

**KWAME NKRUMAH UNIVERSITY OF SCIENCE
AND TECHNOLOGY, KUMASI.
KNUST SCHOOL OF BUSINESS**

BUSINESS INFORMATION TECHNOLOGY

KNUST



***BIOMETRIC FINGERPRINT APPLICATION FOR TIMEKEEPING-
TIME & ATTENDANCE MANAGEMENT- IN GOLD MINING
ORGANISATIONS: A CASE STUDY OF TARKWA GOLDFIELDS GHANA
LIMITED.***

GILBERT K. GIDIGLO

JULY 2008

**KWAME NKRUMAH UNIVERSITY OF SCIENCE
AND TECHNOLOGY, KUMASI.
KNUST SCHOOL OF BUSINESS**

BUSINESS INFORMATION TECHNOLOGY

KNUST



***BIOMETRIC FINGERPRINT APPLICATION FOR TIMEKEEPING-
TIME & ATTENDANCE MANAGEMENT- IN GOLD MINING
ORGANISATIONS: A CASE STUDY OF TARKWA GOLDFIELDS GHANA
LIMITED.***

GILBERT K. GIDIGLO

JULY 2008

**KWAME NKRUMAH UNIVERSITY OF SCIENCE
AND TECHNOLOGY , KUMASI.
KNUST SCHOOL OF BUSINESS**



BUSINESS INFORMATION TECHNOLOGY

*A DISSERTATION SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
MASTERS DEGREE IN BUSINESS ADMINISTRATION*

**TOPIC: BIOMETRIC FINGERPRINT APPLICATION IN TIMEKEEPING (TIME &
ATTENDANCE MANAGEMENT) IN GOLD MINING ORGANISATIONS: A CASE STUDY OF
TARKWA GOLDFIELDS GHANA LIMITED.**

SUBMITTED BY: GILBERT K. GIDIGLO
INDEX NO: PG9773206

SUPERVISOR: MR. OBIRI YEBOAH

2007/2008

© Copyright 2008

DECLARATION

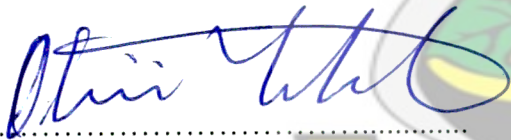
I herein declare that this is the result of my own research. References from the work of others have been clearly stated. I hereby declare that this work is an original one and has not been submitted for any degree, nor is it being submitted to any other university or institute for any other degree.

KNUST



GILBERT KWAKU GIDIGLO

STUDENT



MR. OBIRI YEBOA

SUPERVISOR



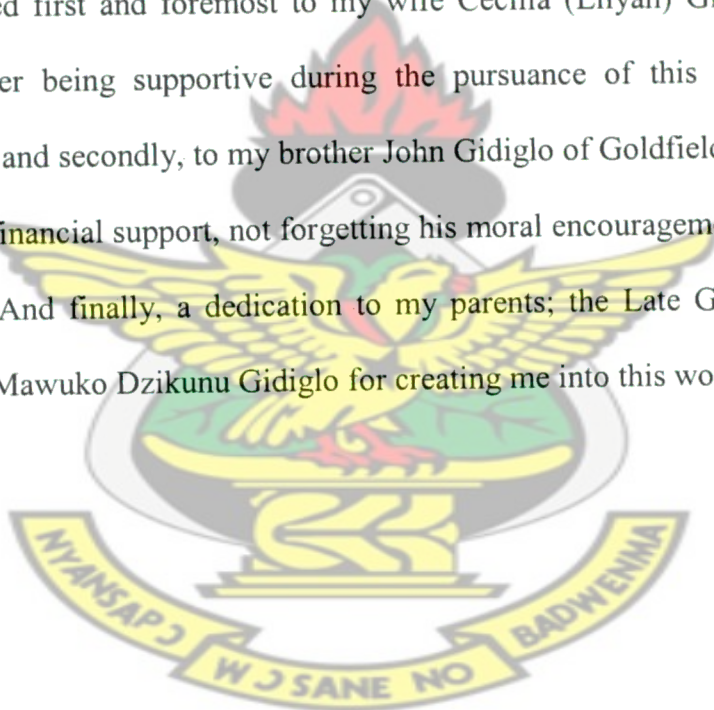


HEAD OF DEPARTMENT

DEDICATION

KNUST

This work is dedicated first and foremost to my wife Cecilia (Lilyan) Gidiglo for her patience, love and her being supportive during the pursuance of this program, not forgetting her prayers and secondly, to my brother John Gidiglo of Goldfields Ghana Ltd. for his brotherly and financial support, not forgetting his moral encouragement during the course of my study. And finally, a dedication to my parents; the Late Gideon Gilbert Gidiglo and the Late Mawuko Dzikunu Gidiglo for creating me into this world.



LIBRARY
KWAME NKUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI

ACKNOWLEDGEMENT

I must above all give the Almighty God the glory and thanks. Without His grace and guidance as well as the provision of strength to hang on even in the midst of discouragement; I would not have been able to finish the course.

A host of people have immensely contributed in diverse ways to the successful execution of my project work and I wish to express my gratitude to them. I would like to thank the former Dean of the KNUST School of Business Professor S.K. Buatsi and the present acting Dean Mr. Magnus J.Frimpong including Messrs Joseph Davis for their incessant brotherly pieces of advice. I am highly grateful to all members of the academic staff of the KNUST School of Business for the knowledge given me including Mr.Dominic Korsah Otchere a course mate at KNUST School of Business for his encouragement and friendship. My gratitude goes to the non-academic staff for their usual co- operation. I am also sincerely grateful to my academic supervisor, Mr. Obiri Yeboah for his assistance and guidance during the course of the project. My sincere thanks go to Mr. Vincent Agbemava of Anglogold Ashanti-Iduapriem, Messrs John Gidiglo and David Quayson all of Goldfields Ghana Ltd.-Tarkwa and Mr. Edward Ansah of Golden Star Bogoso/Prestea Ghana Ltd for their assistance during my fieldwork and their services as liaison between the various gold mining companies and me.

Finally, I wish to be very grateful to Captain Moses Blay Gedzah for his brotherly assistance in all aspects of life during my pursuance of this program and Miss Sussana A. Sencherey, head teacher of Kentinkrono M/A J.H.S.and the staff as a whole of the said school for their support and co-operation during the course of my academic programme in the Business School. My heartfelt gratitude and sincere thanks to you all.

DEFINITION OF TERMS

Biometric: The use of special input devices to analyze some physical parameters assumed to be unique to an individual, in order to confirm his/her identity as part of an authentication procedure.

Biometric identification - the automatic identification of living individuals by using their physiological and behavioral characteristics.

Telebiometric: When biometric system is networked together with telecommunications technology, biometric systems become telebiometric systems

Timekeeping: Accurately recording time worked for every nonexempt employee in order to calculate employee pay and benefits.

Fingerprint Identification: is the method of identification using the impressions made by the minute ridge formations or patterns found on the fingertips

Time: the collection, calculation, reporting and integration of all information necessary for employee compensation.

Attendance: the tracking of infractions and leave in order to provide a fair, unbiased and uniform application of attendance policy.

ABBREVIATIONS/ACRONYMS

A.B.A-Amalgamated Banquet Area

A.F.I.S-Automated Fingerprint Identification System

BF-Biometric Fingerprint

C.C.D-charged coupled device

C.C.L-Carbon in leach

C.J.I.S-Criminal Justice Information Services

IT –Information Technology

D.E.T-Detection Error Trade-off

F.A.C-false accept rate

F.B.I-Bureau of Investigation

F.N.M.R-False Non Match Rate

F.R.M.-False Rate Match.

