



# BUSITEMA UNIVERSITY

*Pursuing Excellence*

**FACULTY OF ENGINEERING  
DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING  
MINING ENGINEERING PROGRAMME**

**FINAL YEAR PROJECT**

**ASSESSING THE MINING SAFETY STANDARDS OF ARTISANAL AND SMALL  
SCALE MINERS IN UGANDA**

**CASE STUDY: TIIRA GOLD FIELD**

**KOMUHENDO MARTINA  
BU/UG/2013/55**

BUSITEMA UNIVERSITY LIBRARY  
CLASS No.:.....  
ACCESS NO.:.....

**Email: [martinask1992@yahoo.com](mailto:martinask1992@yahoo.com); 0781984590**

**SUPERVISOR(S)**

**MAIN SUPERVISOR: Mr. THOMAS MAKUMBI**

**CO-SUPERVISOR: Mr. WYCLIFF TUGUME**



*A final year project report to be submitted to the Department of Mining and Water Resources Engineering as a partial fulfillment of the requirements for the award of a Bachelor of Science degree in Mining Engineering.*

**May, 2017**

## ACKNOWLEDGMENT

With great joy, I am grateful to God for His courage, strength and kindness up on me enroute this success. Having brought me this far, especially in an unknown destination glory be to His name. Let me also express my gratitude to my family (Mum, Philip and Sharon) who have supported throughout this entire journey. My colleagues and friends who provided support and stuck with me through all the ups and downs as I endeavored to finish this report; thank you.

My profound gratitude once again goes to my project supervisors for their guidance and encouragement that led to the output of this project. To all the lectures who assisted me I express my profound gratitude. To all the people I met while gathering data, thank you so much for accepting to participate in the exercise, may God bless you all.

## ABSTRACT

Artisanal and small-scale mining in Uganda has been in existence as far back as pre-colonial era. The industry which is mostly controlled by Ugandans is highly unregulated pre 1987 (Hilson, 2001) with the exception of big mines like Kilembe and Tororo. However, because of dwindling state of the economy, the government has considered legalizing ASM so to control the loss of revenue. This has allowed individuals to mine minerals in both mechanized and un-mechanized manner. Several laws were enacted to strengthen this policy and are still being reviewed under the auspices of the Mining Act 2003. Despite the laws, illegal mining has been going on unabated in the country causing several environmental destructions and fatalities.

This study was carried out using Busitema in Busia district as a case study to determine

- (1) The hazards and risks faced by the ASM miners.
- (2) Proceeded to a risk assessment to determine the hazards that require immediate attention.
- (3) To determine the relationship between productivity and the risk rating so as to display the often ignored fact that safety is vital.

It was discovered that small scale mining has had a significant impact on the district/individuals economy and the environment. The consequences of ASM are just starting to manifest and if not taken into consideration soon, the potential for a catastrophe is imminent. The district have suffered various degrees of environmental degradation, water pollution, deforestation, heavy metal contamination and loss of farm land.

The need for the safety toolkit to pave the way to create a safer mining environment is a necessity, hence my creation of the Offline Hazard Identification Tool kit. (OHIT)

**DECLARATION**

I **KOMUHENDO MARTINA** hereby declare that, this report is a true work of my hands and has never been presented by any person or institution for an academic award

Signature: .....  
Date: .....  
*Martina Komuhendo*  
*30<sup>th</sup> May 2017*



**APPROVAL**

This piece of work has been approved by;

Main Supervisor

MR. THOMAS MAKUMBI

Signature.....

Date.....

Co-supervisor

MR. WYCLIFF TUGUME

Signature.....

Date.....

