



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*



**FACULTY OF ENGINEERING  
DEPARTMENT OF TEXTILE AND GINNING ENGINEERING  
FINAL YEAR PROJECT REPORT**

**ANALYSIS OF BREAKDOWNS AND IMPROVEMENT OF PREVENTIVE  
MAINTENANCE ON DRAWFRAME MACHINES**

**A CASE STUDY**

**FINE SPINNERS UGANDA LIMITED**

**BY**

**BONGOMIN OCIDENT**

**BU/UG/2012/142**

**EMAIL: [ocidentbongomin@gmail.com](mailto:ocidentbongomin@gmail.com)**

**MOBILE: 0779245557/0756243075**

**SUPERVISORS**

**ENG. WANDERA JOHNNIE WAFULA**

**DR. ILDEPHONSE NIBIKORA**



*A final year project report submitted to the department of textile and ginning engineering as a partial fulfilment of the Requirements for award of a Bachelor of Science degree in textile engineering.*

**DECLARATION**

I Bongomin Ocident declare to the best of my knowledge that the information in this project report is a result of my research and effort and it has never been presented or submitted to any institution or university for an academic award

Date: ..... *15-MAY-2016* .....

Signature: ..... *Bongomin Ocident* .....



**APPROVAL**

This final year project report has been submitted for examination with approval from the following supervisors:

Main supervisor

Eng. Wandera Johnnie Wafula

Sign: .....

Date: .....

Co-supervisor

Dr. Ildephonse Nibikora

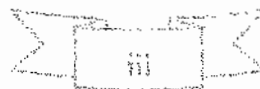
Signature: .....

Date: .....



**DEDICATION**

I dedicate this project to my beloved uncle who offered me a laptop computer and to my parents who supported me financially and constant guidance granted unto me. So the almighty God who created the heaven and the earth bless them abundantly.



**ACKNOWLEDGEMENT**

I am thankful to the almighty God for keeping me healthy until the completion of this dissertation.

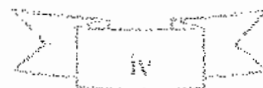
I am indebted to many people for the successful completion of this dissertation. First of all, I owe my deepest gratitude to my supervisors, Eng. Wandera Johnnie Wafula and Dr. Ildephonse Nibikora for the support and confidence that they have given to me. Their vision, ideas and comments on various issues have contributed to the quality of this dissertation.

I am also grateful to Busitema University faculty of engineering for providing the financial support for dissertation and textile engineering for accepting my project.

I am thankful to fine spinning Uganda limited, for providing me place to conduct my research work.

I would also like to extend the deep emotions appreciation and love to my family members, Uncle David, Brother Richard and to my friends and all those hands lifted to pray for me. A very special acknowledgement to my mother, for being first teacher of my educational career. The foundation laid by her helped me at every stage until the completion of this dissertation. Also for love, sympathetic support, special prayers and best wishes.

Finally, I dedicate this dissertation to my father Ocaya James Donas for his providing me with financial support and guidance and encouragement.



**LIST OF ACRONYMS**

CFA	Component Failure Analysis
CRT	Current Reality tree
DOE	department of energy
FMEA	Failure Mode and effect analysis
FSUL	Fine spinner Uganda limited
HAZOP	Hazard and operability
ID	Interrelation diagram
MA	machine availability
MORT	Management oversight risk tree
MTBF	Mean time between failures
MTTR	mean time to repair
No.	Number
PM	Preventive maintenance
RCA	Root cause analysis
RCI	root cause investigation
RCM	Reliability centered maintenance
SRNTL	southern range Nyanja textile limited
TAT	Total available time
TNB	tool number of breakdown
TUT	Total utilized time



**LIST OF FIGURES**

Figure1 root cause analysis approach ..... 5

Figure 2. Profile of machine/ equipment failure..... 20

Figure 3. Factors of components failure ..... 21

Figure 4. Components of drawframe machine ..... 23

Figure 5. Breaker drawframe machines ..... 25

Figure 6. Finisher drawframe machines ..... 25

Figure 7. Flow diagram of proposed methodology..... 27

Figure 8 flow chart use in generating ideas for developing fishbone diagram..... 29

Figure 9 Pareto chart of total down time for each machine ..... 32

Figure 10 DO/6 No.2 Drawframe machine ..... 33

Figure 12 Broken/ damaged belts and broken/ worn out shafts..... 34

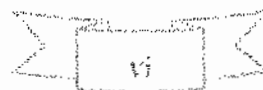
Figure 13 fishbone diagram for damaged/broken belts..... 36