F.R.R-False Reject Rate

F.E.R-Failure to Enrol Rate

F.T.R-Failure to Capture Rate

G.A.G-Ghana Australia Goldfields

I.A.F.I.S-Integrated Automated fingerprint Identification System

M.X.R.F-Micro-X-Ray Fluorescence

P.D.A- Personal Digital Assistant

P.I.N- Personal Identification Number

R.O.C-Receiver Operating Characteristics



TABLE OF CONTENT

	Page
Front Page-----	
Title Page-----	
Declaration-----	i
Dedication-----	ii
Acknowledgement-----	iii
Definition of Terms-----	iv
Abbreviations/Acronyms-----	v
Table of Content-----	vi
List of Tables-----	ix
List of Figures-----	x
List of Appendices-----	xi
Abstract-----	xii
CHAPTER ONE .INTRODUCTION AND BACKGROUND	
Introduction and Background-----	1
1.2 Statement of the Problem-----	4
1.3 Research Questions-----	5
1.4 Research Objective-----	6
1.5 Justification of the Study-----	6
1.6 Hypothesis/Conceptual Framework-----	8
1.6 Methodology-----	8

1.7 The Scope of the Study-----	9
1.8 Organization of the Study (Synopsis) -----	10
CHAPTER TWO: LITERATURE REVIEW.	
2.1 Introduction-----	12
2.2 Some Types of Timekeeping-----	12
2.3 Fingerprint Technology-----	15
2.4 Fingerprint Identification-----	17
2.5 Fingerprint Pattern Types-----	19
2.6 The Automated Fingerprint Identification System-----	20
2.7 Typical Fingerprint Applications-----	22
2.8 Biometrics-----	28
2.8 Comparison of various biometric technologies-----	30
2.9 Biometric systems-----	32
2.10 Cancelable Biometric-----	37
2.11 Biometric time clocks-----	38
2.12 Biometric identification-----	39
2.13 Some Examples of Biometric Fingerprint Softwares-----	41
2.14 Biometric vs. Non-Biometric Fingerprinting-----	48
CHAPTER THREE: METHODOLOGY	
3.0 General-----	50
3.1 Research Methods and Design-----	50
3.2 Data collection techniques and tools-----	50
3.3 Study Population-----	51
3.4 Profile of Study Area-----	51
3.5 Sampling Technique and Sample Size-----	55

3.7 Ethical Consideration-----	56
3.8 Limitation of the Study-----	56
3.9 Assumption-----	57

CHAPTER FOUR: ANALYSIS OF FINDINGS OF THE STUDY

4.1 Socio-demographic characteristics of the study population-----	58
4.2 Departments/ Status of Respondents-----	60
4.3. Computerization of company and timekeeping systems used-----	62
4.4 Time and attendance type respondents prefer-----	63
4.5 Some timekeeping systems known to respondents. -----	65
4.6 Do respondents know about biometric fingerprint in timekeeping? -----	66
4.7 Respondents' perception about biometric fingerprint in timekeeping-----	68
4.8 Benefits and challenges in the usage of biometric fingerprint in timekeeping-----	69
4.9 Management performance appraisal using biometric fingerprint in timekeeping-----	70

CHAPTER FIVE: SUMMARY OF FINDINGS, RECOMMENDATIONS & CONCLUSION

5.1 Summary of findings-----	72
5.2 Recommendations-----	74
5.3 Conclusion-----	75
5.4 BIBLIOGRAPHY/REFERENCE-----	76
5.5 APPENDICES-----	79

LIST OF TABLES

Table: 2.8.1 Comparison of existing biometric systems in terms of those parameters

Table: 2.9.1 Table showing the state of art of some biometric systems

Table: 3.4.1 Gold Fields Classified Mineral Resource and Ore Reserve Statement

Table: 3.4.2 Companies' Employee Population.

Table: 4.1. Socio-demographic characteristics of the study population

Table: 4.2. Departments/ Status of Respondents (151)

Table: 4.3. Computerization & Timekeeping In the Organization

Table: 4.4 Timekeeping System Preference

Table: 4.5. Some Known Timekeeping Systems

Table: 4.6. Knowledge about Biometric Fingerprint In Timekeeping

Table: 4.7. Employees' Perception

Table: 4.8. Benefits& Challenges

Table: 4.9. Management Performance Appraisal

LIST OF FIGURES

Fig 4.1 Type of Timekeeping Preference by Respondents

Fig 4.2 Types of Timekeeping Systems used in the Organization

Fig 4.3 Respondents Knowledge about Biometric Fingerprint in Timekeeping

Fig 4.4 Some Benefits & Challenges using Biometric Fingerprint in Timekeeping

Fig 4.5 Management Performance Appraisal using Biometric Fingerprint in Timekeeping



LIST OF APPENDICES

Appendix 1 Questionnaire for employees of Goldfields Ghana Ltd.

Appendix 2 Questionnaire for employees of AngloGold Ashanti Ghana Ltd

Appendix 3 Questionnaire for employees of Golden Star Bogoso/Prestea Ghana Ltd



L.BRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

ABSTRACT

Timekeeping is very critical to any organization, for it is based on this that employees are correctly remunerated, compensated, effectively rewarded etc. If the systems used are wrought with human errors and mistakes, could there be a more efficacious means that could minimize or solve some, if not all the problems associated with the old systems. This thesis is to assess the present system of timekeeping used in the mining organizations and to evaluate the difference and effect that the introduction of biometric fingerprint in timekeeping will bring. The study was a descriptive cross-sectional one supported with records review. Data was collected in June 2008 using employees of the mining companies at Tarkwa and its environs. During this study, 151 respondents sampled using a three-stage cluster sampling technique were interviewed. Deep investigative interview of all the 151 respondents from three different mining companies in June 2008 with close-ended questionnaire was conducted. There were several visits to the mining companies working sites to assess their various infrastructure and their human resources. Several descriptive processes and outcome indicators with special interest and focus on five (5) were used in the study. These were: knowledge about biometric fingerprint in timekeeping, perception about biometric fingerprint in timekeeping, preference of timekeeping systems vis-à-vis the biometric fingerprint system.etc. The study confirmed that few respondents, just 44.4% have any knowledge about the usage of biometric fingerprint in timekeeping as against 55.6% who do not know any thing at all about it. As much as 87.4% believe that it can correct attendance and time management and 86.8% perceive the biometric fingerprint in time and attendance management to be a tool for the growth of the organization. Also, 81.5% of the respondents believe that it can minimize truancy at work

in the organization as a whopping majority of 90.7% perceives it to give an added value to the company. Furthermore 78.1% of the respondents believe that the challenges and or benefits that biometric fingerprint in time and attendance management can bring to the organization are that it will increase efficiency, reliability and effectiveness of employees, 71.5% also think that it will give the organization an urge and drive over its competitors.etc. Though all the mining companies are computerized and are using various timekeeping systems, little or nothing at all is known about the usage of the biometric fingerprint. Introducing the biometric fingerprint is very necessary and paramount due to its attendant benefits that are numerous, comparative to the other familiar systems.



CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Introduction

Ghana, formally Gold Coast has been known for its gold for centuries. When Portuguese Traders established a port on her coast in 1482, they named her simply “Elmina” (the mine). British colonizers called the country “Gold Coast.”(Oxfam America 2007). Goldfields Ghana Ltd.Tarkwa, formerly Amalgamated Banquet Area (A.B.A.), a gold mining company became known for many years .It is therefore identified as the engine of growth for the country since the colonial Era for the company offered business and financial opportunities to the indigenes. As the trend in mining industry in Ghana has dramatically changed into greater usage of Information Technology (IT), has it changed with timekeeping or time and attendance management?

Time is the collection, calculation, reporting and integration of all information necessary for employee compensation, according to (Legiant 2006). He goes on further to explain attendance as : the tracking of infractions and leave in order to provide a fair, unbiased and uniform application of attendance policy, (Legiant 2006).A much more advanced timekeeping is therefore Time and attendance which refers to the effective management of an organization’s workforce. Depending upon the system you use - as simple as manually recorded time sheets and as sophisticated as biometric data capture - you can manage schedules, track benefits accruals, administer training, and perform job costing, track applied time and product-line details. An effective system will prepare data for

automatic transmittal to payroll and ultimately improve management's decision-making through its comprehensive reporting.

http://www.timeandattendance.com/data_collection_more.php.

In the new benchmark report, "Evolving Time and Attendance: Foundation for Workforce Management Improvements," HHS), Aberdeen Group, a Hart-Hanks Company (2008) stated that time and attendance systems have become the very cornerstone for laying a foundation of effective workforce management systems. This benchmark report is a compilation of surveys and interviews from over 300 organizations globally, and highlights how Best-in-Class performers are maximizing the value of their time and attendance systems to improve employee satisfaction, increase revenue, and decrease labor costs, (Thomson Reuters 2008).

Furthermore, the new benchmark report published by Aberdeen Group, "Evolving Time and Attendance: Foundation for Workforce Management Improvements,"(Erin et al. 2008) statistically, stated that 88% of organizations that achieved Best-in-Class status have partially or fully automated their time and attendance data collection. In doing so, 65% have improved the accuracy of their time data; 60% have increased their revenue per employee; 59% have decreased their overtime as a percentage of total labor costs; and 47% have decreased their labor costs, (Erin; et al., 2008).