## LIST OF ACRONYMS/ABBREVIATIONS

ASM	artisanal small scale miners
ILO	International Labor Organization
LSM	Large Scale Mines
GDP	Gross domestic product
OSH	Occupational safety and health
MSHA	Mining safety and health authority
ASG	Artisanal small scale gold
ASGM	Artisanal small scale gold miners
UNEP	United Nations Environment Programme
MEMD	Ministry of Energy and Mineral Development
PHA	Preliminary Hazard Analysis
MORT	Management Oversight and Risk Tree
FMEA	Failure Modes and Effect Analysis
JHA	Job Hazard Analysis
GPS	Global Positioning System
HRAA	Hazard and Risk Assessment Analysis
ALARP	As Low As Reasonably Practicable

## LIST OF GLOSSARY

**Consultation:** A process of seeking information or the informed opinions from one or more people prior to decision-making. Should particularly include those who may affect the outcomes or be affected by the decisions made, but may also include specialist sources. Consultation does not necessarily mean reaching agreement.

**Due diligence:** The taking of all reasonable precautions in the circumstances to protect the health and safety of employees and others who may be affected by actions or omissions of the individual or corporation.

**Event:** The point in time when a particular set of circumstances occur that results in loss of control of a hazard.

**Hazard:** A source of potential harm in terms of human injury, ill-health, damage to property, the environment or a combination of these. A source of potentially damaging energy.

**Hazard identification:** The process of identifying sources of harm.

**Hierarchy of control:** The priority order in which hazard and risk controls should be considered with the eventual outcome often being a combination of measures. The prime emphasis is on:

1. Elimination; and where this is not practicable,
2. minimization of risk by,
3. substitution;
4. Engineering controls, including isolating the hazard from personnel;

Then, when these options have been implemented as far as is practicable by:

5. Administrative controls (e.g., procedures; training); and
6. Personal protective equipment (PPE). Incident An event that has caused or has the potential for injury, ill-health or damage. (Note that 'incident' is the preferred term rather than 'accident'). Refer also to 'occurrence'.

**Job Safety Analysis (JSA):** The process of breaking a task down into its key components and examining the hazards of each component to identify the required controls. The output of a JSA can be used in the development of written job instructions. Similar processes may have a number of terms such as HIRA (Hazard Identification & Risk Assessment) or JSEA (Job Safety Environmental Analysis).

**Key personnel:** People involved in OHS decision-making or those who are affected by OHS decisions.

**Likelihood:** A colloquial term for 'probability'. When related to risk, it is the probability of the stated consequence occurring, not the likelihood of the hazard or the particular scenario. Likelihood is affected by how often and how long the person (or structure etc.) is exposed to the hazard and the reliability of the controls in place.

**Nomogram:** An alignment chart arranged so that the value of a variable can be found without calculation from the value of one or two other variables that are known.

**Occurrence:** Process (es) which gives rise to damage, injury or ill-health.

**Procedures:** Documents that describe an approach and method for undertaking certain activities or processes.

**Psychosocial hazards:** Sources of potential harm that are related to the way work is organized, the relationships or interactions which operate within the work environment or specific events that may lead to post-traumatic stress.

**Risk:** The potential for unwanted, negative consequences of an event.

**Risk assessment:** A process to develop an understanding of the hazard and its associated risk involving analyzing a hazard.

**Risk ranking:** A process of rating risks according to their severity and likelihood to determine the priority for treatment or control of risks. Also known as 'prioritization'. Risk ranking processes range from quantitative to highly subjective.

**Risk register:** A document, sometimes called a 'Hazard Register' but this is a narrow term implying the inclusion of only limited information relating to the sources of risk rather than the consequences and control measures.

**Root cause:** A condition or circumstance that leads to an event which is identified by following the chain of causation back to the most distant cause that is controllable.

**Stakeholders:** Those people or organizations who may be affected by, or perceive themselves to be affected by, an activity or decision.