Figure 14 fishbone diagram for broken shaft ..... 40

Figure 15 fishbone diagram for bearings failure ..... 40

Figure 17 Comparison of MTBF Before and After RCA for DO/6..... 45

Figure 18 Comparison of MTTR before and after RCA on DO/6 ..... 46



**LIST OF TABLE**

Table 1 comparative differences of selected RCA Tools and RCA methods..... 16

Table 2. Total number of breakdowns and down time due maintenance in period of 9 months. 32

Table 3 breakdowns occurred on DO/6 no.2, frequency and total time spent to repair ..... 33

Table 4 Correctives countermeasures for broken belts..... 37

Table 5 corrective countermeasures of broken shafts..... 41

Table 6 Preventive maintenance checklist suggested after root causes analysis..... 42

Table 7 breakdowns occurred on DO/6 No.2 in March 2016..... 43

Table 8 Process measureable before root cause analysis on DO/6 breaker drawframe no. 2 44

Table 9 process measureable after RCA on DO/6 breaker drawframe..... 44

Table 10 Average values of MA, MTBF and MTTR before and after RCA for DO/6 No.2... 46



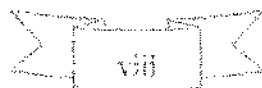
**ABSTRACT**

Maintenance is the actions necessary for retaining or restoring a piece of equipment, machine or system to the specified operating conditions to achieve maximum useful life. Preventive maintenance is the set of plan activities that are performed on plant, equipment, machinery and systems before the occurrence of a failure in order to protect them to prevent or eliminate any degradation in their operating conditions. Production may be stopped due to many reasons like breakdown of machine, maintenance work, labour issues, and inventory problem. It is necessary to reduce the breakdown of machine or equipment in the company for efficient production to meet the demands.

The main objective of this project is to analyse the breakdown and improve the preventive maintenance on drawframe machines. The drawframes are the last quality improvement machines in spinning process in textile industry. Breakdown history for four drawframe machines (DO/6 no.1, DO/6 no.2, RSB 951 no.1 and RSB 951 no.2) were analysed and noticed that DO/6 no.2 and RSB 951 no.2 have higher downtime and therefore contributed major production loss to the company. Hence detailed study was carried out to minimise production loss. The machine breakdowns were studied using different analysis and inspection tools like fishbone diagram, why-why analysis, Pareto analysis, and counter measures to determine the root causes of the breakdown and develop preventive corrective actions. The machine availability (MA) was determine by MTBF and MTTR. Based on the problems, root cause analyses were carried to develop and improve new preventive maintenance schedule and checklist for a machine. After implementation of root cause analysis and new preventive maintenance schedule, the machine availability was increased by 2.26% and Mean time between failures (MTBF) was increased by 29.58% and Mean time to repair (MTTR) was reduced by 34.48%.

*Final year project report*

*Bongomin Ocident*



**Keywords:** machine availability, fishbone diagram, why-why analysis, preventive maintenance, corrective action, Pareto analysis, root cause analysis, breakdown and downtime.