Nucleus Research, a global provider of IT advisory and research services, found that 74% of organizations experience payroll losses that are directly related to buddy punching. Nucleus Research found that organizations can save 2.2% of gross payroll annually on average by eliminating buddy punching through the use of innovative biometric

technology. It is also advanced that when time and attendance management is improved through automation, it provides the following:

I. Reduce labor costs: Streamline the organizational operations by eliminating paper timesheets and other error-prone manual processes and decrease the payroll error rates.

II. Improve productivity: Empower managers with real-time employee information and labor data along with the tools to boost workforce performance and productivity.

III. Increase labor insight: Make use of reliable data and increased visibility into critical workplace activities. Drive better decision-making and continuous improvement. (Erin,

Kathy, Herman, 2008). The introduction of Biometric Fingerprint (BF) as a business enabler in Timekeeping in the mining company will result in greater economic success

and provide Goldfields a competitive advantage in the industry. BF is a business enabler as a result, when it is efficiently and effectively employed then the economic success is

enormous. BF must be viewed as a critical success factor to be used in the business processes to achieve not only economic success but also a competitive advantage. With

the introduction and diffusion of BF as a critical success factor it is often viewed as both an indication and a vehicle of economic success. This reason therefore is what informs

our venture into choosing the topic: Biometric Fingerprint Application in Timekeeping (Time& Attendance Management) In Gold Mining Organizations: A Case Study Of

Goldfields Ghana Limited-Tarkwa. Access to these technologies in a form suitable to the specific needs of a country is a prerequisite for participation in the Global Information

Society. (Kiessling,2007). Goldfields Ghana Ltd has undergone some sort of computerization of some of its activities; and this we assume puts it a step ahead of its

competitors. The question which still remains is, “whether the introduction of Biometric

Fingerprint in Timekeeping or Time & Attendance Management will give it an added advantage over its competitors that are massively infiltrating in recent time into Tarkwa for gold mining activities, threatening a denial of Goldfields Gh. Ltd. a sole monopoly?” Can BF be the tool of growth for the company/industry in question – Goldfields Ghana Limited, Tarkwa with special reference to its application of BF in Timekeeping? These and others are questions that this study seems to answer or unravel.

1.2 Statement of the Problem

Comments and statements received from gold miners and indigenes in towns and villages in and around Tarkwa suggest that mining companies in Ghana do not seem to offer any or much variety in the nature of Timekeeping or in other words Time and Attendance of workers. Is this attributable to lack of innovation to apply biometric fingerprint in a unique way for timekeeping?

The study attempts to address the following questions:

- What is the extent or level of automation of gold mining companies in Tarkwa and its Environs or in Ghana, using Goldfields Gh.Ltd.as a case study?
- Can biometric fingerprint add value to Goldfields Gh.Ltd? That is for example: increase profit, reduce cost, streamline processes, increase efficiency, effectiveness, reliability, accessibility, empowerment etc.
- Can Goldfields Gh. Ltd use biometric fingerprint to streamline its processes of timekeeping and increase profit?
- Will the use of or applications of Biometric Fingerprint Technology in Timekeeping or Time and Attendance Management solve the related problems associated with the use of the Manual or Time Sheet System by these mining companies such as: Goldfields

Gh.Ltd. AngloGold Ashanti Gh.Ltd.-Iduapriem(Tarkwa), Golden Star Bogoso/ Prestea Goldfields Gh. Ltd.

1.3 Research Questions

1. Does BF give Tarkwa Goldfields Ghana Ltd. a competitive urge and drive over its major competitors?
2. Does Biometric Fingerprint provide better Timekeeping device to the Industry?
3. Does Biometric Fingerprint help to enhance management of employee Time and Attendance to work and be a critical success factor for the business hence it is worth its cost?

1.4 Research Objective

1.4.1 General Objective

The general objective of this paper is to assess and evaluate the impact of Information Technology Usage in general but specifically The Biometric Fingerprint for Timekeeping in mining organizations as can be identified in Goldfields Ghana Ltd-Tarkwa.

1.4.2 Specific Objective

Specifically, the study seeks:

- 1 .To assess the attitude and perception of the miners in time and attendance management of mining companies.
2. To identify the various timekeeping systems employed by mining companies and problems associated with them.
3. To assess the level of knowledge, perception, benefits and challenges about the use of biometric fingerprint in time keeping or attendance management.

4. To recommend ways of improving timekeeping through the use of the biometric fingerprint.

1.5 Justification of the Study

A primary responsibility of the gold mining companies is on one hand to make profits, and on the other for the workers to earn salaries hence the economic improvement of both the country Ghana and the citizens.

- The ability to do this very successfully is for the companies to put in place a very efficient time and attendance management or timekeeping devoid of cheating on the part of both the companies as well as the workers.

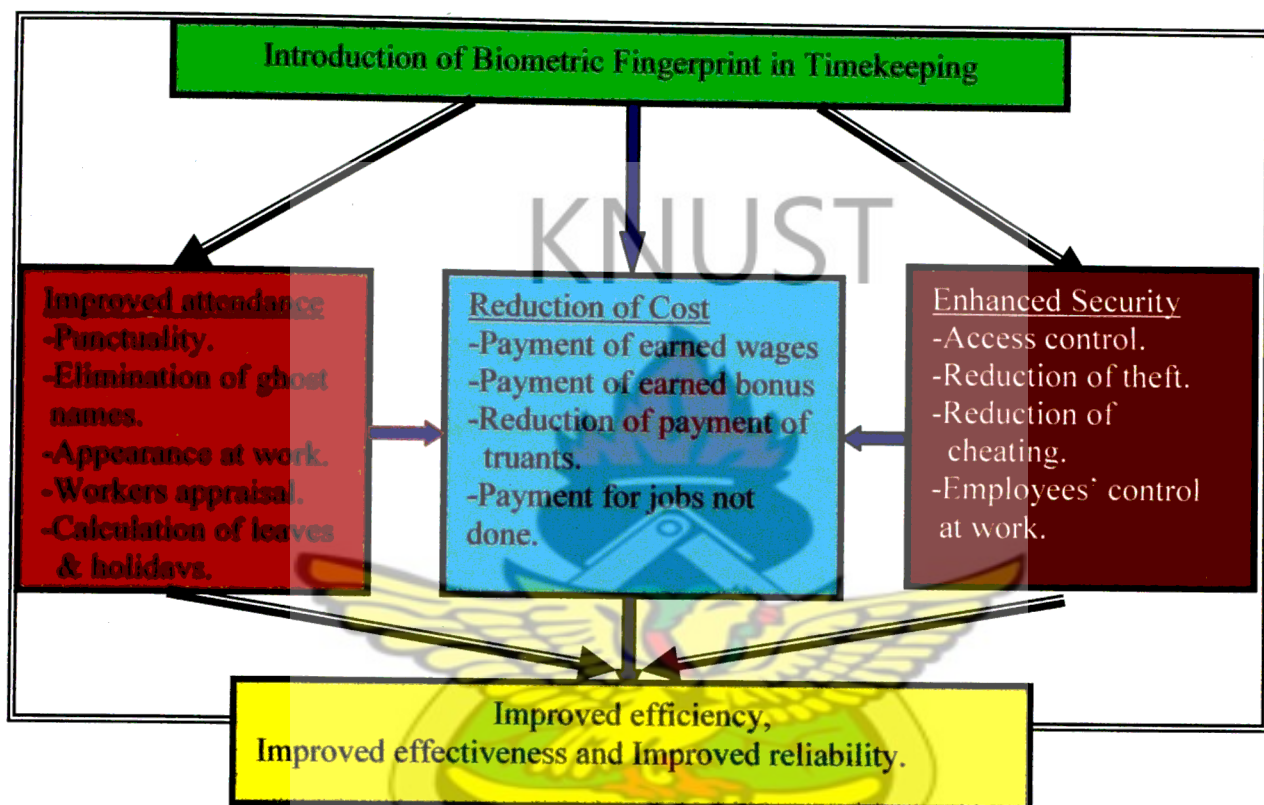
- The system whereby workers that are absent are marked present by their cronies and /or their relations that head sections and /or departments not only cheats those who are regularly present at work but also cheats the companies concerned and eats into their profits.

- On the other hand, where workers' time and attendances are not well managed leading to them being under- booked or less marked, the companies therefore cheat them due to human errors.

