PROCESS IMPROVEMENT IN MANUFACTURING INDUSTRY USING TIME STUDY AND WORK MEASUREMENT ANALYSIS

NURULWAHIDA BINTI MOHD ZAIN

B051710094

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

PROCESS IMPROVEMENT IN MANUFACTURING INDUSTRY USING TIME STUDY AND WORK MEASUREMENT ANALYSIS

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

by

NURULWAHIDA BINTI MOHD ZAIN

B051710094

960822-03-5500

FACULTY OF MANUFACTURING ENGINEERING

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: ***PROCESS IMPROVEMENT IN MANUFACTURING INDUSTRY USING TIME STUDY AND WORK MEASUREMENT ANALYSIS***

Sesi Pengajian: **2020/2021 Semester 2**

Saya **NURULWAHIDA BINTI MOHD ZAIN (960822-03-5500)**

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.
4. *Sila tandakan (√)

☐ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

☑ TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan)

☐ TIDAK TERHAD

Yang benar:

Alamat Tetap:
No. 7, Jalan Tembusu 5,
Taman Impian Ehsan,
43300 Seri Kembangan, Selangor.

Tarikh: 1 September 2021

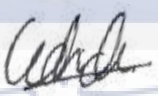
Disahkan oleh:

Cop Rasmi:
NOR AKRAMIN BIN MOHAMAD
Senior Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

Tarikh: 1.9.2021

DECLARATION

I hereby, declared this report entitled “Process Improvement in Manufacturing Industry using Time Study and Work Measurement Analysis” is the result of my own research except as cited in references.

Signature : 

Author’s Name : NURULWAHIDA BINTI MOHD ZAIN

Date : 1st September 2021

APPROVAL

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

Supervisor Signature:

.....

Supervisor's Name : MR. NOR AKRAMIN BIN MOHAMAD

Date : 1st September 2021

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

ABSTRAK

Analisis kajian masa dan kaedah pengukuran kerja merupakan pendekatan analisis saintifik yang bermaksud mencari cara optimum bagi melakukan tugas dan mengukur waktu yang digunakan oleh para pekerja di tempat kerja yang ditetapkan untuk menyelesaikan tugas tertentu. Matlamat utama projek adalah meningkatkan produktiviti di syarikat biskut dengan melaksanakan analisis kajian masa dan kaedah pengukuran kerja. Kerana proses pengeluaran yang panjang, industri tidak dapat memenuhi permintaan tinggi biskut tongkat dari pelanggan. Objektif kajian adalah untuk melakukan masa analisis dan kaedah pengukuran kerja di barisan pembuatan. Kaedah pemerhatian dan rakaman video digunakan bagi mengenal pasti aliran proses biskut tongkat. Kajian tertumpu pada tujuh proses utama dalam pembuatan biskut tongkat, daripada jumlah keseluruhan 17. Bagi kajian terperinci, setiap proses utama dibahagikan kepada beberapa elemen kerja. Pemerhatian pada tujuh proses utama, dengan pertimbangkan masa dan pergerakan setiap tugas yang dilakukan oleh pekerja, dan waktu piawai ditentukan dengan mengambil kira elaun dan penilaian prestasi. Gambar rajah sebab dan akibat digunakan bagi analisis tujuh masalah dalam proses pengeluaran kini. Empat dari tujuh masalah kritikal dianalisis menggunakan 5 mengapa teknik, dan diberi penanggulangan. Tujuan penyelidikan ini juga adalah menyediakan alternatif proses bagi mengurangkan masa pembuatan. Aliran proses yang menuju pengeluaran yang panjang telah ditentukan; terdapat satu proses utama dan tiga elemen kerja yang menyebabkan usaha diperlukan untuk menghasilkan biskut tongkat. Terdapat empat penyelesaian yang telah dicadangkan untuk meningkatkan masa pengeluaran, iaitu penggunaan teknik 5S untuk Proses 1, penggunaan standard baru prosedur operasi (SOP) untuk Proses 2, dan penggunaan peralatan baru untuk proses 4 dan 7. Alternatif yang dicadangkan mampu mewujudkan stesen kerja yang teratur, menjadikan kaedah kerja lebih mudah, dan mengoptimumkan tenaga kerja untuk melaksanakan tugas tertentu.

