

MAINTENANCE STRATEGY BASED ON RELIABILITY
(CASE STUDY IN COOPERATIVA CAFÉ TIMOR, EAST TIMOR)

THESIS

Submitted as Partial Fulfill of the Requirements
To Obtain the Bachelor of International
Industrial Engineering Degree



Arranged by:

NIZIA MARIA SARMENTO LOPES DA CRUZ

Student number: 07 14 05284

INTERNATIONAL INDUSTRIAL ENGINEERING PROGRAM
FACULTY OF INDUSTRIAL TECHNOLOGY
UNIVERSITAS ATMA JAYA YOGYAKARTA
YOGYAKARTA

2011

STATEMENTS OF WORK'S ORIGINALITY

I honestly declare that this thesis, which I wrote does not contain the works or parts of the works of other people, except those cited in the quotations and bibliography, as a scientific paper should.

Yogyakarta, June 24th 2011.

METERAI
TEMPEL
PAJAK NEGARA
TGL. 20



Writer,

384D8AAF735712695

ENAM RIBU RUPIAH

6000

DJP

(Nizia M. S. Lopes da Cruz)

A BACHELOR OF
INTERNATIONAL INDUSTRIAL ENGINEERING PROGRAM
On
MAINTENANCE STRATEGY BASED ON RELIABILITY
(CASE STUDY IN COOPERATIVA CAFÉ TIMOR, EAST TIMOR)

Has been examined and Approved

On July 6th, 2011.

Advisor


Ag. Gatot B., S.T., M.T.

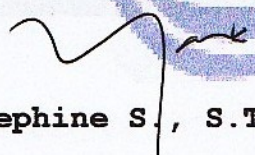
Co-Advisor


Josef H. Nudu, S.T., M.T.

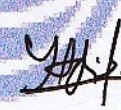
Board of Examiners,
Chairman,


Ag. Gatot Bintoro, S.T., M.T.

Member


Yosephine S., S.T., M.T.

Member



P. Yudi Dwi A., S.T., M.Sc.

Yogyakarta, July 6th, 2011.

Dean of Faculty of Industrial Technology

Universitas Atma Jaya Yogyakarta




Ir. B. Kristyanto, M.Eng, Ph.D.



Dedicated to:

Pai, Mae

Gina, Ivo, Toni

With LOVE

ACKNOWLEDGEMENT

First, thanks for the blessing, spirit and guidance of Jesus Christ, so the writer can finish this thesis report entitled: **MAINTENANCE STRATEGY BASED ON RELIABILITY (CASE STUDY IN COOPERATIVA CAFÉ TIMOR, EAST TIMOR)** to fulfill one of the requirements to reach bachelor degree of Industrial Engineering from Universitas Atma Jaya Yogyakarta.

The successful completion of this thesis was also able by splendid cooperation of everyone who support. Therefore, in this opportunity, the writer would like to say thank you to:

1. Mr. Ir. B. Kristyanto, M.Eng, Ph.D as the Dean of Industrial Technology Faculty UAJY.
2. Mr. The Jin Ai, S.T., M.T., D.Eng, as the Chief of Industrial Engineering Study Program FTI UAJY.
3. Mrs. Ririn Diar Astanti, D.Eng. as the Chief of International Industrial Engineering Study Program FTI UAJY.
4. Mr. Ag. Gatot Bintoro, S.T., M.T. as the advisor, for the critical supports and suggestions during this thesis process enabled the writer to accomplish this thesis.
5. Mr. Josef Hernawan Nudu, S.T., M.T. as the co-advisor, for the guidance and discussion during the report constructing so that this report can be completed.

6. All the lectures and staffs of Industrial Technology Faculty UAJY, for the knowledge and help.
7. Mr. Bency Issac and Mr. Eusebio Dias Quintas for letting the writer did the observation at Cooperativa Café Timor (CCT).
8. Mr. Adelino do Carmo, as the co-advisor in Cooperativa Café Timor (CCT), for the discussion and inputs to this thesis.
9. My parents (Pai and Mae), Gina my elder sister, Ivo my elder brother, Toni my younger brother, Tio Pe. Iso, M'Nuno, Nita, and Nivio for all the supports, prayers, loves, cares, and helps.
10. All my family, uncles, aunties, cousins, nieces, and nephews, for all the prayers and supports.
11. Titina, Sela, Eka, Yani, Melly and kak Ima, all my boarding house friends, for the friendship, supports, helps, cares, and "stress therapy".
12. Henny, Imelda, Rina, Marshela Pausha, Yosepina, Ana and Ardi for the friendship.
13. My classmates, batch 2007, Randi, Danang, Phi, Sherly, Melly, Phanie, Rachel, Panpan, Lilik, Thomas, Alex (2006), and Chuck (2008) for such a great friendship, supports and helps.
14. Other parties that could not say one by one that have given much support to finish this thesis.

Last, the writer hopes that this report could bring many advantages and new knowledge for the readers.

