

**STRATEGY TO INCREASE PHYSICAL AVAILABILITY OF KOMATSU
HD785-7 FOCUS ON FRAME & BODY AREAS THROUGH MAINTENANCE
APPROACH AND FMEA AT PT. UNITED TRACTORS SITE SATUI**

By

FAHMI AFRIANSA

22452018

MASTER'S DEGREE

In

MECHANICAL ENGINEERING – ENGINEERING MANAGEMENT

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 – Indonesia

Revision after the Thesis Defense on 20 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 which 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.



Fahmi Afriansa

Student

Date: 30 August 2025

Approved by:



Dr. Ir. Eka Budiarto, S.T., M.Sc.

Thesis Advisor

Date: 30 August 2025

Dr. Eng Aditya Pratama, S.Si., M.T

Thesis Co-Advisor

Date: 31 August 2025

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

Dean

Date: 31 August 2025

ABSTRACT

STRATEGY TO INCREASE PHYSICAL AVAILABILITY OF KOMATSU HD785-7 FOCUS ON FRAME & BODY AREAS THROUGH MAINTENANCE APPROACH AND FMEA AT PT. UNITED TRACTORS SITE SATUI

By

Fahmi Afriansa

Dr. Ir. Eka Budiarto, S.T., M.Sc. Advisor

Dr. Eng. Aditya Tirta Pratama, S.Si., M.T. Co-Advisor

SWISS GERMAN UNIVERSITY

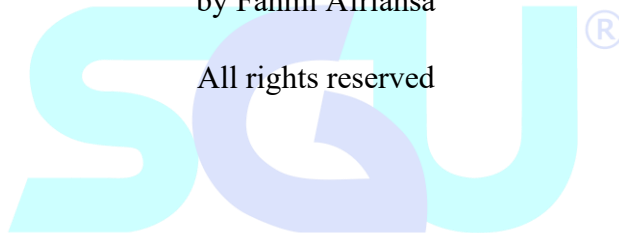
This study addresses recurring chassis failures of Komatsu HD785-7 dump trucks at PT United Tractors Site Satui, where structural cracks contributed to 40,1% of total downtime in 2023, reducing Physical Availability (PA) below the contractual target of 92%. The objective is to restore PA through an optimized maintenance strategy using the DMAIC framework. Analytical tools including pareto analysis, why-why analysis, and failure mode and effect analysis were applied to identify high-risk positions and determine corrective actions. Crack mapping was introduced to standardize inspection points, while repair and reinforcement methods were compared based on lifetime, redo rate, downtime, and cost. Results show that reinforcement extends component lifetime beyond 3.000 hours, reduces redo rates to below 15%, and provides long-term cost efficiency despite higher initial expense. The study concludes that integrating crack mapping with FMEA based decision making effectively reduces structural failures and enables PA recovery to exceed 92%, offering a replicable method that can be applied to other mining equipment models.

Keywords: Crack Failure, FMEA, Mining Equipment Reliability, Physical Availability, Repair vs Reinforcement,

© Copyright 2025

by Fahmi Afriansa

All rights reserved



DEDICATION

This thesis is my gift to my parents who has educated me with patience, taught the sciences of life, and tirelessly loves me to this day.

This thesis is a special offering for my beloved wife. Thank you for your support, kindness, care and wisdom. Thank you for telling me how to live an honest and happy life.

I dedicate this thesis especially to my children who have given up losing their playing time with me because of work and college time.



ACKNOWLEDGEMENTS

With His grace, Alhamdulillah, the author can complete this thesis on time. This thesis will not be completed without the help and support of various parties. The author would like to express my deepest gratitude to all those involved in writing this thesis, namely:

1. Syafril and Fetty Choeroyyaroh as the author's father and mother who always support and wish their son the success.
2. Sekar Arum, Shenna Prameswari, Defita & Esty as my family who always support to the author.
3. Dr. Ir. Gembong Baskoro, M.Sc as SGU's SDC Director who always provides motivation and education
4. Dr. Ir. Eka Budiarto, S.T., M.Sc. and Dr. Eng. Aditya Tirta Pratama, S.Si., M.T. as Advisor and Co-Advisor who always gave directions and corrections in writing the thesis.
5. Dr. Ir. Maulahikmah Galinium, S.Kom, M.Sc. as Dean of the Faculty of Engineering and Information Technology at Swiss German University who has streamlined the thesis writing process.
6. Swiss German University student friends who always support and encourage each other from the beginning to the end of the lecture period.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR	2
ABSTRACT	3
DEDICATION	5
ACKNOWLEDGEMENTS	6
TABLE OF CONTENTS	7
LIST OF FIGURES	11
LIST OF TABLES	14
LIST OF EQUATION	16
CHAPTER 1 – INTRODUCTION	17
1.1. Background	17
1.2. Research Problems	19
1.3. Research Objectives	19
1.4. Significance of Study	19
1.5. Research Questions	20
1.6. Hypothesis	20
CHAPTER 2 - LITERATURE REVIEW	21
2.1. Overview PT. United Tractors Tbk Site Satui	21
2.2.1. Maintenance Contract	23
2.3. Performance Maintenance	26
2.4. Specification Komatsu HD785-7	27
2.5. Maintenance Strategies	28
2.6. Inspection	33

