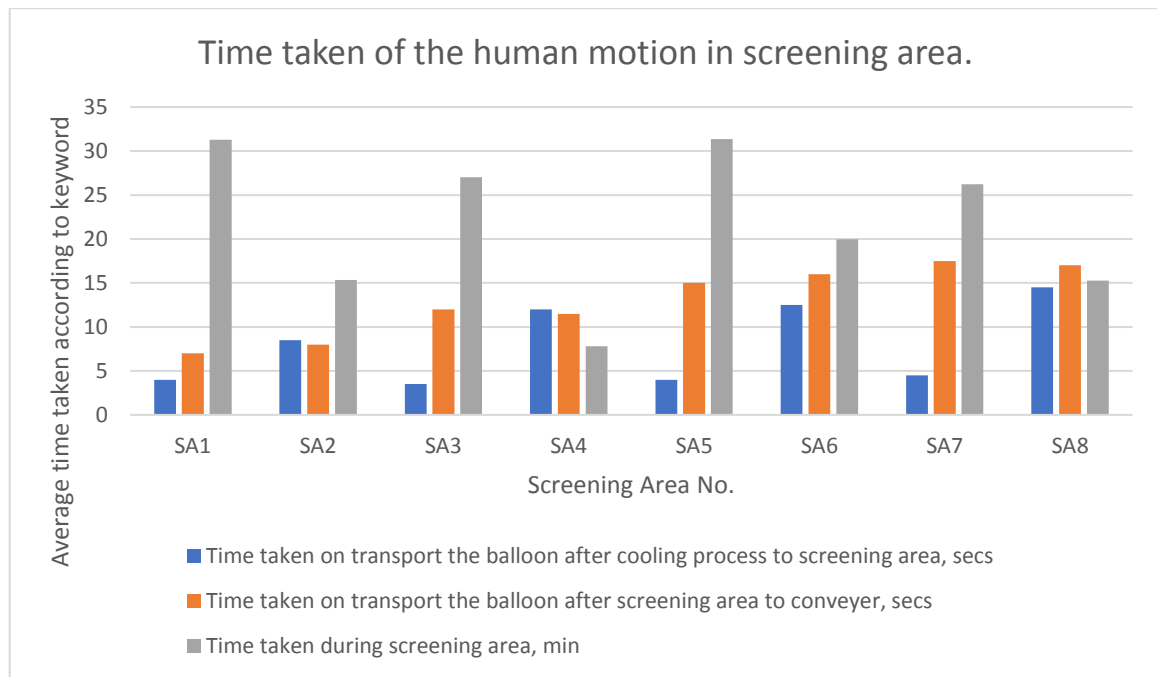d, measurement, man and machine. These factors will help to figure out the root causes issues in term of motion. From the waste analysis, motion has been identified as one of the critical issues that happened at cooling and screening area. Video of each process during cooling and screening process will be captured by camera to measure its cycle time. Analysis of motion will be conducted to analyze each movement made during the assembly processes. The unnecessary or excessive motion will be reducing and cycle time can be shortened.

1.5   Important of Study

This project is critical for improving productivity and optimizing the system of cooling and screening process in Evert (Melaka) manufacturing industry. Upon researching this plan, the waste of repetitive activity or unnecessary motion can be established and removed. Lean approach will determine the most effective tool and technique in process optimization. This project will study the industry process and then facilitate the implementation of the concept of lean manufacturing into the Evert (Melaka) industry when prepared for lean manufacturing.

1.6   Report Outlines

In the motion analysis study, there consist five main chapters. Every chapter have their own meaning and purpose. Below shown the brief descriptions of each chapter:

The goal and justification for this project is indicated in Chapter 1. This section discusses the history of the study. Problems were detected through analysis as well as the operator's conversation. Study aims are accomplished throughout the research and context which reduces the field of study. Study's effect shows how the lean solution benefited the company.

The recent thesis or research related to this research is discussed in Chapter 2. It focuses on the in-depth historical elaboration and the theory of lean manufacturing as well as the software used to authenticate after implementation. This usually covers the study subject hypotheses and prior paper, book and web reviews.

The technique applied in this study is defined in Chapter 3. This chapter discusses how the study was conducted throughout the overall research. Flow chart will be needed in showing the ideal of the study's process This segment addresses the process for collecting information and simulating the results.

Chapter 4 shows the Lean approach to process optimization. This chapter will contain all the process optimization results throughout the validation and simulation with lean approach. This chapter will contain all the process optimization results throughout the validation and simulation with lean approach.

Finally, Chapter 5 provides recaps of the research results and the input from this study. The conclusion and advice on this work is reviewed.

CHAPTER 2
LITERATURE REVIEW

2.1   Introduction

This chapter contains the literature review of motion analysis. Lean manufacturing, 7 wastes, lean tools, simulation tools and others will be discussing in literature review.

2.2   Background of Company

Everts (M) Sdn Bhd, the balloon company was developed in 1924 by Wilhelm Everts as a printing company and distributor of novelties. The company launched its production by producing the balls in 1954. In 1965, Everts began producing its own balloons in Dattein, Germany. Everts (M) Sdn Bhd in Melaka, Malaysia was established as a second manufacturing plant in 1987. In 2011, Everts acquired by Amscan Holdings Inc, the largest party company in the world.

Everts is a modern purposed built plant in Melaka, Malaysia by using the automated machines and equipment in balloon production. Everts can produce 5 colours or all around or global print by the advanced silk screen printing technology. Packing department of this company is very flexible to pack their own internal branded products or private label and handle different materials of the balloon.

Everts sell around 45 various shapes and size with over 60 vibrant colour pallets into different market for decorator, retail and promotion segments. Everts have 2 shifts of production line based on the size of packaging which are small balloon in the morning shift and big balloon in the night shift. Every Everts balloon have products safety certification with TUV product safety GMBH from TUV Rheinland in 1998.

2.3   Motion Analysis

There have 2 type of the motion analysis carry out which are micro motion analysis and macro motion analysis. Based on Kanjanapas and Masayoshi (2013), they are using micro motion for human gait analysis which is human joint motion sensing and torque estimation during walking. Based on Ong et al (2018), micro motion research focuses on human movements of activity in the context of gait assessment applications for medical purposes.

The macro motion analysis stated by Manthan (2017) is the operation or process changes the location of the product, storage wait until needed and delay for start of operation, transportation or inspection. The improvement sequence is defined, it is necessary to draw process flow plan, process operation chart, process chart, flow process chart, work cell loaf chart and route sheet.

Macro motion analysis is the most analysis or approach in improving the manufacturing of a company. Hand the other hand, micro motion analysis only apply on rehabilitation of the hospital or clinic.

2.4   Lean Manufacturing

Five lean principles are a specify value, value stream, flow, pull and perfection. Mimeo (2016) state that specify value is everything that your customer is willing to pay for. It is important to remember that customers enjoy the overall value but are not delivered on a piece. In building up a business, organizer needs to pay attention on the satistification of the customers and brand equity. Womack & Jones (2014) stated that to carry out lean thinking with a precise and details value in terms of the quality of the products and its capabilities. Specifying value accurately is the first critical step in lean thinking.

2.4.1   Value Stream

Value stream is one of the tools needed in lean manufacturing. Masuti & Dabade (2019) stated that the value stream uses the current state map to record the state of the