**TABLE OF CONTENT**

DECLARATION ..... i

APPROVAL ..... ii

DEDICATION ..... iii

ACKNOWLEDGEMENT ..... iv

LIST OF ACRONYMS ..... v

LIST OF FIGURES ..... vi

LIST OF TABLE ..... vii

ABSTRACT ..... viii

CHAPTER I INTRODUCTION ..... 1

1.0 INTRODUCTION ..... 1

1.1 Background ..... 1

1.2 Problem statement ..... 2

1.3 Justification of the study ..... 2

1.4 Objective of the study ..... 3

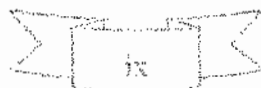
1.4.1 Main objectives ..... 3

1.4.2 Specific objectives ..... 3

1.5 Scope of study ..... 3

CHAPTER II LITERATURE REVIEW ..... 4

2.0 LITERATURE REVIEW ..... 4



2.1 Root cause analysis ..... 4

    2.1.1 Definitions..... 4

    2.1.2 Concept of root cause analysis and corrective action ..... 4

    2.1.3 Root cause analysis tools ..... 5

    2.1.4 Root cause analysis methods ..... 13

    2.1.5 Difference between RCA tools and RCA methods..... 16

2.2 Other level of analyses of breakdowns ..... 17

    2.2.1 Component failure analysis (CFA) ..... 17

    2.2.2 Root cause investigation (RCI) ..... 17

2.3 Maintenance ..... 17

    2.3.1 Definition of maintenance..... 17

    2.3.1 Types of maintenance ..... 17

2.4 Breakdowns ..... 19

    2.4.1 Process measurable ..... 19

    2.4.2 Profile of machine/equipment failure (bath tub curve) ..... 20

    2.4.3 Factors of the machine component failure ..... 21

2.5 Drawframe machine ..... 22

    2.5.1 The purpose of drawframe ..... 22

    2.5.2 Main parts of drawframe..... 22

    2.5.3 Models of drawframe ..... 25

2.6 Related studies..... 26

CHAPTER III METHODOLOGY ..... 27

3.0 METHODOLOGY ..... 27

    3.1 Formation of a team ..... 27

    3.2 Data collection..... 28



3.3 Data analysis and evaluation ..... 28

3.4 Cause charting ..... 29

3.5 Root cause identification ..... 30

3.6 Recommendation generation ..... 30

    3.6.1 Corrective countermeasures ..... 30

    3.6.2 Assessment of effectiveness of RCA and preventive corrective actions ..... 30

CHAPTER IV RESULTS AND DISCUSSION ..... 32

4.0 RESULTS AND DISCUSSION ..... 32

4.1 Total down time on drawframe machines ..... 32

    4.1.1 Major breakdowns on Drawframe DO/6 no. 2 ..... 33

4.2 Root cause identification ..... 36

    4.2.1 Root cause identification of belts breakage/damage ..... 36

    4.2.2 Root cause identification of shaft breakages ..... 39

4.3 Preventive maintenance schedule ..... 42

4.4 Effectiveness of preventive corrective actions on drawframe machines ..... 43

CHAPTER V CONCLUSIONS AND RECOMMENDATIONS ..... 48

5.0 CONCLUSIONS AND RECOMMENDATIONS ..... 48

5.1 Conclusion ..... 48

5.2 Challenges ..... 48

5.3 Recommendations ..... 48

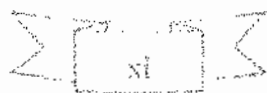
APPENDICES ..... 49

    APPENDIX A Data generations and collection methods ..... 49

    APPENDIX B corrective actions implementations on DO/6 No.2 ..... 51

    APPENDIX C breakdown records on drawframe encountered from (April- December) 2015 52

    APPENDIX E Production downtime and total available time for (April-December) 2015 ..... 55



REFERENCES ..... 56



## CHAPTER I INTRODUCTION

### 1.0 INTRODUCTION

#### 1.1 Background

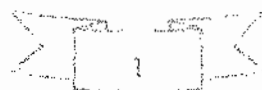
Textile industry belongs to the oldest industrial branches and maintaining its sustained growth for improving the quality of human life. Despite of being old, spinning process is still developing and very essential for the production of most of the textile fabrics. The main objective of the staple yarn spinning process is to achieve the highest possible yarn evenness with minimum imperfections, which impart uniformity in yarn strength(Dan et al. 1997). An overview of spinning process illustrates drawframe as the last quality improvement machine. Its performance is greatly affected by breakdowns (Chang 2012).

Breakdown is a function of availability, performance rate, and quality rate. It is one of the six major categories of losses that affect overall equipment effectiveness (OEE) (Kiran et al. 2013). According to Mishra and Pathak breakdown is a failure of machine to function or an occurrence in which a machine stops working(Mishra & Pathak 2012). Machine breakdowns are caused by either external or internal factors. The internal factor refers to aging (time usage)or physical causes while external factor consists of environmental causes, human errors and management system/latent causes(Sachs 2012). When unplanned breakdown or unexpected failure happen due to equipment failure the production will automatically stop. Therefore it would be expensive to bring the production system into running condition under emergency situation without maintenance (Kotwal 2015).

Maintenance is the combination of activities to restore the component or machine to a state in which it can perform its designated functions(Mishra & Pathak 2012). It is gaining importance in textile industries because of the need to increase reliability and to decrease the possibility of production loss due to machine breakdowns(Praveen & Rudramurthy 2013). According to the study reported by Mobley about 15% to 40% (average 28%) of the total production cost is due to maintenance activity in the factory(Mobley 2002). A good maintenance program requires company-wide participation and support by everyone ranging from the top executive to the shop floor personnel (Krar 2013). One of the maintenance strategy is preventive maintenance which is a set of activities that are performed on plant, equipment, machinery, and systems before the

