

THESIS

STRATEGIC APPLICATION OF CUSTOMER OPERATION IMPROVEMENT PROGRAM
(COIP) FOR OPTIMIZING 125-TON EXCAVATOR PRODUCTIVITY AT PT XYZ

By

WETA HARY WAHYUNUGRAHA
22452028

MASTER'S DEGREE
in

MASTER OF MECHANICAL ENGINEERING - ENGINEERING MANAGEMENT
FACULTY OF ENGINEERING & INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143
Revision after the Thesis Defense on 11 August 2025

August 2025

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work, and to the best of my knowledge, it contains no material previously published or written by another person, nor material that to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



Weta Hary Wahyunugraha

Student

25 August 2025

Date

Approved by:



Togar Wiliater Soaloon Panjaitan, S.T., MBA., Ph.D.

25 August 2025

Date

Thesis Advisor



Dr. Yunita Umniyati, S.Si., M.Sc.

25 August 2025

Date

Thesis Co-Advisor

Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc.

25 August 2025

Date

Dean of Faculty of Engineering & Information
Technology

ABSTRACT

STRATEGIC APPLICATION OF CUSTOMER OPERATION IMPROVEMENT PROGRAM (COIP) FOR OPTIMIZING 125-TON EXCAVATOR PRODUCTIVITY AT PT XYZ

By

Weta Hary Wahyunugraha
Togar Wiliater Soaloon Panjaitan, S.T., MBA., Ph.D., Advisor
Dr. Yunita Umniyati, S.Si., M.Sc, Co-Advisor

SWISS GERMAN UNIVERSITY

Persistent productivity fluctuations in heavy equipment remain a critical challenge in the mining sector, yet studies on the application of the Customer Operation Improvement Program (COIP) within mining operations are still limited. Most prior research focuses on service and manufacturing contexts, creating a gap in understanding COIP's potential for optimizing large-scale mining productivity. This study employs COIP utilizing the DMAIC (Define–Measure–Analyze–Improve–Control) framework to enhance the performance of 125-ton excavators at PT XYZ, operating in an open-pit coal mining environment. A qualitative-descriptive approach was adopted, supported by primary data from on-site observations, semi-structured interviews, and COIP digital scoring, as well as secondary data from performance logs and maintenance records (Aug–Dec 2024). Key interventions included operator refresher training, standardization of SOPs, predictive maintenance scheduling, and deployment of a real-time KPI dashboard. These initiatives resulted in measurable improvements—productivity increased from 413 to 505 BCM/hour, while downtime decreased from 17% to 5%. The findings demonstrate that COIP, when adapted to the mining context and supported by digital monitoring systems, can effectively stabilize equipment performance, reduce operational waste, and enhance competitiveness. This research not only addresses a clear gap in COIP applications for the mining industry but also provides a practical framework for achieving sustained operational excellence in heavy equipment-intensive sectors.

Keywords: COIP, DMAIC, Excavator Productivity, Mining Operations, Preventive Maintenance, KPI Dashboard.

© Copyright 2025
by Weta Hary Wahyunugraha
All rights reserved



DEDICATION

This thesis is wholeheartedly dedicated to:

My beloved parents, for their unwavering love, sacrifices, and endless support that have been the foundation of my journey.

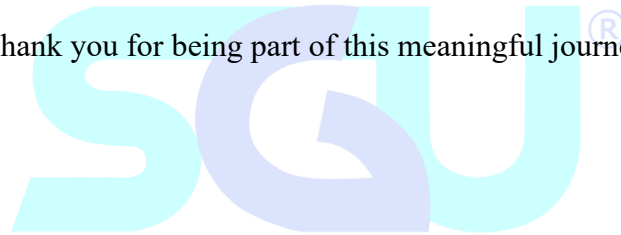
My beloved family, whose encouragement and belief in me provided strength in every step of this academic pursuit.

My respected lecturers and thesis advisors, whose guidance and knowledge shaped the course of this research and inspired me to strive for excellence.

Swiss German University, for providing an environment that fostered learning, growth, and discovery.

And to all individuals—friends, colleagues, and field collaborators—who contributed their time, insights, and support throughout this research process.

Thank you for being part of this meaningful journey.



ACKNOWLEDGEMENTS

First and foremost, I would like to express my deepest gratitude to Allah SWT for the strength, health, and perseverance granted to me throughout the completion of this thesis.

I would like to extend my sincere appreciation to my thesis advisor, **Togar Wiliater Soaloon Panjaitan, S.T., MBA., Ph.D.**, and my co-advisor, **Dr. Yunita Umniyati, S.Si., M.Sc.**, for their invaluable guidance, insight, and constructive feedback. Their expertise and support were crucial throughout the research process and significantly enriched the quality of this work.