-Companies especially the mining ones persistently and generally have their profits eaten into, and workers under paid due to bad or wrong timekeeping or bad time and attendance management. In many organizations, large human resources departments, along with even bigger payroll departments, spend the majority of their time gathering, sorting, calculating, and reporting on all that data. Only about one out of three organizations with 50 or more employees control this data through the use of time and attendance software. We feel that the need for automated time and attendance systems is

obvious, simply to handle the huge number of data collection equipment types suggested, (Thomson Reuters 2008).

CONCEPTUAL FRAMEWORK



1.6 Methodology

This is a descriptive and analytical cross sectional study to be completed within one year duration. Data will be collected from both primary and secondary sources. Primary data will be collected through interviews by interviewing the appropriate personnel. Interview guides will be designed to facilitate the primary data collection. The same set will be designed and administered to the personnel at the top managerial position, specifically the Managers, the functional managers, not forgetting the IT officers etc. Others will be

administered to the general staff body. Purposive sampling method will be used to select subjects at the top managerial positions whilst stratified sampling method will be used to administer questionnaire to some selected goldmines in and around Tarkwa.

Approximately 50 questionnaires will be administered to both the top management and the general working staff of Tarkwa Goldfields Gh.Ltd. That is 50 questionnaires will be administered to both the top management and to the general staff body. About 50 each to Golden Star Bogoso/Prestea Goldfields Gh.Ltd. and AngloGold Ashanti Iduapriem Gh.Ltd. respectively. Moreover, data on some performance trends will be extracted from newsletters journals critically analyzed and appraised. There will be further reading on existing literature on the research topic to prove the theoretical essence of the study.

1.7 The Scope of the Study

Every topic is always too broad for a study if the scope is not defined. In the light of the above, we wish to limit our study to be within the parameters stated below: the time limit shall be within one year duration, the geographical location shall be Tarkwa and its environs, the companies for the study are the mining companies in and around Tarkwa the specific companies are: Tarkwa Goldfields Gh. Ltd., Golden Star Bogoso/Prestea Goldfields Gh. Ltd., and AngloGold Ashanti Iduapriem Gh. Ltd. The specific topic for our study is the usage of Biometric Fingerprint for Timekeeping or Time and Attendance Management. This study cannot be without any limitations as is always usual with research works. These are therefore some of our limitations as we do our study: the time for the study is extra too short as we assume the duration should be a complete one year,

the distance between the various mines is far, and that between Kumasi and Tarkwa is another; financial limitations are more precarious than expected for journeys must be effected for information and the administration of the questionnaires, some respondents failed to answer some of the questions.

1.8 Organization of the Study (Synopsis)

The study is organized into five chapters. These are:

Chapter 1- the general introduction

Chapter 2 -the literature review

Chapter 3 -the methodology and the organizational profile

Chapter 4 -the analysis of findings of the study and finally

Chapter 5 –the summary of findings, recommendations and conclusion.

1.8.1 The General Introduction

This chapter contains a short introduction of the study including a short history or background of the subject for the study. This is followed by the statement of the problem or the problem identified in the subject that informs its study. This leads to the objective of the study or in other words our aims/goals to achieve as we investigate this topic. After the objective of the study is the justification of the research work, or the reason why the research is worth undertaking. The methodology or the ways and means, the process utilized in the research work and its presentation. In the general introduction we also look at the scope of the study or the parameter within which we work. And finally, in the general introduction, we look at the limitations of the study which are the problems, the constraints the hurdles encountered during the course of the study.

1.8.2 The Literature Review

This contains a short introduction to the review itself, a brief review of the theme of the topic of our research, definitions of the technical terms in the topic of our choice, concepts, theories and classifications of works based on the topic etc. and finally the empirical literature.

1.8.3 The Methodology and Organizational Profile

These contain facts information, and data collected from the field. Data, in this case is both from primary and secondary sources. In the profile, facts and data about the subject under study are presented, stated and established without doubt.

1.8.4 Analysis of Findings of the Study

Here, we try a brief analysis of our findings. This consists of facts about the company or subject under study including information, data, operational and performance evaluations.

1.8.5 Summary of Findings, Recommendations and Conclusion

Under this heading, we try to give a short or brief summary of our findings realized in course of our research. We proceed to give recommendations to various parties such as the company, the government, the employees, the management of the company, and if possible, the customers of the company. Finally, we conclude our research work, stating briefly what needs to be done after our work.

Reference: <http://www.oxfamamerica.org>

*** 1.9 Some Types of Timekeeping**

Attendance management is the act of managing or presence in a work setting to minimize loss due to employee downtime. Attendance control has traditionally been approached

using Time clocks, Timesheets, and Time tracking software, but attendance management goes beyond this to provide a working environment which maximizes and motivates employee attendance. A timesheet is a method for recording the amount of a worker's time spent on each job.

1.9.1 Use of Timesheets

Originally developed for an employer to determine payroll, timesheets are not just for payroll anymore. Timesheets may record the start and end time of tasks, or just the duration. It may contain a detailed breakdown of tasks accomplished throughout the project or program. This information may be used for payroll, client billing, and increasingly for project costing, estimation, tracking and management. Some companies provide web-based timesheet software or services that provide a means to track time for payroll, billing and project management. This project management data can make complex cost relationships visible, thereby allowing lower costs. This knowledge can drive corporate strategy as users let their competitors perform the unprofitable work.

1.9.2 Time cards

The time cards usually had the workdays and time in and time out areas marked on them so that employees could "punch in" or "punch out" in the correct place. The employee was responsible to line up the correct area of the card to be punched with an indicator on the time card. Software applications offer such a system. Factory workers often have a "time card" and "punched in" by inserting their card into an automatic timestamp machine (sometimes known as a Bundy clock) when starting and ending their work shift.

<http://encyclopedia.thefreedictionary.com/bundy+clock>

Advantage: Time tracking can lower costs in 3 ways: by making payroll processing more efficient, by making costs visible so you can lower them, and by automating billing & invoicing. Time tracking can increase revenue through automating billing, which tends to make it easier for a company to get correct invoices out for all hours worked by consulting staff. This speeds up payment and eliminates the hassles of 'dropping' bills. By lowering costs in 3 ways, and increasing revenue in one way, timesheet management technologies that are web-based can improve the health of companies. In the project management world, timesheets can also be used to build a body of knowledge about how much effort tasks take to develop. For example if developing a training plan has historically taken a month, then it can be assumed that creating a new one will take a month. Also most timesheet software has the ability to track resource costs and project expenses to allow for better future budgeting.

[http://encyclopedia.thefreedictionary.com/project+ management](http://encyclopedia.thefreedictionary.com/project+management)

Disadvantages

- Error prone (did I forget to enter yesterday's timesheet?) and repetitive.
- Rounding errors (12:27:34 is not the same as 12:30).
- Breaks concentration of person using timesheets.
- Consumes time in the process of completing the timesheet which is not accounted for in the recording process and inaccurate.
- Requires human interaction.

["http://encyclopedia.thefreedictionary.com/Timesheet"](http://encyclopedia.thefreedictionary.com/Timesheet)>Timesheet

1.9.2 A time clock

A time clock (sometimes known as a Clock card machine) is a mechanical timepiece used to assist in tracking the hours an employee of a company worked. This was accomplished by inserting a heavy paper card, called a time card, into a slot on the time clock. When the time card hit a contact at the rear of the slot, the machine would print day and time information on the card. This allows a timekeeper to have an official record of the hours an employee works to calculate and pay him/her.

"<http://encyclopedia.thefreedictionary.com/timekeeper>

In the 1990s, time clocks started to move away from the mechanical version to computer based time tracking systems. On these systems, the employee enters an employee number, swipes a magnetic striped card, or brings an RFID tag into proximity with a reader, or uses some other device to identify the employee to the system. Based on the system being used, the employee then enters what should be recorded. This could be "punching in", "punching out", lunch breaks, reason for leaving early, or any other type of information the employer requires. Biometric time clock systems are also used that authenticate employees while "punching in/out" through scanning fingerprints, palm prints, or by measuring dimensions of the hand.

"<http://encyclopedia.thefreedictionary.com/RFID>.