ABSTRACT

Time study analysis and work measurement method is defined as a scientific analysis approach meant to find the optimum way to do a regular task and measure the time spent by an average worker in a set workplace to accomplish a particular task. The primary goal of this project was to enhance productivity at the biscuit company by implementing time study analysis and work measurement methods. Due to the lengthy production process, the industry was unable to meet the high demand for long rusk biscuits from customers. The objective of the study is to conduct time analysis and work measurement method in the manufacturing line. The approach of direct observation and video recording was used to identify the present process flow of the long rusk biscuit. This study only focuses at the first seven processes in the manufacture of long rusk biscuits, out of a total of 17. For detailed study, each main process was divided into several work elements. The observation was carried out on the seven key processes, taking into consideration the cycle time and motion of each job done by the worker, and the standard time was established by taking allowances and performance rating into account. A cause-and-effect diagram was used to examine seven problems in the present production process. Four of the seven critical issues were analyzed utilizing 5 whys techniques, and each problem was given a countermeasure. Another aim of the research is to provide a process flow alternative to reduce manufacturing time. The process flow that leads in a prolonged production line has been determined; there is one main process and three work elements that cause effort required to produce the long rusk biscuit. There are four solutions that have been proposed to improve the production time, which is adoption of 5S techniques for Process 1, adoption of new Standard Operating Procedure (SOP) for Process 2, and adoption of new equipment for process 4 and 7. The proposed alternatives are capable of creating a well-organized workstation, making the work method easier to execute, and optimizing the labor action to perform the specific task.

DEDICATION

Only

To my beloved parents, who have raised me to be the person who I am today. Thank you for all your unconditional love and for encouraging me when I give up and continue to provide me with moral and emotional support. You are the reason for all the achievements in my life.

To my brothers, who have always shared their words of advice to inspire and encourage me throughout my studies. You're infinitely loving, and giving the spirit is what inspires me when things get difficult.

To my lecturers, because of your sincere concern, my future is brighter, my thinking is clearer, and I hope more doors are opened for me in the future. I will always be grateful for all the hard work and prolonged effort you have made during my studies.

To my love, who always being beside me when I was unable to stand on my own through such a hard time. Thanks for being my unpaid therapist. I will forever be grateful to have you in my life.

I dedicate this work to all of you and I wish you all the happiness.

Thank you so much. May Allah bless all of you.

ACKNOWLEDGMENT

When I did my Final Year Project, it was a beneficial experience that I had to take on the support and advice of some respected people. Praised to Allah S.W.T who gives me health and strength to accomplish my Final Year Project. I would like to express my indebtedness appreciation to my respectful supervisor, Mr. Nor Akramin Bin Mohamad. I thank you for all the reprimand and guidance as it is very helpful for me throughout my Final Year Project. I was greatly influenced by his creativity, sight, sincerity, and encouragement. The special thanks go to my beloved parents, Mr. Mohd Zain Bin Mat Husain, and Mrs. Rosmah Binti Supaat for all their unconditional love with moral and financial support to fulfill my studies. I am also thankful to my industrial supervisor and support team from the biscuit company for their guidance and full during my case study in their factory. Last but not least, I also want to give thanks to my classmates because of the availability from all of them for discussed and shared their knowledge, time, and commitment throughout completing the Final Year Project. Throughout the semester, with all the experience and difficulty, moments of success reminded me of happiness, and times of defeat reminded me of my weaknesses and mistakes. Without the contribution and cooperation of others, my project would not have been workable. With all this, I feel that every day is a new chance to improve myself so that I must keep on grinding.

TABLE OF CONTENT

ABSTRAK	i
ABSTRACT	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENT	v
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xiv
LIST OF SYMBOLS	xv
CHAPTER 1: INTRODUCTION	1
1.1 Overview	1
1.2 Background of Study	2
1.3 Problem Statement	3
1.4 Objectives	4
1.5 Scopes	4
1.6 Significant of Study	4
1.7 Organization of Report	5
CHAPTER 2: LITERATURE REVIEW	6
2.1 History of Time Study Analysis and Work Measurement	6
2.2 Relationship of Time Study Analysis, Work Measurement and Standard Time	7

2.2.1 Methods to Determine Time Standard 8
2.3 Introduction of Technique for Time Study Analysis 10
2.3.1 Equipment for Time Study Analysis 11
2.4 Stopwatch Technique 12
2.4.1 Importance of Stopwatch Technique 13
2.5 Requirement of Conducting Time Study Analysis 14
2.6 Work Sampling Technique 16
2.6.1 Performance Rating 16
2.6.2 Allowance Factor 17
2.7 Introduction of Technique for Work Measurement Method 18
2.8 Motion Study 20
2.9 Relationship of Work Cycle and Time Cycle 20
2.10 Cause Effect Diagram 21
2.11 5S Technique 22
2.12 Decision Matrix Analysis 23
2.13 Productivity of Manufacturing Industry 24
2.14 Summary 24

