IMPLEMENTATION OF DMAIC METHODS TO REDUCE SCRAP IN PLASTIC INJECTION MOLDING AREA AT PT.ABC INDONESIA

UNDERGRADUATE FINAL PROJECT

Submitted as one of the requirements to obtain Sarjana Teknik (S. T.)

By
Denartha Randhika
ID No. 004201900057

FACULTY OF ENGINEERING
INDUSTRIAL ENGINEERING STUDY PROGRAM
CIKARANG
MAY, 2023

PANEL OF EXAMINER APPROVAL

The Panel of Examiners declare that the undergraduate thesis entitled **"Implementation of DMAIC Methods to Reduce Scrap in Plastic Injection Molding Area at PT.ABC Indonesia"** that was submitted by Denartha Randhika majoring Industrial Engineering from the Faculty of Engineering was assessed and approved to have passed the Oral Examination on 31th May 2023

Panel of Examiner

Ir. Adi Saptari, M.Sc., Ph.D.

Chair of Panel Examiner

Athina Sakina Ratum, S.T., M.Sc.

Examiner I

THESIS ADVISOR RECOMMENDATION LETTER

This thesis entitled "**Implementation of DMAIC Methods to Reduce Scrap in Plastic Injection Molding Area at PT.ABC Indonesia"** is prepared and submitted by **Denartha Randhika** in partial fulfillment of the requirements for the degree of Bachelor Degree in the Faculty of Engineering has been reviewed and found to have satisfied the requirements for a report fit to be examined. I therefore recommend this final project for Oral Defense.

Cikarang, Indonesia, May 31st , 2023

Ir. Andira Taslim M. T.

STATEMENT OF ORIGINALITY

In my capacity as an active student of President University and as the author of the undergraduate thesis/final project/business plan stated below:

Name	: Denartha Randhika
Student ID number	: 004201900057
Study Program	: Industrial Engineering
Faculty	: Engineering

I hereby declare that my undergraduate thesis/final project/business plan entitled **"Implementation of DMAIC Methods to Reduce Scrap in Plastic Injection Molding Area at PT.ABC Indonesia "** is to the best of my knowledge and belief, an original piece of work based on sound academic principles. If there is any plagiarism, including but not limited to Artificial Intelligence plagiarism, is detected in this undergraduate thesis/final project/business plan, I am willing to be personally responsible for the consequences of these acts of plagiarism, and accept the sanctions against these acts in accordance with the rules and policies of President University.

I also declare that this work, either in whole or in part, has not been submitted to another university to obtain a degree.

Cikarang, 31st May 2023

(Denartha Randhika)

SCIENTIFIC PUBLICATION APPROVAL FOR ACADEMIC INTEREST

As an academic community member of the President's University, I, the undersigned:

Name : Denartha Randhika
Student ID number : 004201900057
Study program : Industrial Engineering

for the purpose of development of science and technology, certify, and approve to give President University a non-exclusive royalty-free right upon my final report with the title:

Implementation of DMAIC Methods to Reduce Scrap in Plastic Injection Molding Area at PT.ABC Indonesia

With this non-exclusive royalty-free right, President University is entitled to converse, to convert, to manage in a database, to maintain, and to publish my final report. There are to be done with the obligation from President University to mention my name as the copyright owner of my final report.

This statement I made in truth.

Cikarang, 31st May 2023

(Denartha Randhika)

ADVISOR'S APPROVAL FOR JOURNAL/INSTITUTION'S REPOSITORY

As an academic community member of the President's University, I, the undersigned:

Name : Ir. Andira Taslim M. T.
ID number/ NIDN : 0426037002
Study program : Industrial Engineering
Faculty : Faculty of Engineering

declare that following thesis:

Title of thesis : Implementation of DMAIC Methods to Reduce Scrap in Plastic Injection Molding Area at PT.ABC Indonesia
Thesis author : Denartha Randhika
Student ID number : 004201900057

will be published in **journal/institution's repository.**

Cikarang, 31st May 2023

(Ir. Andira Taslim M. T.)

Implementation of DMAIC Methods to Reduce Defect in Plastic Injection Molding Area at PT.ABC Indonesia

By:

Denartha Randhika

ID No. 004201900057

Approved by

Ir. Andira Taslim M. T.

Final Project Advisor

Ir. Andira Taslim M. T.