## LIST OF FIGURES

Figure 1: showing representation of selecting a random sample using stratified sampling technique .....	18
Figure 2: a flow sheet showing the risk management process .....	20
Figure 3: the relationship of all the main components in the mining system .....	20
Figure 4: showing extraction SUBSYSTEM BLOCK diagram .....	28
Figure 5: hazard category.....	30
Figure 6: graph showing the hazard-risk rating relationship .....	31
Figure 7: showing the relationship between costs incurred to the risk rating.....	36
Figure 8: captions 1-4 display the hazards in asm .....	45
Figure 9: SHOWING THE RESEARCHER DURING DATA COLLECTION IN THE FIELD	45

## LIST OF TABLES

Table 1: showing the hazard trigger identification.....	17
Table 2: showing the basic semi-quantitative risk rating matrix.....	20
Table 3: showing the risk categories.....	20
Table 4: consequence table.....	21
Table 5: HRAA TABLE FORMAT.....	22
Table 6: data from the questionnaires.....	23
Table 7: showing the identified hazards and risks.....	24
Table 8: showing the chemical levels in the environment.....	25
Table 9: showing the probability and consequence of each hazard.....	26
Table 10: showing the calculated rating and category.....	26
Table 12: showing the risk category.....	28
Table 13: showing the costs incurred per hazard category.....	29

## TABLE OF CONTENTS

ACKNOWLEDGMENT.....	i
ABSTRACT.....	ii
APPROVAL.....	iv
LIST OF ACRONYMS/ABBREVIATIONS.....	v
LIST OF GLOSSARY.....	vi
LIST OF FIGURES.....	viii
CHAPTER ONE.....	1
1.0 INTRODUCTION.....	1
1.1 BACKGROUND.....	1
1.2 PROBLEM STATEMENT.....	2
1.3 PURPOSE OF THIS STUDY.....	3
1.4 OBJECTIVES.....	3
1.5.1 Main objective.....	3
1.5 JUSTIFICATION.....	3
1.6 CONCEPTUAL HYPOTHESIS.....	4
1.7 SCOPE OF THE PROJECT.....	4
CHAPTER TWO.....	5
2.0 LITERATURE REVIEW.....	5
2.1 GEOLOGICAL BACKGROUND OF AREA.....	5
2.2 OVERVIEW OF ASM.....	5
2.3 THE MINING PROCESS.....	6
2.4 MINING SAFETY AND HEALTH STANDARDS.....	7
2.5 HAZARDS.....	9
2.5.1 Physical Hazards.....	9
2.5.2 Chemical Hazards.....	10
2.5.3 Biological Hazards.....	11
2.6 Sampling methods.....	11
2.7 SAFETY SYSTEMS EXISTING.....	12
CHAPTER THREE.....	17
3.0 METHODOLOGY.....	17
3.1 PROJECT AREA.....	17

3.2 MATERIALS AND EQUIPMENT .....	17
3.3 METHODS OF DATA COLLECTION .....	17
3.4 HAZARD AND RISK ASSESSMENT ANALYSIS .....	19
3.5 DESIGNING A BASELINE TOOLKIT FOR MINING SAFETY AND HEALTH .....	27
3.5.1 Step-by-step procedure for performing a failure modes and effects analysis .....	27
CHAPTER FOUR.....	29
4.0 RESULTS AND DISCUSSION .....	29
4.1 DATA OBTAINED FROM THE FIELD SURVEY.....	29
4.2 ANALYSIS OF THE FIELD SURVEY DATA .....	30
4.2.1 RISK RATING .....	32
4.3 MINE SAFETY AND HEALTH Vs ECONOMIC ASPECT .....	35
4.4 THE OFFLINE HAZARD IDENTIFICATION TOOLKIT.....	37
CHAPTER FIVE.....	39
5.0 CONCLUSIONS AND RECOMMENDATIONS .....	39
5.1 CONCLUSIONS .....	39
5.2 RECOMMENDATIONS.....	40
APPENDIX.....	41
REFERENCES .....	46

## CHAPTER ONE

### 1.0 INTRODUCTION

This chapter entails relevant information about the project, problem statement, and justification, objectives of the study, purpose of the study and the scope of the study.