CHAPTER 3: METHODOLOGY 25
3.1 Flow Chart of the Methodology 25
3.2 Implement Phase 26
3.2.1 Conduct Time Study Analysis and Work Measurement Method 27
3.3 Analyze Phase 32
3.3.1 Create Cause and Effect Diagram 33
3.3.2 Develop Five Whys Technique 34
3.4 Propose Phase 34
3.4.1 Proposal of Improvement 35

CHAPTER 4: RESULTS AND DISCUSSION 36

4.1 Introduction 36

4.2 Flowchart of Long Rusk Biscuit Production 37

4.3 Implementation of Time Study and Work Measurement Analysis 38

4.3.1 Work Element of Process 1 38

4.3.2 Work Element of Process 2 41

4.3.3 Work Element of Process 3 42

4.3.4 Work Element of Process 4 43

4.3.5 Work Element of Process 5 44

4.3.6 Work Element of Process 6 45

4.3.7 Work Element of Process 7 46

4.4 Data Collection of Time Study 47

4.4.1 Observation Time of Process 1 47

4.4.2 Observation Time of Process 2 51

4.4.3 Observation Time of Process 3 52

4.4.4 Observation Time of Process 4 53

4.4.5 Observation Time of Process 5 54

4.4.6 Observation Time of Process 6 55

4.4.6 Observation Time of Process 7 55

4.5 Number of Cycle Time Analysis 56

4.5.1 Number of Cycle Time for Process 1 57

4.5.2 Number of Cycle Time for Process 2 59

4.5.3 Number of Cycle Time for Process 3 59

4.5.4 Number of Cycle Time for Process 4 60

4.5.5 Number of Cycle Time for Process 5 61

4.5.6 Number of Cycle Time for Process 6 61

4.5.7 Number of Cycle Time for Process 7 62

4.6 Standard Time of Work Element for Each Process 63

4.7 Analysis of Critical Issues in Current Process Flow 65

4.7.1 Analysis of Root Cause using Cause-and-Effect Diagram 66

4.7.2 Analysis of Root Cause using Five Whys Technique 70

4.8 Propose an Alternative for Improvement 71

4.8.1 Propose 5S Techniques for Process 1 71

4.8.1.1 Sort 72

4.8.1.2 Set in Order 73

4.8.1.3 Shine 75

4.8.1.4 Standardize 75

4.8.1.5 Sustain 76

4.8.16 Expectation Results of Implementing 5S Techniques 77

4.8.2 Propose a Standard Operating Procedure (SOP) for Process 2 79

4.8.2.1 Expectation of Results of Implementing Standard Operation Procedure (SOP) 80

4.8.3 Propose a New Equipment for Process 4 80

4.8.3.1 Decision Matrix Analysis for Replace the Dough Cutter Option 81

4.8.3.2 Expectation of Results for Change to the 5 Wheel Dough Cutter 83

4.8.4 Propose a New Equipment for Process 7 84

4.8.4.1 Decision Matrix Analysis for Replace the Grease Option 86

4.8.4.2 Expectation of Results for Change to DIY Baking Spray 88

4.9 Verification by Industry Representative 88

CHAPTER 5: CONCLUSION AND RECOMMENDATION 90

5.1 Conclusion 90

5.2 Recommendation 92

5.3 Sustainable Design and Development 92

5.4 Complexity 93

5.5 Life Long Learning 93

REFERENCES 94

APPENDICES 107

A Gantt Chart of Final Year Project 1 107

B Gantt Chart of Final Year Project 2 108

C Flow Chart of the Project 109

D Overall Flow Process Long Rusk Biscuit Production 110

E Flow Process Long Rusk Biscuit Production with Figure 111

F Table of t-distribution 112

G 5S Checklist 113

H Poster for Process of Inserting Mixing Bowl and Hook Beater 114

I Verification Form by Company Representative 115

LIST OF TABLES

1.1	Organization of report	5
2.1	Definitions	8
2.2	Summary of time study techniques	10
2.3	Summary of time study equipment	12
2.4	Summary of stopwatch technique	13
2.5	Summary of importance of stopwatch technique	14
2.6	Requirement of time study analysis	15
2.7	Allowance Factor	18
2.8	Steps to construct Cause and Effect Diagram	21
2.9	Description of 5S	22
4.1	Observation Time of Process 1	48
4.2	Observation Time of Process 2	51
4.3	Observation Time of Process 3	52
4.4	Observation Time of Process 4	53
4.5	Observation Time of Process 5	54
4.6	Observation Time of Process 6	55
4.7	Observation Time of Process 7	56
4.8	Number of Cycle Time for Process 1	57