Study Program Head of Industrial Engineering

SIMILIARITY CHECKING RESULT

Final Project - Denartha Randhika - IMPLEMENTATION OF DMAIC METHODS TO REDUCE SCRAP IN PLASTIC INJECTION MOLDING AREA AT TOY MANUFACTURING COMPANY, INDONESIA

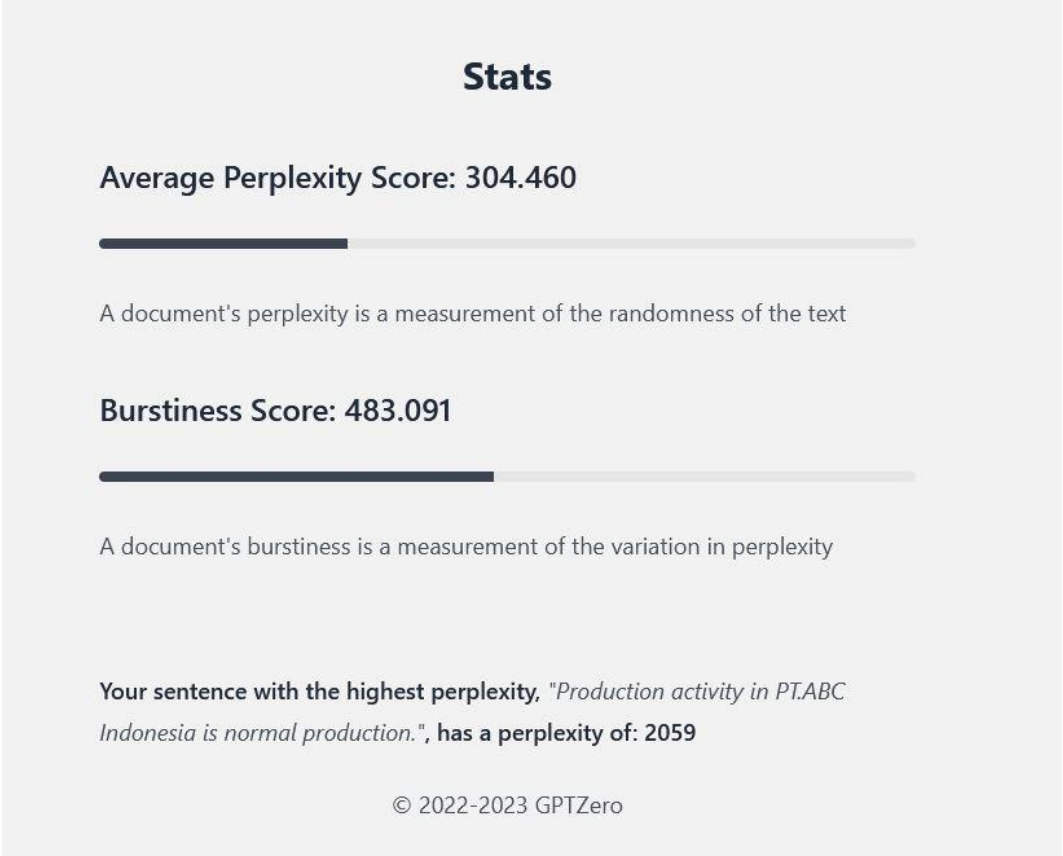
ORIGINALITY REPORT

7%	4%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.president.ac.id Internet Source	1%
2	docobook.com Internet Source	<1%
3	Amitava Mitra. "Fundamentals of Quality Control and Improvement", Wiley, 2021 Publication	<1%
4	International Journal of Lean Six Sigma, Volume 1, Issue 3 (2012-08-06) Publication	<1%
5	duepublico.uni-duisburg-essen.de Internet Source	<1%
6	dokumen.pub Internet Source	<1%
7	The TQM Magazine, Volume 17, Issue 1 (2006-09-19) Publication	<1%

AI BASED PLAGIARISM CHECKING RESULT



ABSTRACT

PT.ABC Indonesia has a project to reduce high number of scraps in Primary Production area. Plastic Injection Molding area contributes over 50% from total scrap in Primary Production area and resulted scrap value that total Rp. 378.803.000 in first quarter of 2023. These scraps happen because of the changeover process procedure. This research use Lean Six Sigma approach through DMAIC Methodology. Several improvements are implemented new procedure for color change and tool change without purging process and slide the hopper when Daily Schedule Adherence achieve 95%. The improvement resulted 57% reduction of scrap in Plastic Injection Molding. In detail, color change and tool change procedure reduce 62% scrap, While the slide hopper process was reduce wrong color scrap by 16%. By this research, the company already saving the cost Rp. 49.237.000 and predicted will save up to Rp. 434.660.000 by the end of year 2023.