### 1.1 BACKGROUND

Artisanal and Small scale mining (ASM) is defined as a multi- unit mining operation with an annual production of unprocessed material of 50,000 tons or less (*Hinton, 2009; 2011*). It is usually characterized as informal, illegal, undercapitalized, utilizing simple tools and hazardous under labor intensive conditions (Aryee et al, 2003). However, it is a source of income for those living in rural, remote, and poor areas of over 158 countries around the world (Shoko, 2002).

ASM employs 20-30 million people worldwide with 3-5 times that number indirectly supported through their activities (World Bank, 2012). Last official figures were 10 million including up to 50% women and 10% children estimated by the International Labor Organization (ILO, 1999). ASM generates five times the income of other rural poverty-driven activities. The sector employs ten times more people than the large scale mining sector (LSM) and stimulates considerable local economic development around ASM mines.

Artisanal and small scale mining in Uganda provides a source of livelihood for almost 200,000 men and women, over half of which are involved in production of industrial minerals to serve the construction demands of the country's rapidly growing population. (3.3% per annum) (ECOLOGICAL CHRISTIAN ORGANISATION, 2011). At least 20,000 of these are involved in ASM in gold mining. An economic activity mostly in the region of Busitema; in 2008, the amount of unlicensed, informal gold produced through ASM by over 15000 miners, was estimated to be at over 1.2 tonnes (*Hinton, 2009; 2011*). ASM is 3-5 times more lucrative with direct impact on both household income and contribution to local economies (Siegel, 2009), Uganda's 200,000 ASM contribute twenty times more to the GDP than other small scale sectors (Buxton, 2013).

The mining sector is one of the sectors that accounts for many accidents. However due to the remoteness and largely informal system (Shoko, 2002) many go unreported to the national occupational health and safety (OSH). Many small scale mining operations are said to be lacking

## REFERENCES

- {CRSS}, I. S. & E. d. H. (. a. S. T., April 2016. *no golden future*. s.l.:s.n.
- {CRSS}, I. S. & E. d. H. (. A. S. T., April 2016. *no golden future*.
- Anon., 1985. *chemistry: the central science*. s.l.:Prentice Hall Inc.
- Anon., 1995. *Safety and Health in Mines Convention*.
- Anon., 1995. *safety and health in mines convention*. s.l.:s.n.
- Anon., 2003. *Occupational safety and health*.
- Anon., 2015. <https://en.m.wikipedia.org/wiki/Busitema>. [Online].
- Anon., 2016. *draft MINING AND MINERAL POLICY FOR UGANDA*. s.l.:s.n.
- Anon., 2016. *Draft MNING AND MINERAL POLICY FOR UGANDA*. s.l.:s.n.
- Anon., 2016. *mining and mineral for Uganda (draft)*. s.l.:s.n.
- Anon., 2016. *Random House Dictionary*. s.l.:Random House, Inc.
- Anon., n.d. *Draft MINING AND MINERAL POLICY FOR UGANDA*. 2016: s.n.
- Bong, Sharon A., 2002. *Debunking Myths in Qualitative Data Analysis*. Volume 3 ed. s.l.:s.n.
- Buxton, A., 2013. *Responding to the challenge of artisanal and small mining*, London: IIED.
- ECOLOGICAL CHRISTIAN ORGANISATION, 2011. *The mining and minerals sector in Karamoja region: development opportunities and constraints*, KAMPALA: ECOLOGICAL CHRISTIAN ORGANISATION.
- Hentschel Thomas , 2002. *Global report on Artisanal Small-Scale Mining*, London: IIED.
- Hentschel, H. & P., 2002. *Mining, MInerals and Sustainable Development*.
- Hilson, G., 2016. *Artisanal and small-scale mining and agriculture*, London: IIED.
- Shoko, 2002. *Women miners in developing countries: pit women*, s.l.: Amazon.
- Siegel, V. a., 2009. *Artisanal small scale mining the future*. *ASM*, pp. 16-20.
- Telmer, 2009. *Artisanal and small scale mining: policy for Cambodians*, Cambodia: UNDP.