4.9	Number of Cycle Time for Process 2	59
4.10	Number of Cycle Time for Process 3	60
4.11	Number of Cycle Time for Process 4	60
4.12	Number of Cycle Time for Process 5	61
4.13	Number of Cycle Time for Process 6	62
4.14	Number of Cycle Time for Process 7	62
4.15	Standard Time of Job Element for Each Process	64
4.16	5 Whys analysis	70
4.17	List of option for replace the use of dough for the dough cutting process	81

4.18 Decision Matrix Analysis Unweighted Assessment 82
4.19 Decision Matrix Analysis Weighted Assessment 83
4.20 List of option for replace the use of butter for the greasing process 85
4.21 Decision Matrix Analysis Unweighted Assessment 87
4.22 Decision Matrix Analysis Weighted Assessment 87
4.23 Summary of the comments by industry representative 89

LIST OF FIGURES

2.1	Method to Determine Time Standard	9
3.1	Process flow chart of methodology	26
3.2	Process Flow Chart for Phase 1 to achieve Objective 1	27
3.3	(a) Process to conduct time study	28
3.3	(b) Process to conduct time study	29
3.4	Process Flow Chart for Phase 2 to achieve Objective 2	33
3.5	Process Flow Chart for Phase 2 to achieve Objective 2	35
4.1	Flowchart of long rusk biscuit production	37
4.2	Process 1 – Preparing the ingredient	38
4.3	Process of mixing ingredient A	39
4.4	Process of mixing ingredient B	40
4.5	Process of mix all ingredient in mixing bowl	41
4.6	Process 2 – Mixing the ingredient	42
4.7	Process 3 – Collecting the dough	43
4.8	Process 4 – Cutting dough into small pieces	44
4.9	Process 5 – Weighing the small pieces of dough	45
4.10	Process 6 – Tabling the small pieces of dough	46
4.11	Process 7 – Arranging the small pieces of dough in tray	47
4.12	Cause and effect diagram for critical issues in process in process 1	66
4.13	Cause and effect diagram for critical issues in process in process 2	67
4.14	Cause and effect diagram for critical issues in process in process 3	67
4.15	Cause and effect diagram for critical issues in process in process 4	68
4.16	Cause and effect diagram for critical issues in process in process 5	68
4.17	Cause and effect diagram for critical issues in process in process 6	69
4.18	Cause and effect diagram for critical issues in process in process 7	69
4.19	Current layout of the long rusk biscuit production	72
4.20	Alternative layout of the long rusk biscuit production	73

4.21	Alternatives maps for the ingredient station	74
4.22	Alternatives idea for organizing and labelling for ingredient station	74
4.23	Orimas Universal Mixer with Model GF-201	78
4.24	Standard Operating Procedure (SOP) for work element 2 and 4 in process 2	79
4.25	Plastic dough cutter	80
4.26	Pastry brush	84

LIST OF ABBREVIATIONS

SMEs	-	Small and Medium-sized Enterprises
MTM	-	Method Time Measurement
PTSS	-	Predetermined Time Standard System
MOST	-	Maynard Operation Sequence Technique
PTS	-	Predetermine Time Standard
PMTS	-	Predetermine Motion Time Standard
DTS	-	Direct Time Study
SDS	-	Standard Data System
5S	-	Sort, Set in order, Shine, Standardize, Sustain
SOP	-	Standard Operating Procedure
MCO	-	Movement Control Order
DIY	-	Do It Yourself
OPL	-	One Point Lesson

LIST OF SYMBOLS

R_f	-	Rating factor
P	-	Pace of rating factor
D	-	Job difficulty
S	-	Standard deviation
x	-	Average time of work element
$\bar{x}$	-	Average time of process
n	-	Number of cycles
t	-	t-distribution
k	-	Interval size
T_n	-	Normal time
A_f	-	Allowance factor
T_{std}	-	Standard time

CHAPTER 1

INTRODUCTION

This report illustrates the implementation strategy to increase productivity by a production line in the manufacturing sector. This chapter explains the overall review for the task description including the background of the study, problem statement, objective, and scope of the project development.