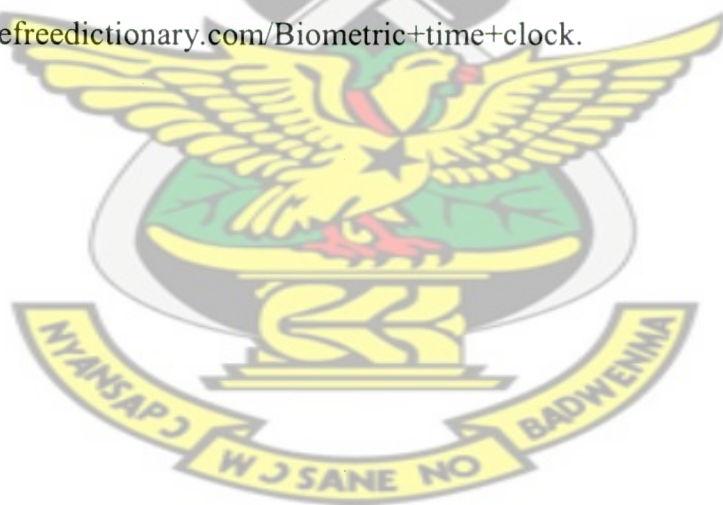
1.9.3 Fingerprinting: The first year for the first known systematic use of fingerprint identification began in the United States in 1902. The New York Civil Service Commission established the practice of fingerprinting applicants to prevent them from having better qualified persons take their tests for them. The New York state prison system began to use fingerprints for the identification of criminals in 1903. In 1904 the fingerprint system accelerated when the United States Penitentiary at Leavenworth,

Kansas, and the St. Louis, Missouri, Police Department both established fingerprint bureaus. During the first quarter of the 20th century, more and more local police identification bureaus established fingerprint systems. The growing need and demand by police officials for a national repository and clearinghouse for fingerprint records led to an Act of Congress on July 1, 1921, establishing the Identification Division of the FBI. In 1924 the Identification Division of the Federal Bureau of Investigation (FBI) was established to provide one central repository of fingerprints. When the Identification Division was established its purpose was to provide a central repository of criminal identification data for law enforcement agencies throughout the Nation. However, in 1933 the United States Civil Service Commission (now known as the Office of Personnel Management) turned the fingerprints of more than 140, 000 Government employees and applicants over to the FBI. Therefore, a Civil Identification Section was established. These innovations marked the initiation of the FBI's Civil File which was destined to dwarf the criminal files in size. In 1992 the Identification Division was re-established as the Criminal Justice Information Services Division (CJISD). In the IT space, low-priced fingerprinting systems represent a potential solution to a number of problems. Companies need to supplement password systems, which can be easily compromised, and fingerprinting represents a stronger security check. Fingerprinting also has the potential to lower IT costs. "Currently, companies pay help desk personnel a lot of money to handle support calls, and many problems arise when users have problems with or forget their passwords," said Gerry Gebel a senior analyst with the Burton Group. Gebel reiterated that "Fingerprinting offers companies an easier-to-maintain authentication system." As a result, the technology has started to be used in a few niche markets to

ensure that only the right individuals access certain services. Financial services represent an area where new security options are often readily adopted. These firms need to be certain that employees and customers are who they claim to be when they undertake various transactions. Firms such as Fidelity Investments have started to use fingerprinting devices for user identification, (Paul Korzeniowski 2007).

1.9.4 Biometrics (ancient Greek: *bios* ="life", *metros* ="measure") refers to two very different fields of study and application. The first, which is the older and is used in biological studies, including forestry, is the collection, synthesis, analysis and management of quantitative data on biological communities such as forests. Biometrics in reference to biological sciences has been studied and applied for several generations and is somewhat simply viewed as "biological statistics," (Jain, A. K.; Ross, et al. 2006).

"<http://encyclopedia.thefreedictionary.com/Biometric+time+clock>."



CHAPTER TWO-LITERATURE REVIEW.

2.1 Introduction

Fingerprint biometric technology has improved and expanded since its conception. Initially, the fingerprints of almost 30% of BanCafe's customers who enrolled in the pilot project were unable to be read by the then existing technology. Current developments in biometric imaging technology, however, has reduced the instances of error to approximately 8%, (Peter Mucklestone and Stuart Louie; 2006). In addition to fingerprint biometrics, finger scans (in which identity is confirmed by multiple points on the finger), hand scans (in which identity is confirmed by measuring the widths of the palms and the lengths of the fingers), and even scans that read the pattern of a user's blood vessels have been developed, (Jack Crystal; 2006). The most common personal authentication techniques used for identity management employ a secret PIN or password that must be remembered. Password mania prevails. Fingerprint biometric technology is an ideal alternate solution to the password recall problem. However, fingerprint biometric systems still remain uncommon in public sectors of industry such as banking, healthcare, and education. Two proposed reasons for this lack of deployment are: (1) society's misunderstanding regarding the personal privacy, security, and function of the technology, and (2) inadequate education regarding the technology, (Green, N.; Romney, G.W., 2005). Using biometrics to verify identity means using a physical characteristic such as face, voice or fingerprints to authenticate an individual's claimed identity (Ola Svedin; et al, 2004).

2.2 Fingerprint Technology

2.2.1 Fingerprint Identification

Fingerprint Identification is the method of identification using the impressions made by the minute ridge formations or patterns found on the fingertips. No two persons have exactly the same arrangement of ridge patterns, and the patterns of any one individual remain unchanged throughout life, (Paul Korzeniowski; 2007). Fingerprints offer an infallible means of personal identification. Other personal characteristics may change, but fingerprints do not, (Wirtz and Heracleous; 2005). Fingerprints can be recorded on a standard fingerprint card or can be recorded digitally and transmitted electronically to the FBI for comparison. By comparing fingerprints at the scene of a crime with the fingerprint record of suspected persons, officials can establish absolute proof of the presence or identity of a person, (Ola Svedin, et al 2004). Traditional methods for obtaining fingerprints, which involve powders, liquids or vapors, can destroy the print for further analysis. However, a new technique uses X-rays to detect salts from a person's sweat is used. If there are enough of these salty residues, a fingerprint can be identified without altering the sample. The alternative could prove advantageous in taking prints from certain difficult substances, like paper, wood, leather, plastic, and even human skin. It may also be useful in obtaining fingerprints from children, who have less oil on their skin. And more information can be obtained from some prints. Bits of a murder suspect's last meal might be detected in the residue of a print, for example, (Schirber; 2005).

A valuable complement: Scientists from Los Alamos National Laboratory have used a thin beam of X-rays to illuminate prints, in a technique called micro-X-ray fluorescence (MXRF). Elements like sodium, potassium and chlorine, which are present in human

sweat, will absorb X-rays and reemit light - or "fluoresce" - at lower frequencies, said Chris Worley. Preliminary laboratory studies have shown that the sweat deposits form an outline of the person's fingerprints. Identification was also possible when hands were covered with lotion, soil, saliva or sunscreen - contaminants that can foil the traditional tools of the crime scene investigator, (Schirber; 2005).

"This process represents a valuable new tool for forensic investigators that could allow them to nondestructively detect prints on surfaces that might otherwise be undetectable by conventional methods," said Chris Worley, who led the research. He emphasizes that, "It won't replace traditional fingerprinting, but could provide a valuable complement to it." The MXRF method is still two to five years from real-world application, the researchers say. It is limited by the fact that sometimes the amount of detectable material is too small. The X-rays do not see lighter - more common - elements, like carbon, nitrogen and oxygen, (Michael; 2005).

2.2.2 Fingerprint Pattern Types: In the late 19th Century, scientists began describing the uniqueness and permanence of fingerprints, said Sir Francis Galton. He further classified fingerprints based on their patterns of arches, loops, and whorls. Examples are: Plain Arch, Tented Arch, Ulnar Loop, Radial Loop, Plain Whorl, Central Pocket Whorl, Double Loop Whorl, Accidental Loop Whorl and Accidental Whorl, (Galton; 1901).

The Poughkeepsie National Guard Armory had on display one of the oldest operating time clocks, as of 1980.

Fingerprint clocks



Contact less magnetic time clock card

<http://encyclopedia.thefreedictionary.com/United+State+Poughkeepsie+New+York>

Fingerprint clocks are a type of biometric time clock for recording workers' hours on the job. Fingerprint clocks do not store images of a person's fingerprint, but store binary data representing the ridges and swirls of the fingerprint. One common configuration is to have a fingerprint reader connected by USB cable to a computer which uses that data to authenticate a person. <http://encyclopedia.thefreedictionary.com/USB>

2.2.3 The Automated Fingerprint Identification System

The Automated Fingerprint Identification System (AFIS) is a biometric identification (ID) methodology that uses digital imaging technology to obtain, store, and analyze fingerprint data. The AFIS was originally used by the U.S. Federal Bureau of Investigation (FBI) in criminal cases. Lately, it has gained favor for general identification and fraud prevention. Fingerprinting, as a form of personal identification, is a refined methodology that is proven in practice and accepted in courts of law. AFIS itself has been around for more than 25 years. Recently, a more advanced form of AFIS uses a process called plain-impression live scanning. Several vendors offer AFIS equipment and programs.