*Final year project report*

*Bongomin Ocident*

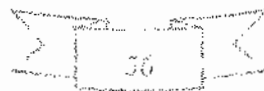


## REFERENCES

1. Anderson, B. & Fagerhaug, T., 2000. *Root Cause Analysis: simplified tools and techniques*, ASQ Quality press.
2. Chandrakar, J. & Rejesh, K., 2015. Reduction of breakdown in food processing plants through failure analysis. *International journal of Advanced engineering research and studies*, 4(02), pp.212–214.
3. Chang, L., 2012. *An investigation of yarn hairiness*, Deakin University Australia, Ph .D Thesis.
4. Charles, E.E., 1996. *An Introduction to Reliability and Maintenance Engineering*, McGraw Hill College Divison.
5. City Process Management, 2008. Cause and Effect Analysis using the Ishikawa Fishbone. , 44(0), pp.1–4.
6. Dan, J.M., Ralph, W.F. & James, H. Booterbaugh Everett, E.B., 1997. *Short Staple Yarn Manufacturing*, Durham, North Carolina: carolina academic press.
7. Dean, L., 2007. *comparison of common Root cause analysis Tools and methods*. *Apollo Root cause analysis* 3rd ed., A new way of thinking.
8. Dew, J., 1991. n search of the root cause. *Quality progress*, 24(3), pp.97–107.
9. Dhillon, B.S., 2002. *ENGINEERING MAINTENANCE, a modern approach*, New york, washington, D.C.: CRC Press.
10. DOE, G., 1992. *Root cause Analysis Document*, Washington: US Department of energy.
11. Doggett, M., 2004. A Statistical Comparison of Three Root-Cause Analysis Tools A Statistical Comparison of Three Root Cause Analysis Tools. , 20(2), pp.1–9.
12. Dr. Zoltan, S. & Szaloki, 1998. *Drawing, Combing and Roving*; *Institute of Textile Technology*, Virginia, USA: Charlottesville.
13. Faltin, F. & Kenett, R., 2007. Bayesian Networks.
14. Hingve, T.S. & Rothe, R.G., 2015. Fault Detection & Diagnosis of Air-Separator Breakdowns in Ginning Industry using Root Cause Analysis. , 3(02), pp.2232–2235.

*Final year project report*

*Bongomin Ocident*



15. Ishikawa, K., 1986. Preview CAUSE & EFFECT DIAGRAM ( Fishbone or Ishikawa Diagram ) Preview , contd ... Why use it ? What does it do ? How do I do it ? How do I do it ? contd ... How do I do it ? contd ...
16. Kiran, M., Mathew, C. & Kuriakose, J., 2013. Root cause Analysis for reducing breakdown in a manufacturing industry. *international journal of emerging Technology and advanced engineering*, 3(01).
17. Kotwal, A., 2015. Evaluation of Machine Downtime and Failure Analysis of Components in Paint Manufacturing Unit : Review Paper. , 3(1), pp.170–174.
18. Krar, S., 2013. The IMPORTANCE of MAINTENANCE. , pp.1–3.
19. Mahto, D. & Kumar, A., 2008. Application of root cause analysis in improvement of product quality and productivity. *Journal of Industrial Engineering and Management*, 1(2), pp.16–53.
20. Manoj, M. & Mallesh, G., 2014. BREAKDOWN AND ROOT CAUSE ANALYSIS OF CRITICAL MACHINE- A CASE STUDY. , (02), pp.250–260.
21. Mishra, R.. & Pathak, K., 2012. *Maintenance engineering and managemnt*, PHI learning pvt.Ltd.
22. Mobley, R., 2002. *An introduction to predictive maintenance*, BUtterworth Heinemann.
23. Moubray, J., 1997. *Reliability Centred Maintenance* 2nd ed., Elsevier.
24. Parida, A. & Kumar, U., 2012. Maintenance performance measurement(MPM) issues and challenges. *journal of quality in maintenance Engineering*, 12(3), pp.239–251.
25. Piotrowski, J., 2001. Pro-Active maintenance for pumps. In pump-zone.com.
26. Praveen, K. & Kumar, 2013. Analysis of Breakdowns and Improvement of Preventive Maintenance on 1000 Ton Hydraulic Press. , 3(8), pp.636–645.
27. Rausand, M., 2005. Hazard and Operability Study. , pp.1–44.
28. Rosmaini Ahmad, 2007. Development of Decision Model for Maintenance Analysis of Non- Repairable Component by Considering the External factor.
29. Sachs, N.W., 2012. Reliability Center , Inc . Reliability Center , Inc . , pp.1–5.
30. Scutti, J.J., Mcbrine, W.J. & Corporation, A., 1990. *Introduction to Failure Analysis and Prevention*,
31. Street, C., 2000. Decision Analysis and Resolution Guidelines.





32. Tomi, B. & Brki, V.S.Ć., 2012. EFFECTIVE ROOT CAUSE ANALYSIS AND CORRECTIVE ACTION PROCESS. , 1(1), pp.16–20.
33. Tools, P.A., Pareto, S. & Table, D., 2004. Pareto Diagram. , pp.1–4.
34. Valyakala, A. et al., 2013. Root cause analysis for the failure of a forced draft fans in a petrochemical indury. *International Journal of engineering research and development*, 6(05), pp.84–90.
35. Vessely, W.E. & Roberts, N.H., 1981. *FaulttreeHandbook\_USNRC.pdf*,