1.1 Overview

Productivity enhancement is now one of the most impacted by company processes and management. Both the manufacturing and services industries may be considered as applicable (Piyachat, 2019). According to Hayes et al., (2008), due to the different factors impacting the production line, the efficiency of productivity can encourage a complicated process to be determined where is; Business strategy, vendor competence, machinery competence, manufacturing taxation, the effect of human factors, and variations. This makes it necessary for identity management of the production to evaluate, perceive accurately (Diego et al., 2014). A series of complementary approaches may be adopted or applied as a recommendation for growing efficiency in the industrial sector. This report discusses different approaches to increasing efficiency.

1.2 Background of Study

Time study analysis is the assessment of a particular worker's completion of a specific job or activity to find the most appropriate approach in terms of time reduction. According to Meyers, time standards can be defined as "the time needed to produce a product with the three conditions at a workstation: I a skilled, well-trained operator, (ii) operating at a regular speed, and (iii) performing a specific task.", (Meyers and Stewart, 2001). A constant quest for improvement improves the competitiveness of the market. A constant quest for the enhancement of processes, goods, and services in all organizations improves the competitiveness of the market. If a business does not focus on cost control and maintaining the quality of what it sells, its market survival is threatened. The idea of lean manufacturing and its tools, which seek to minimize all forms of waste within a company, is illustrated in this context.

Time and motion analysis offers strategies for a detailed evaluation of an activity or task, for measuring which actions bring value, and for reducing or eliminating those that do not contribute positively or are perceived loss. It is possible to quantify its potential and improve its efficiency and productivity using a time and motion analysis of a production process, making the company more efficient to the point of getting lower production costs, offering the consumer a quality product at a lower price. A better way to perform the operations of a process can be created by using the analysis of time and motion. Standard movements and times are allocated to each operation, which must be followed so that the company finds better results in the market in which it works. According to Souto (2002), methods engineering studies and analysis work systematically which develop practical and efficient methods, to standardize the process.

1.3 Problem Statement

Generally, the industrial sector leads to the increase of the economy and has an impact on the growth of sustainable production establishment (Yati and Yanfitri, 2010) (Marcel et al., 2018) (Emilia, 2015). Due to the development of the economy, establish value and customer satisfaction are the expectations of the entire manufacturing sector. Promising means that sufficient emphasis is put on the market of goods in order to attract consumers and to build customer loyalty at a certain level. With a rapid increase in demand for production, manufacturing industries need to enhance their production and efficiency potential in order to remain competitive against their competitors. This research was carried out at one of the Small and Medium-sized Enterprises (SMEs) which based in Jasin, Malacca. The nature of the business with this enterprise is the bakery foodstuffs, and long rusk biscuit "Biskut Tongkat" was a best-seller, among other products.

The company is unable to meet the high demand for long rusk biscuits from customers The customer demand of biscuit is 350 to 450 packets per week However, currently the biscuit production is 300 to 340 packets per week, due to the longer production process. The workers have difficulty completing their jobs with the task time allocation by the company. Based on the observation, the planned production process flow is not reliable and consumes a lot of time to meet the customer's requirements and incentives. There is a lack of suitable tools and equipment in the production line, which causes time data variances in several job elements. The current tools and equipment used in the production line also give and effect on the process flow. This will lead the SMEs businesses sector to be unable to adequately schedule their production and satisfy consumer requirements. Long processing times can occur without an acceptable standard operating process and the commodity cannot be shipped on schedule. This is not only unacceptable to consumers, but also a poor reputation for SMEs businesses themselves. This study will expose the factor of affecting the problem occur thereby presenting an effective method for minimizing production time to enhance the productivity in SMEs industry.

1.4 Objectives

The main goal of the project is to increase the industry's productivity. Several sub-objectives have been established and must be accomplished in order to make this project a success:

i. To implement Time Study Analysis and Work Measurement Method in long rusk biscuit production.
ii. To analyze the critical issues of the current biscuit production process flow.
iii. To propose the alternatives for process flow to improve production time.

1.5 Scopes

The scope of this study will concentrate on implementing a time study analysis and a work measurement method in the long rusk biscuit production to determine the standard time necessary to complete each task. The study will focus on the first seven processes out of a total of 17 in the manufacturing of long rusk biscuit at the SMEs of biscuit company. The proposed idea will be given to the company representative in the form of a set of proposals in order to receive feedback. The idea proposed in this study will not be executed or evaluated due to the pandemic Covid-19.

1.6 Significant of Study

Time study analysis and work measurement method are highly significant to be used in manufacturing industry both are regarded as key tools to enhance productivity. It is an impetus to keep the organization going forward and earnings rising. This approach will directly watch and measure skilled labor with a timing device to determine the time necessary for a qualified worker to do the task at a specified level of performance.