Keywords: *DMAIC, Lean, Six Sigma, Plastic Injection Molding, Purging, Scrap, Wrong Color*

ACKNWOLEDGEMENT

In the name of Sanghyang Adi Buddha, the most Gracious and the most merciful, all praises to Buddha for the strengths and His blessing in completing this final project report. This research has been kept on track and been seen through to completion with the support and encouragement of numerous people. At the end, I would like to express my gratitude to:s my gratitude to:

1. Mam Ir. Andira Taslim M.T. as my thesis advisor who give me a lot of suggestion, advice, and support from the beginning of my final project until I finish this final project. Thank you for being a very kind mentor for me and inspiring me to do better.
2. My beloved family: My dad, Mom, Koko Dimas, Cece Ayu, Cece Lili who always support me in all things I have done. I wouldn't have arrived at this point if they were not supporting me. I love you 3000 in every universe.
3. All industrial engineering study program lecturer who taught me from the beginning of my university until now I am reaching the end of my university life. Thankyou for sharing the preciouse knowledge to me.
4. All of PT.ABC Indonesia employee especially Mr.AM, Mr.WDC, Ms.GS, Mr.SW as my internship supervisor and manager. Thankyou for all the internship knowledge and experiences.
5. My dearest friend, Gissa A. Supit who make me feeling lovely and burn my spirit to finish this final project.
6. Two Musketeers. Arifky Aldi & Prima Yahya Yudistira, thanks for the coloring my university life with all those crazy party that support my worklife balance.
7. Industrial Engineering 2019, Mr. & Ms. President University, Ikatan Koko Cici Jawa Barat, PUBA. Thankyou for the support. Let us graduate together!
8. Others that I cannot mention one by one. Thankyou for all support, help, and experience that given to me.

Sincerely,

Denartha Randhika (Mr.Koko)

TABLE OF CONTENTS

PANEL OF EXAMINER APPROVAL ..... **ii**

FINAL PROJECT ADVISOR RECOMMENDATION LETTER ..... **iii**

STATEMENT OF ORIGINALITY ..... **iv**

SCIENTIFIC PUBLICATION APPROVAL FOR ACADEMIC INTEREST **v**

ADVISOR'S APPROVAL FOR PUBLICATION ..... **vi**

SIMILIARITY CHECKING RESULT ..... **viii**

AI BASED PLAGIARISM CHECKING RESULT ..... **ix**

ABSTRACT ..... **x**

ACKNWOLEDGEMENT ..... **xi**

TABLE OF CONTENTS ..... **xii**

LIST OF TABLES ..... **xv**

LIST OF FIGURES ..... **xvi**

LIST OF TERMINOLOGIES ..... **xviii**

CHAPTER I INTRODUCTION **1**

1.1 Problem Background 1

1.2 Problem Statement 2

1.3 Objective 2

1.4 Scope 3

1.5 Assumptions 3

1.6 Research Outline 3

CHAPTER II LITERATURE STUDY **5**

2.1 Lean Six Sigma 5

2.1.1 Lean 5

2.1.2 Six Sigma 7

2.1.3 The Integration of Lean and Six Sigma 8

2.2 Quality 9
2.3 Quality Control 10
2.4 DMAIC Methodology 11
2.5 7 Quality Control Tools 14
2.6 Process Capability 21
2.7 Plastic Injection Molding 22
CHAPTER III RESEARCH FRAMEWORK 27
3.1 Research Methodology 27
3.1.1 Initial Observation 28
3.1.2 Problem Identification 28
3.1.3 Literature Study 28
3.1.4 Data Collection & Analysis 29
3.1.5 Conclusion and Recommendation 29
3.2 Research Framework 30
CHAPTER IV DATA COLLECTION & ANALYSIS 32
4.1 Research Overview 32
4.1.1 Production Flow in PT.ABC Indonesia 32
4.1.1.1 Plastic Stream 33
4.1.1.2 Head Stream 33
4.1.1.3 Fabric Stream 33
4.1.1.4 Final Assembly Stream 33
4.1.2 Introduction to Project 33
4.2 Raw Data Collection 34
4.3 Analysis: DMAIC Methodology 36
4.3.1 Define Phase 36
4.3.1.1 Problem Statement 36
4.3.1.2 Business Flow Process 38
4.3.1.3 Business Case 39
4.3.1.4 Goals and Scope of the Project 41
4.3.1.5 Project Team 42
4.3.1.6 Timeline 42
4.3.2 Measure Phase 43
4.3.2.1 Baseline Performance 43