2.2.4 Integrated Automated Fingerprint Identification System or IAFIS.

Criminal Identification by means of fingerprints is one of the most potent and accurate factors in apprehending fugitives who might otherwise escape arrest and continue their criminal activities indefinitely, (Michielsen; 2005) of ABI Research. Fingerprints are now processed through the Integrated Automated Fingerprint Identification System. The fingerprints are submitted electronically or by mail, processed on IAFIS, and a response is returned to the contributing agency within two hours or less for electronic criminal fingerprint submissions and twenty-four hours or less for electronic civil fingerprint submissions, (Hooshang; 2000). Fingerprint processing has been reduced from weeks and months to hours and minutes with IAFIS. The Integrated Automated Fingerprint Identification System, more commonly known as IAFIS, is a national fingerprint and criminal history system maintained by the Federal Bureau of Investigation (FBI), the Criminal Justice Information Services (CJIS) Division said, (Bures; 2000). The IAFIS provides automated fingerprint search capabilities, latent searching capability, electronic image storage, and electronic exchange of fingerprints and responses, 24 hours a day, 365 days a year. The IAFIS became operational in July 1999, (Paul Korzeniowski; 2007).

Fingerprint Identification is the method of identification using the impressions made by the minute ridge formations or patterns found on the fingertips. No two persons have exactly the same arrangement of ridge patterns, and the patterns of any one individual remain unchanged throughout life. Fingerprints offer an infallible means of personal identification, (Paul Korzeniowski; 2007) of TechNewsWorld. Other personal characteristics may change, but fingerprints do not, (Paul Korzeniowski; 2007). Fingerprints can be recorded on a standard fingerprint card or can be recorded digitally

and transmitted electronically to the FBI for comparison. By comparing fingerprints at the scene of a crime with the fingerprint record of suspected persons, officials can establish absolute proof of the presence or identity of a person.
<http://www.fbi.gov/hq/cjisd/ident.pdf>

The aura of criminality that accompanies the term "fingerprint" has not significantly impeded the acceptance of finger-scan technology, because the two authentication methods are very different. Fingerprinting, as the name suggests, is the acquisition and storage of the image of the fingerprint. Fingerprinting was for decades the common ink-and-roll procedure, used when booking suspects or conducting criminal investigations, (International Biometric Group; 2007). More advanced optical or non-contact fingerprinting systems (known as live-scan), which normally utilize prints from several fingers, are currently the standard for forensic usage. They require 250kb per finger for a high-quality image. Finger-scan technology also acquires the fingerprint, but doesn't store the full image. It stores particular data about the fingerprint in a much smaller template, requiring from 250-1000 bytes. After the data is extracted, the fingerprint is not stored. Significantly, the full fingerprint cannot be reconstructed from the finger-scan template, (International Biometric Group; 2007).

2.2.5 Typical Fingerprint Applications

Fingerprint technology is used by hundreds of thousands of people daily to access networks and PCs, enter restricted areas, and to authorize transactions. The technology is used broadly in a range of vertical markets and within a range of horizontal applications, primarily PC/Network Access and Physical Security/Time and Attendance. Most deployments are 1:1, though there are a number of "one-to-few" deployments in which

individuals are matched against modest databases, typically of 10-50 users. Large-scale 1: N applications, in which a user is identified from a large fingerprint database, are classified as AFIS, (International Biometric Group; 2007).

2.2.6 Fingerprint Feature Extraction

Once a high-quality image is captured, there are several steps required to convert its distinctive features into a compact template. This process, known as feature extraction, is at the core of finger-scan technology. Each of the 50 primary finger-scan vendors has a proprietary feature extraction mechanism; the vendors guard these unique algorithms very closely, (Fingerprint Identification Technology; 2005). What follows is a series of steps used, in some fashion, by many vendors - the basic principles apply even to those vendors who use alternative mechanisms. The image must then be converted to a usable format. If the image is grayscale, areas lighter than a particular threshold are discarded, and those darker are made black. The ridges are then thinned from 5-8 pixels in width down to one pixel, for precise location of endings and bifurcations. Minutiae localization begins with this processed image. At this point, even a very precise image will have distortions and false minutiae that need to be filtered out, (Fingerprint Identification Technology; 2005). For example; an algorithm may search the image and eliminate one of two adjacent minutiae, as minutiae are very rarely adjacent. Anomalies caused by scars, sweat, or dirt appear as false minutiae, and algorithms locate any points or patterns that don't make sense, such as a spur on an island (probably false) or a ridge crossing perpendicular to 2-3 others (probably a scar or dirt). A large percentage of would-be minutiae are discarded in this process, (Fingerprint Identification Technology; 2005).

2.2.7 Fingerprint Form Factors

Form factor is a term used to describe the manner in which a biometric sensor is imbedded into an acquisition device. Biometric sensor, in particular finger-scan sensors, can be imbedded on top of a device, on its side, recessed or protruding. Some biometric devices require users to sweep their fingers across them while others require that users place their fingers on the sensors and hold them still until they are authenticated. Though the placement of the biometric sensor is important from an ergonomic standpoint, several other considerations are equally important form factors. One of them is the type of device that the user interacts with. Several broad categories of device types do exist, (Fingerprint Identification Technology; 2005).

2.2. 8 Optical - Silicon - Ultrasound Fingerprint Technologies

Acquiring high-quality images of distinctive fingerprint ridges and minutiae are a complicated task. The fingerprint is a small area from which to take measurements, and the wear of daily life affects which ridge patterns show most prominently. Increasingly sophisticated mechanisms have been developed to capture the fingerprint image with sufficient detail and resolution. The technologies in use today are optical, silicon, and ultrasound. Optical technology is the oldest and most widely used. The finger is placed on a coated platen, usually built of hard plastic but proprietary to each company. In most devices, a charged coupled device (CCD) converts the image of the fingerprint, with dark ridges and light valleys, into a digital signal. The brightness is either adjusted automatically (preferable) or manually (difficult), leading to a usable image, (International Biometric Group; 2007).

2.2.9 Fingerprint Growth Inhibitors

Though radical changes in the composition of the marketplace would need to occur to undermine fingerprint's anticipated growth, the technology does face potential growth inhibitors. As opposed to technologies such as facial recognition and voice-scan, which can leverage existing acquisition devices, fingerprint's growth is contingent on the widespread incorporation of sensors in keyboards, peripherals, access control devices, and handheld devices. The ability to acquire fingerprints must be present wherever and whenever users want to authenticate. Currently, acquisition devices are present as against a tiny fraction of authentication environment, <http://www.cilab.upf.edu/biosecure1>

The goal was to confirm that education on security issues improves personal confidence in and acceptance of the technology. With this renewed validation, fingerprint biometric authentication was deployed in the IT security labs of Brigham Young University to control access to physical facilities and computers, (Jackie Fenn; 2006). Professor Rutty added: "We believe that, through conversations with our colleagues throughout the fingerprint world and the failure to identify any previous peer reviewed publication, we have demonstrated the first use of a handheld PDA based biometric fingerprinting device for use for fingerprinting the dead". While there are a variety of biometric identification systems available today- face, voice, retinal and iris scans among them - fingerprint scanners are poised to dominate the market for PC security, according to analyst Jackie Fenn, of the Gartner research firm. "They're certainly the most established and the most proven of this kind of technology," she said. "Iris scanners are the most accurate, but fingerprint scanners have come way down in price", she emphasized. In the IT space, low-priced fingerprinting systems represent a potential solution to a number of problems. Companies need to supplement password systems, which can be easily compromised, and

fingerprinting represents a stronger security check. This time-tested technique has gained popularity because it is the most mature biometric system. As use has expanded beyond law enforcement, pricing has dropped. "A fingerprint scanner costs only \$50 to \$100," according to David Ostlund, a consultant with International Biometric Group.

2.3.0 Strengthening Weak Links

Fingerprinting also has the potential to lower IT costs. "Currently, companies pay help desk personnel a lot of money to handle support calls, and many problems arise when users have problems with or forget their passwords," said Gerry Gebel a senior analyst with the Burton Group. "Fingerprinting offers companies an easier-to-maintain authentication system," Gerry Gebel emphasizes.