Writer

TABLE OF CONTENT

Title Page.....	i
Statement of Work's Originality.....	ii
Approval.....	iii
Dedication.....	iv
Acknowledgement.....	v
Table of Content.....	vii
Figure List.....	ix
Table List.....	xi
Abstract.....	xii

CHAPTER 1 INTRODUCTION

1.1. Background.....	1
1.2. Problem Statement.....	4
1.3. Research Objective.....	4
1.4. Scope of Research.....	4
1.5. Research Methodology.....	5
1.6. Report Outline.....	9

CHAPTER 2 LITERATURE REVIEW

2.1. Previous Research.....	12
2.2. Current Research.....	14

CHAPTER 3 THEORY

3.1. Definition of Maintenance.....	15
3.2. Types of Maintenance.....	16
3.3. Reliability Function.....	19
3.4. Failure Rate.....	21
3.5. Time to Failure Distribution.....	24
3.6. Optimum Interval Preventive Maintenance.....	27

3.7. Spare Part Inventory.....	31
--------------------------------	----

CHAPTER 4 COMPANY OVERVIEW AND DATA

4.1. Company Overview.....	34
4.2. Data.....	49

CHAPTER 5 ANALYSIS

5.1. Plant Reliability.....	51
5.2. Failure Rate Test.....	56
5.3. Optimum Interval Preventive Maintenance.....	59
5.4. Spare Part Management.....	63

CHAPTER 6 DISCUSSION..... 66

CHAPTER 7 CONCLUSION AND RECOMMENDATION

7.1. Conclusion	72
7.2. Recommendation	72

REFERENCE..... 73

APPENDIX 75

FIGURE LIST

Figure 1.1. Flow Chart of Research Methodology.....	6
Figure 3.1. Reliability Curve.....	20
Figure 3.2. Block Diagram of Reliability.....	21
Figure 3.3. Failure Rate Curve.....	23
Figure 3.4. Bath Tub Curve.....	23
Figure 3.5. Form of Normal Distribution Curve.....	24
Figure 3.6. Form of Weibull Distribution Curve.....	25
Figure 3.7. Form of Gamma Distribution Curve.....	26
Figure 3.8. Form of Uniform Distribution Curve.....	27
Figure 3.9. Optimum Interval Preventive Maintenance	28
Figure 3.10. Interval of t_p	28
Figure 3.11. Elements of $C(t_p)$	30
Figure 3.12. Total Maintenance Cost per Time.....	31
Figure 3.13. Classical EOQ Model.....	32
Figure 4.1. Packaged Green Bean Coffee.....	38
Figure 4.2. Packaged Roasted Coffee.....	38
Figure 4.3. Packaged Ground Coffee.....	38
Figure 4.4. Coffee Cherry.....	44
Figure 4.5. Peeler Polisher Machine.....	45
Figure 4.6. The Husks.....	45
Figure 4.7. Dencimetric Table.....	46
Figure 4.8. Grader Machine.....	46
Figure 4.9. Women Sorting Using Sorting Conveyor....	47
Figure 4.10. Women Sorting Manually.....	47
Figure 4.11. Packaging of the Green Bean Coffee.....	48
Figure 5.1. Plant Reliability System.....	53
Figure 5.2. Machine and Plant Reliability System....	56
Figure 5.3. Failure Rate Curve of Peeler Polisher...	58
Figure 5.4. Failure Rate Curve of Elevator 1.....	59

Figure 5.5. $C(t_p)$ Curve of Peeler Polisher.....	61
Figure 5.6. $C(t_p)$ Curve of Elevator 1.....	63



TABLE LISTS

Table 4.1. List of Machines.....	49
Table 4.2. Data of Machines Downtime.....	49
Table 4.3. Machines Working Hours Year 2007-2010....	50
Table 4.4. Data of Machines.....	50
Table 5.1. List of Machines, Functions.....	52
Table 5.2. TTF Data of Peeler Polisher and Elevator1	54
Table 5.3. Parameter Based on Weibull Distribution..	55
Table 5.4. Machine Reliability.....	55
Table 5.5. Calculation of $r(t)$ for Peeler Polisher..	57
Table 5.6. Calculation of $r(t)$ for Elevator 1.....	58

ABSTRACT

The purpose of this research is to determine the plant reliability and propose a proper maintenance strategy that can be applied in dry processing factory of Cooperativa Café Timor (CCT), East Timor. The analysis done such as: plant reliability, failure rate, optimum interval preventive maintenance, and spare part inventory.

The analysis of plant reliability is done to know the reliability of the plant and type of plant reliability system. The plant reliability is 0.99915 with series system. The analysis of failure rate is done with purpose to find a proper maintenance strategy for the potential subsystems (machines), such as peeler polisher and elevator 1. The analysis shows that the failure rate curve of peeler polisher and elevator 1 are increasing, therefore a proper maintenance strategy that can be applied is preventive maintenance. The analysis of optimum interval preventive maintenance is done to know the optimum interval time in doing the preventive maintenance. The optimum interval for peeler polisher and elevator are 1,229 Hours and 634 Hours respectively. The analysis of spare part inventory is done in order to ensure that the spare part is available when needed. This analysis is done using the Classical Economic Order Quantity (EOQ) Model, where the result shows that the order quantity of peeler polisher and elevator 1 are 7 and 9 Units respectively and reorder point are the same, which is 1 Unit.

Based on the analysis and discussion, a proper maintenance strategy that can be applied on peeler polisher and elevator 1 is preventive maintenance, where the preventive maintenance for peeler polisher will be done by over-time, whereas for elevator 1 will be done during the break hours of the workers.