My heartfelt thanks also go to all the lecturers and academic staff of **Swiss German University**, who have shared their knowledge and continuously supported my academic journey. It has been a privilege to learn and grow in such a stimulating environment.

To **PT XYZ** and all parties involved in the research activities—field supervisors, operators, and technical teams—thank you for your cooperation, data access, and contributions that made this study possible.

To my **beloved family**, especially my parents, I am forever indebted for your unconditional love, support, and prayers. Your encouragement gave me the strength to overcome every challenge along the way.

Lastly, to my colleagues and friends who stood by me with encouragement and understanding—thank you for your presence and inspiration during this journey.

This thesis is a reflection of the support, patience, and shared dedication of all those mentioned, and I am truly grateful.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	1
ABSTRACT.....	2
DEDICATION.....	4
ACKNOWLEDGEMENTS.....	5
TABLE OF CONTENTS.....	6
LIST OF FIGURES	8
LIST OF TABLES.....	9
1. CHAPTER 1 - INTRODUCTION.....	10
1.1 Background.....	10
1.2 Research Problems.....	13
1.3 Research Objective	13
1.4 Significance of Study.....	14
1.5 Research Questions.....	14
1.6 Hypothesis.....	15
1.7 Scope and Limitation	16
2. CHAPTER 2 - LITERATURE REVIEW.....	17
2.1 Heavy Equipment Management in Mining.....	17
2.2 Challenges in Equipment Management	17
2.3 Best Practices in Equipment Management	18
2.4 Factors Affecting Excavator Productivity	18
2.5 Operational Efficiency in Mining.....	20
2.6 Competitiveness in the Mining Industry.....	20
2.7 Strategies for Enhancing Operational Efficiency	21
2.8 Equipment Optimization Strategies in the Mining Sector	23
2.9 Customer Operation Improvement Program (COIP).....	23
2.10 DMAIC Method.....	27
2.11 PDCA Method	28
2.12 Statistical Validation.....	30
2.13 Kaizen	30
2.14 Comparison of COIP and Other Strategic Performance Management Tools	32

2.15	Literature Review.....	34
3.	CHAPTER 3 - RESEARCH METHOD.....	37
3.1	Research Methodology	37
3.2	Problem identification.....	38
3.3	Literature Review.....	39
3.4	Research Objective	40
3.5	Data Collection	40
3.6	Data Analysis Using DMAIC	41
3.7	Research Timeline	45
4.	CHAPTER 4 – RESULT AND DISCUSSION.....	46
4.1.	Overview of Data Collection and COIP Integration.....	46
4.2.	DEFINE—Operational Problem Identification	48
4.3.	MEASURE – Baseline COIP Key Performance Indicators (KPI)	50
4.4.	ANALYZE – Root Cause Identification.....	54
4.5.	IMPROVE—COIP-Based Improvement Plan.....	61
4.6.	CONTROL – Monitoring and Sustainability Plan.....	71
5.	CHAPTER 5 – CONCLUSION AND RECOMMENDATION	74
5.1.	Conclusion	74
5.2.	Recommendation	74
5.3.	Future Research	74
	REFERENCE.....	76
	APPENDIX.....	79
	CURRICULUM VITAE	82

LIST OF FIGURES

Figure 2.1 Framework of COIP 26

Figure 3.1 Research Flowchart 38

Figure 4.1 Root Cause Analysis..... 55

Figure 4.2 Operator Competency (Post-Training)..... 62

Figure 4.3 The Excavator SOP Workflow with Precise Angles and Zero-Residual Requirements
..... 63

Figure 4.4 Predictive Maintenance 65

Figure 4.5 Real-Time Excavator KPI 66

Figure 4.6 Closed-Loop Feedback System 68



LIST OF TABLES

Table 2.1 Comparison of COIP and Other Strategic Performance Management Tools 32

Table 2.2 Literature Review 34

Table 3.1 Mapping of COIP Parameters to DMAIC Stages 42

Table 4.1 Excavator Performance 47

Table 4.2 Baseline KPI Measurement Summary Table (Aug–Dec 2024) 51

Table 4.3 Quantitative Analysis (Paired t-tests) 57

Table 4.4 Qualitative Analysis (Thematic Frequency) 57

Table 4.5 Correlation Analysis 58

Table 4.6 Sustainability Implementation Framework 59

Table 4.7 Long-Term Sustainability Roadmap 60

Table 4.8 Summary of Successes vs. Challenges per Objective 68

Table 4.9 Benefit Analysis of COIP Implementation at PT XYZ 70