2.7. Redo Rate in Maintenance Management	34
2.8. Downtime	35
2.9. Loss	35
2.10. DMAIC	36
2.11 Pareto Analysis	38
2.12 Why-Why Analysis	40
2.13 Failure Mode & Effect Analysis (FMEA)	42
2.14. Analysis the Center of Gravity Distribution on HD785-7	45
2.15 Review of the Fatigue Analysis of Heavy-Duty Truck Frames	45
2.16 Repair & Reinforced Method on Truck Frames	46
2.17. Previous Study	48
CHAPTER 3 – RESEARCH METHODOLOGY	53
3.1 Research Framework	55
3.1.1 Define Phase	56
3.1.2 Measure Phase	58
3.1.3 Analyze Phase	59
3.1.4 Improve Phase	62
3.1.5 Control Phase	63
3.2 Time Frame DMAIC	64
CHAPTER 4 – RESULTS AND DISCUSSIONS	66
4.1 Define	66
4.1.1 Overview of PT XYZ at Site Satui FMC United Tractors	66
4.1.2 Physical Availability FMC HD785-7 Site Satui	69
4.2 Measure	70

4.3 Analyze	71
4.3.1 Why-Why Analysis	71
4.3.2 FMEA Analysis	72
4.4 Improvement	78
4.4.1 Chassis Mapping Visualization Code	78
4.4.2 Additional Inspection Check Sheet	79
4.4.3 Sharing Database Inspection & Action	80
4.4.4 Training Methods of Repair & Reinforcement	81
4.4.5 Analysis After the Implementation of Chassis Position Mapping	83
4.4.6 Analysis of Failure Trend Based on Chassis Position Mapping	85
4.4.7 FMEA Based on Mapping Position and Repair VS Reinforced Methods	86
4.5.1 Control Weekly Performance Review and Chassis Management Meeting	90
4.5.2 Control Visual Documentation of Reinforced Actions	91
4.5.3 Forecast Planning and Standardization of Reinforced Actions	92
4.6 Review Physical Availability	93
4.7 FMEA Review Interval	94
4.8 Review Pareto Problem Duration	95
4.9 Loss of Production Analysis	96
4.9.1 Impact to Business FMC Contract	97
4.9.2 Comparison of Loses Repair VS Reinforced at Hourly Cost Rate	97
4.9.3 Productivity Loss Based on Overburden Hauling Revenue	98
4.10 Summary of Success Criteria Achievement	99
4.11 Future Research Direction	100
CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS	101

5.1 Conclusions	101
5.2 Recommendations	102
5.3 Merits of the Study	103
5.4 Drawbacks	103
5.5 For Future Research & Replication Opportunities	103
GLOSSARY	104
REFERENCE	106
CURRICULUM VITAE	110



LIST OF FIGURES

	Page
Figure 1. 1 Chart population unit at PT XYZ	17
Figure 1. 2 Graph pareto problem HD785-7 2023	18
Figure 1. 3 The damage occurred due to cracks in the chassis	19
Figure 2. 1 Support area PT United Tractors Tbk	21
Figure 2. 2 After sales service program PT United Tractors Tbk	21
Figure 2. 3 Maintenance contract program United Tractors	22
Figure 2. 4 Graph UT products VS Non-UT Product	22
Figure 2. 5 Chart HD785-7 population unit at PT XYZ	22
Figure 2. 6 Komatsu payload policy standard operation in mining sector	23
Figure 2. 7 Graph shifting payload distribution at PT. XYZ 2021 to 2023	23
Figure 2. 8 Maintenance contract and rental scheme	24
Figure 2. 9 Spesification Komatsu	27
Figure 2. 10 Evaluation of maintenance strategies over time	29
Figure 2. 11 The process to establish optimal inspection and PM Scheduling	34
Figure 2. 12 Pareto chart for downtime and occurrence	38
Figure 2. 13 Flow process of why-why analysis	41
Figure 2. 14 Preliminary COG of HD785-7	45
Figure 2. 15 Fatigue crack of the sub frame	46
Figure 2. 16 Construction of the common chassis frame	46
Figure 2. 17 Repair welding method	47
Figure 2. 18 Reinforced welding method	48
Figure 3. 1 Main framework	55
Figure 3. 2 Define Flow process in DMAIC framework	57