2.3.1 Potential Uses Abound

. A quick check of patients' fingerprints will make it clear to nurses and doctors that patients are properly identified as they are about to undergo various surgical procedures. Vendors are also finding more uses for fingerprinting technology. As employees have become more mobile, notebook theft has become a vexing problem. Fingerprint scanning is emerging as one way to make sure that mobile devices do not fall into the wrong hands. Last year, for example, IBM (NYSE: IBM) outfitted its ThinkPad systems with fingerprinting capabilities so thieves cannot boot up the system. Corporations also want to safeguard PCs - not only the devices themselves but often the data that resides on them. In response, Microsoft Corp. (NASDAQ: MSFT) has begun incorporating fingerprint scanning into PC keyboards. "Recently, there has been a big push by cellular carriers to use fingerprinting to enhance handset security," said Erik Michielsen, a director at market research firm ABI Research. Authentec Inc. has helped Korea Telecom

and Japan NTT DoCoMo (NYSE: DCM) incorporate its fingerprint sensor into their wireless handsets, so users do not have to worry about their phones being hijacked.

2.2.3 An Orwellian Omen

While fingerprint use has expanded, there are still a few hurdles that need to be cleared before it becomes a common security check. First, there's the human challenge: Many users are concerned about privacy issues. In addition, some users understand that no security system is 100 percent effective, including fingerprinting systems, and they become concerned about false positives, (Gerry Gebel; 2005).

“Fingerprinting authentication success rates are quite high - in the upper 90 percent range - but that can also mean that sometimes legitimate users may not be allowed access to needed resources,” said Gerry Gebel. Because of these concerns, fingerprinting deployment can require involvement from human resources specialists, lawyers and top management as well as the IT department. Deploying a fingerprinting system is not easy. To date, fingerprint identification devices have been designed in autonomous fashion, so it is difficult to connect devices from different manufacturers, he noted. “Companies find that fingerprinting hardware is not very expensive, but the required systems integration work can become quite costly,” Burton Group's Gebel told TechNewsWorld.

2.3.2 Can Be High-Maintenance

The ongoing maintenance of biometric devices can often be expensive because few IT technicians are familiar with them. Since it is more complicated than traditional security

checks, fingerprinting adds overhead to servers and networks. Transferring a user's biometrics template over a network and storing it is much more costly than transmitting and storing that same user's password data, (Michelson; 2005). Analysts view these as short-term rather than long-term roadblocks. Already, vendors have begun a handful of initiatives in order to create standards so users can mix and match biometric systems. "In the next few years, fingerprinting will continue to find only niche use in corporations, but eventually its advantages compared to traditional security mechanisms will lead to widespread use," ABI Research's Michielsen concluded. "Who you are" systems like fingerprint scanners have a number of advantages over other systems. To name few: Physical attributes are much harder to fake than identity cards. You can't guess a fingerprint pattern like you can guess a password. You can't misplace your fingerprints, irises or voice like you can misplace an access card. You can't forget your fingerprints like you can forget a password, (Tom Harris; 2007).

2.4 Biometrics

2.4.1 Biometrics may be the next major technology after the internet enabling further value and productivity enhancements for those firms that know how to harness its power, (Wirtz and Heracleous; 2005).

Biometrics - The use of special input devices to analyze some physical parameters assumed to be unique to an individual, in order to confirm his/her identity as part of an authentication procedure. Examples include fingerprint scanning, iris recognition, facial recognition, voice recognition (speaker recognition), signature, vascular pattern recognition. <http://www.findbiometrics.com/Pages/guide2.html>

Using biometrics to verify identity means using a physical characteristic such as face, voice or fingerprints to authenticate an individual's claimed identity (Wirtz and Heracleous; 2005). Fingerprint matching is by far the most successful biometric technology because of its ease of use, non-intrusiveness and reliability, (Jain, A. K.; et al, 2006). Fingerprints consist of ridges and valleys formed in complex patterns that are unique for every person and thereby provide an optimal verification method, because every fingerprint consists of a number of ridges and valleys. (Ola Svedin; et al, 2004). Ridges are the upper skin layer segments of the finger and valleys are the lower segments. The ridges form so-called minutia points: ridge endings-where a ridge ends, and ridge bifurcations-where a ridge splits. (Bergenek; et al, 2004). Some researchers have coined the term behaviometrics for behavioral biometrics such as typing rhythm or mouse gestures where the analysis can be done continuously without interrupting or interfering with user activities. <http://en.wikipedia.org/wiki/biometric>.

2.4.2 Overview

Biometrics is used to identify the identity of an input sample when compared to a template, used in cases to identify specific people by certain characteristics.

Possession-based: using one specific "token" such as a security tag or a card;

Knowledge-based: the use of a code or password. Standard validation systems often use multiple inputs of samples for sufficient validation, such as particular characteristics of the sample. This intends to enhance security as multiple different samples are required such as security tags and codes and sample dimensions.

2.4.3 Classification of some biometric traits

Biometric characteristics can be divided in two main classes:

1-Physiological classes: are related to the shape of the body. The oldest traits that have been used for more than 100 years are fingerprints. Other examples are face recognition, hand geometry and iris recognition (Jain, A. K.; et al, 2006).

2-Behavioral classes: are related to the behavior of a person. The first characteristic to be used, still widely used today, is the signature. More modern approaches are the study of keystroke dynamics and of voice. Strictly speaking, *voice* is also a physiological trait because every person has a different pitch, but voice recognition is mainly based on the study of the way a person speaks, commonly classified as behavioral.

Other biometric strategies are being developed such as those based on gait (way of walking), retina, hand veins, ear recognition, facial thermogram, DNA, odour and palm prints.(Ross, A.; et al, June 2006).









2.4.4 Comparison of various biometric technologies

It is possible to understand if a human characteristic can be used for biometrics in terms of the following parameter (A. K. Jain; et al, 2006):

- Uniqueness: is how well the biometric separates individually from another.
- Permanence: measures how well a biometric resists aging.
- Collectability: ease of acquisition for measurement.
- Performance: accuracy, speed, and robustness of technology used.
- Acceptability: degree of approval of a technology.
- Circumvention: ease of use of a substitute.

The following table shows a comparison of existing biometric systems in terms of those parameters:

Comparison of various biometric technologies, according to A. K. Jain (H=High, M=Medium, L=Low)

Biometri	Universal	Uniquene	Permanen	Collectabil	Performan	Acceptabil	Circumventi
cs: 	ity 	ss 	ce 	ity 	ce 	ity 	on* 
Face	H	L	M	H	L	H	L
Fingerpri							
nt	M	H	H	M	H	M	H
Hand							
geometry	M	M	M	H	M	M	M
Keystrok							
es	L	L	L	M	L	M	M
Hand							
veins	M	M	M	M	M	M	H
Iris	H	H	H	M	H	L	H
Retinal							
scan	H	H	M	L	H	L	H
Signature	L	L	L	H	L	H	L
Voice	M	L	L	M	L	H	L
Facial							
thermoga	H	H	L	H	M	H	H
ph							
Odor	H	H	H	L	L	M	L

DNA	H	H	H	L	H	L	L
Gait	M	L	L	H	L	H	M
<u>Ear</u>							
<u>recogniti</u>	M	M	H	M	M	H	M
<u>on</u>							

* - *circumventability listed with reversed colours because low is desirable here instead of high.*

A. K. Jain ranks each biometric based on the categories as being low, medium, or high. A low ranking indicates poor performance in the evaluation criterion whereas a high ranking indicates a very good performance.

2.4.5 Biometric systems

When biometric system is networked together with telecommunications technology, biometric systems become telebiometric systems. The main operations a system can perform are *enrollment* and *test*. During the enrollment, biometric information from an individual is stored. During the test, biometric information is detected and compared with the stored information. Note that it is crucial that storage and retrieval of such systems themselves be secure if the biometric system is to be robust. The first block (sensor) is the interface between the real world and our system; it has to acquire all the necessary data. Most of the times it is an image acquisition system, but it can change according to the characteristics desired. The second block performs all the necessary pre-processing: it has to remove artifacts from the sensor, to enhance the input, e.g. removing background noise, to use some kind of normalization, etc. In the third block features needed are extracted. If enrollment is being performed the template is simply stored somewhere (on

a card or within a database or both). If a matching phase is being performed, the obtained template is passed to a matcher that compares it with other existing templates, estimating the distance between them using any algorithm, e.g. Hamming distance. The matching program will analyze the template with the input. This will then be output for any specified use or purpose, e.g. entrance in a restricted area, (R. Cappelli; et al, 2006).

2.4.6 Functions

A biometric system can provide the following two functions:

Verification: A pre-stored template is matched against a sample directly, e.g. a card or a known database entry.