4.3.3 Analyze Phase 45
4.3.3.1 Root Cause Analysis 46
4.3.3.2 Root Cause Verification 50
4.3.4 Improve Phase 52
4.3.4.1 Generating Alternative Solution 52
4.3.4.2 Solution Selection 53
4.3.4.3 Improvement Plan 55
4.3.4.4 Implementation 56
4.3.5 Control Phase 59
4.3.5.1 Standard Operation for Change Over 59
4.3.5.2 Stop PVC Machine Procedure 61
4.3.5.3 Empty Barrel Reporting 61
4.3.5.4 Scrap Audit 62
4.4 Comparison Before and After Improvement and Saving 62
4.4.1 Scrap from East Plant Manufacturing by Area 62
4.4.2 Scrap Breakdown from Plastic Injection Molding Area 64
4.4.3 Cost Saving 65
4.5 Room for Improvement 66
4.5.1 Tool Change Scheduling 66
4.5.2 Pigment 67
4.5.3 Wrong Color Utilization 67
CHAPTER V CONCLUSION & RECCOMENDATION 69
5.1 Conclusion 69
5.2 Recommendations 70
REFERENCE 71

LIST OF TABLES

Table 2. 1 Relationship Between Component Quality and Final Product Quality . 8
Table 2. 2 Cost Benefit Scale Meaning 14
Table 2. 3 Types of Graphs and the Purpose 20
Table 4. 1 Types of Scrap 34
Table 4. 2 Scrap Value Quarter 1 2023 35
Table 4. 3 Primary Production Area Scrap 35
Table 4. 4 Timeline of Project 42
Table 4. 5 Root Cause Verification 50
Table 4. 6 Alternative Solution 52
Table 4. 7 Solution Selection Score 53
Table 4. 8 Improvement Action Plan 55
Table 4. 9 Cost Saving Calculation 65

LIST OF FIGURES

Figure 2. 1 Lean Management & Six Sigma Improvement Nature 9
Figure 2. 2 Solution Selection Matrix 13
Figure 2. 3 Pareto Diagram 15
Figure 2. 4 Cause and Effect Diagram 16
Figure 2. 5 Histogram 17
Figure 2. 6 Control Chart 17
Figure 2. 7 Xbar – R Chart 19
Figure 2. 8 Scatter Diagram 20
Figure 2. 9 Cp Concept 21
Figure 2. 10 C_{pk} index 22
Figure 2. 11 Plastic Injection Molding Machine Diagram 24
Figure 2. 12 Plastic Scrap 26
Figure 3. 1 Research Methodology 27
Figure 3. 2 Research Framework 31
Figure 4. 1 Production Flow 32
Figure 4. 2 Pareto Chart of Scrap per Production Area 2023 37
Figure 4. 3 Scrap Value Primary Production Area 2023 37
Figure 4. 4 Process Flow Plastic Injection Molding Area 38
Figure 4. 5 Plastic Injection Molding Scrap Value Variation 40
Figure 4. 6 Pie Chart Top 5 Scrap Value Plastic Injection Molding 40
Figure 4. 7 SMART Goals 41
Figure 4. 8 Weekly Scrap Plastic Injection Molding January – March 2023 44
Figure 4. 9 Weekly Purging Scrap Plastic Injection Molding January – March 2023 44
Figure 4. 10 Weekly Wrong Color Scrap Plastic Injection Molding January – March 2023 45
Figure 4. 11 Wrong Color Scrap Fishbone Diagram 47
Figure 4. 12 Factor in Method Category 47

Figure 4. 13 Factor in Machine Category 48
Figure 4. 14 Factor in Material Category 48
Figure 4. 15 Purging Scrap Fishbone Diagram 49
Figure 4. 16 Factor in Method Category 49
Figure 4. 17 Factor in Machine Category 50
Figure 4. 18 Color Change and Tools Change Illustration 51
Figure 4. 19 Solution Selection Matrix 55
Figure 4. 20 Current Changeover Procedure 56
Figure 4. 21 Color Change without Purging Illustration 57
Figure 4. 22 Tool Change without Purging Illustration 58
Figure 4. 23 Hopper Position when DSA Achieve 95% 58
Figure 4. 24 SOP Changeover Plastic Injection Molding 60
Figure 4. 25 SOP Stop PVC Machine 61
Figure 4. 26 Empty Barrel Reporting 61
Figure 4. 27 Scrap Audit 62
Figure 4. 28 Scrap Trend East Plant Manufacturing by Area 63
Figure 4. 29 Scrap Value Trend East Plant 2023 63
Figure 4. 30 Weekly Scrap Plastic Injection Molding Area 2023 64
Figure 4. 31 Weekly Wrong Color Scrap and Purging Scrap 2023 64
Figure 4. 32 Comparison Week 1 – 14 between 2022 Versus 2023 65
Figure 4. 33 Proposed Scheduling for Tool Change 66
Figure 4. 34 Pigment Black & Pigment Gold 67
Figure 4. 35 Wrong Color Utilization Process 68