Figure 3. 3 Schematic mapping chassis crack position HD785-7	57
Figure 3. 4 Measure flow process in DMAIC framework	58
Figure 3. 5 Analyze flow process in DMAIC framework	59
Figure 3. 6 Improve flow process in DMAIC framework	63
Figure 3. 7 Control flow process in DMAIC framework	64
Figure 4. 1 Flow process of maintenance strategy site Satui	69
Figure 4. 2 Pareto problem HD785-7 2023	70
Figure 4. 3 Database daily breakdown HD785-7 2023	71
Figure 4. 4 Schematic mapping chassis crack position HD785-7	78
Figure 4. 5 Additional Inspection Check Sheet PI & PS Maintenance HD785-7	79
Figure 4. 6 Database Inspection	80
Figure 4. 7 Database Action	81
Figure 4. 8 Database Monitoring	81
Figure 4. 9 Repair & reinforced methods chassis Crack Action on HD785-7	82
Figure 4. 10 Coordination meeting for welder training strategy	82
Figure 4. 11 Failure frequency based on chassis position mapping data 2024 (n=56)	84
Figure 4. 12 Engineering schematic Cener of Gravity (CoG) HD785-7	84
Figure 4. 13 Flow process for planning follow up chassis inspection	89
Figure 4. 14 Weekly meeting fabrication process chassis management	90
Figure 4. 15 Weekly meeting performance review	91
Figure 4. 16 KPI PA review HD785-7	91
Figure 4. 17 Control documentation action of reinforced method	92
Figure 4. 18 Forecast planning of chassis management	93
Figure 4. 19 Pareto problem duration HD785-7 YTD 2024	95

Figure 4. 20 Pareto problem duration HD785-7 YTD May 2025

96



LIST OF TABLES

	Page
Table 1. 1 PA HD785-7 YTD 2023 <92%	18
Table 2. 1 Saverity classification	43
Table 2. 2 Occurence Classification	44
Table 2. 3 Detection Classification	44
Table 2. 4 Previous study	50
Table 3. 1 DMAIC framework	56
Table 3. 2 Stakeholder roles & contributions in FGD	60
Table 3. 3 Success criteria from identified problems and analytical questions	61
Table 3. 4 DMAIC framework	65
Table 4. 2 PA HD785-7 YTD 2023 under target <92%	70
Table 4. 3 Why-why analysis on high duration on chassis pareto problem duration	72
Table 4. 4 Severity value criteria level to calculate FMEA	74
Table 4. 5 . Occurrence value criteria level to calculate FMEA	75
Table 4. 6 Detection value criteria level to calculate FMEA	76
Table 4. 7 FMEA – Before chassis mapping	77
Table 4. 8 Repair methods analysis data from Jan 2024 – May 2025 (n=56)	85
Table 4. 9 Reinforced methods analysis data from Jan 2024 – May 2025 (n=56)	86
Table 4. 10 FMEA value position – After improvement	87
Table 4. 11 FMEA value by methods per position – After improvement	88
Table 4. 12 Physical availability of HD785-7 Site Satui YTD 2024	93
Table 4. 13 Physical availability of HD785-7 site Satui YTD May 2025	94
Table 4. 14 Calculation FMEA interval based on data analysis	94
Table 4. 15 Cost benefit comparison Repair VS Reinforced method	97

Table 4. 16 Potential production loss Repair VS Reinforced method	98
Table 4. 17 Succes criteria	99



LIST OF EQUATION

	Page
Equation 2. 1 PA formula	26
Equation 2. 2 MTBF Formula	26
Equation 2. 3 PI achievement	31
Equation 2. 4 PS achievement	32
Equation 2. 5 PS accuration	32
Equation 2. 6 Redo rate	35
Equation 2. 7 Loss production	36
Equation 2. 8 Percentage pareto formula	40
Equation 4. 1 RPN scores	73