Identification: Identifying from all the templates which one is the closest match to the input sample.

2.4.7 Performance measurement

-*False accept rate (FAR) or false match rate (FMR):* the probability that the system incorrectly declares a successful match between the input pattern and a non-matching pattern in the database. It measures the percent of invalid matches. These systems are critical since they are commonly used to forbid certain actions by disallowed people.

-*False reject rate (FRR) or false non-match rate (FNMR):* the probability that the system incorrectly declares failure of match between the input pattern and the matching template in the database. It measures the percent of valid inputs being rejected.

<http://en.wikipedia.org/wiki/Biometric>

-*Receiver (or relative) operating characteristic (ROC):* In general, the matching algorithm performs a decision using some parameters (e.g. a threshold). In biometric systems the FAR and FRR can typically be traded off against each other by changing

those parameters. The ROC plot is obtained by graphing the values of FAR and FRR, changing the variables implicitly. A common variation is the *Detection error trade-off (DET)*, which is obtained using normal deviate scales on both axes. This more linear graph illuminates the differences for higher performances (rarer errors).

<http://en.wikipedia.org/wiki/Biometric>

-*Equal error rate (EER)*: the rate at which both accept and reject errors are equal. ROC or DET plotting is used because how FAR and FRR can be changed, is shown clearly. When quick comparison of two systems is required, the ERR is commonly used. Obtained from the ROC plot by taking the point where FAR and FRR have the same value. The lower the EER, the more accurate the system is considered to be.

-*Failure to enroll rate (FTE or FER)*: the percentage of data input is considered invalid and fails to input into the system. Failure to enroll happens when the data obtained by the sensor are considered invalid or of poor quality.

<http://en.wikipedia.org/wiki/Biometric>

-*Failure to capture rate (FTC)*: Within automatic systems, the probability that the system fails to detect a biometric characteristic when presented correctly.

-*Template capacity*: the maximum number of sets of data which can be input in to the system. <http://en.wikipedia.org/wiki/Biometric>

2.4.8 Performance

The following table shows the state of art of some biometric systems:

State of art of biometric recognition systems

Biometrics	EER	FAR	FRR	Subjects	Comment	Reference
Face	n.a.	1 %	10 %	37437	Varied lighting, indoor/outdoor	FRVT (2002)
Fingerprint	n.a.	1 %	0.1 %	25000	US Government operational data	FpVTE (2003)
Fingerprint	2 %	2 %	2 %	100	Rotation and exaggerated skin distortion	FVC (2004)
Hand geometry	1 %	2 %	0.1 %	129	With rings and improper placement	(2005)
Iris	< 1 %	0.94 %	0.99 %	1224	Indoor environment	ITIRT (2005)
Iris	0.01 %	0.0001 %	0.2 %	132	Best conditions	NIST (2005)
Keystrokes	1.8 %	7 %	0.1 %	15	During 6 months period	(2005)
Voice	6 %	2 %	10 %	310	Text independent, multilingual	NIST (2004)

<http://en.wikipedia.org/wiki/Biometric>

One simple but artificial way to judge a system is by EER, but not all the authors provided it. Moreover, there are two particular values of FAR and FRR to show how one parameter can change depending on the other. For fingerprint there are two different

results, the one from 2003 is older but it was performed on a huge set of people, while in 2004 far references belong to the same year, but one was performed on more people, the other one is the result of a competition between several universities so, even if the sample is much smaller fewer people were involved but stricter conditions have been applied. For iris, both, it could reflect better the state of art of the field.

2.5.0 Issues and concerns

As with many interesting and powerful developments of technology, there are concerns about biometrics. The biggest concern is the fact that once a fingerprint or other biometric source has been compromised it is compromised for life, because users can never change their fingerprints. A theoretical example is a debit card with a personal Identification Number (PIN) or a biometric. Some argue that if a person's biometric data is stolen it might allow someone else to access personal information or financial accounts, in which case the damage could be irreversible. However, this argument ignores a key operational factor intrinsic to all biometrics-based security solutions: biometric solutions are based on matching, at the point of transaction, the information obtained by the scan of a "live" biometric sample to a pre-stored, static "match template" created when the user originally enrolled in the security system. However, the big concern is when the biometric features of an individual are successfully attacked (compromised) by impostors and the legitimate owner runs out of new biometric feature to replace the old ones since they will not be secure to be used anymore as an identity. Therefore, the so called Cancellation Biometric came to tackle this limitation.

2.5.1 Sociological concerns As technology advances, and time goes on, more and more private companies and public utilities will use biometrics for safe, accurate identification.

However, these advances will raise many concerns throughout society, where many may not be educated on the methods. Some societal concerns are:

Physical - Some believe this technology can cause physical harm to an individual using the methods, or that instruments used are unsanitary. For example, there are concerns that retina scanners might not always be clean.

Personal Information - There are concerns whether our personal information taken through biometric methods can be misused, tampered with, or sold.

<http://en.wikipedia.org/wiki/Biometri>

2.5.2 Cancelable Biometric

Physical features, such as face, fingerprint, iris, retina, hand, or behavioral features, such as signature, voice, gait, must fulfill a certain criteria to qualify for use in identification. They must be unique, universal, acceptable, collectable and convenient to the person, in addition, to reliability at identification performance and circumvention. However, most importantly, permanence is a key feature for biometrics. They must retain all the above features in particular the uniqueness unchanged, or acceptably changed, over the lifetime of the individual. On the other hand, this fundamental feature has brought biometrics to challenge a new risk. If biometric data is obtained, for example compromised from a database, by unauthorized users, the genuine owner will lose control over them forever and lose his/her identity. But one ordinary advantage of password does not exist in biometrics. That is re-issuing. If a token or a password is lost or stolen, they can be cancelled and replaced by a newer version i.e. reissued. On the other hand, this is not naturally available in biometrics. If someone's face is compromised from a database, they cannot cancel it neither reissue it. Besides reliable accuracy performance and the

replacement policy cancelable biometric has to be non-revisable in order to fulfill the aim, (Ratha; et al.) <http://en.wikipedia.org/wiki/Biometric>

Several methods for generating cancelable biometrics have been proposed. The main idea behind cancelable biometrics is to transform the original data to a certain domain, where recognition can be accurately performed, and cannot be transformed back to the original data. Some of the proposed techniques operate using their own recognition engines, such as Teoh; et al and Savvides; et al, whereas other methods, such as Dabbah; et al, take the advantage of the advancement of the well-established biometric research for their recognition front-end to conduct recognition. Although this increases the restrictions on the protection system, it makes the cancelable templates more accessible for available biometric technologies. (Wikipedia, the free encyclopedia).

2.5.3 Biometric time clocks are a class of employee time clock that detects a persons biological attributes to identify him/her. Examples of this are the hand print clock, which detects the overall attributes of a person's hand, fingerprint clock, and retina scanning clock. Several reasons for using a biometric device for tracking employee time include access control in high security environments, and protection from employee dishonesty, or "buddy punching".<http://encyclopedia.thefreedictionary.com/access+control>.

2.5.4 Biometric identification - the automatic identification of living individuals by using their physiological and behavioral characteristics; "negative identification can only be accomplished through biometric identification"; "if a pin or password is lost or forgotten it can be changed and reissued but a biometric identification

cannot" Biometric authentication, identity verification act of terrorism, terrorism, terrorist act - the calculated use of violence (or the threat of violence) against civilians in order to attain goals that are political or religious or ideological in nature; this is done through intimidation or coercion or instilling fear.

DNA fingerprint, genetic fingerprint - biometric identification obtained by examining a person's unique sequence of DNA base pairs; often used for evidence in criminal law cases. Automatic face recognition, face recognition, facial recognition - biometric identification by scanning a person's face and matching it against a library of known faces; "they used face recognition to spot known terrorists."

Fingerprint - a print made by an impression of the ridges in the skin of a finger; often used for biometric identification in criminal investigations.

Finger scan, finger scanning - biometric identification by automatically scanning a person's fingerprints electronically.

Iris scanning - biometric identification by scanning the iris of the eye; "the structure of the iris is very distinctive".

Signature recognition - biometric identification by automatically scanning a person's signature and matching it electronically against a library of known signatures.

Retinal scanning - biometric identification by scanning the retina of the eye; "identification by retinal scanning is complicated by eye movements".

Voiceprint - biometric identification by electronically recording and graphically representing a person's voice; "voiceprints are uniquely characteristic of individual

speakers".

Identification - evidence of identity; something that identifies a person or thing.

(<http://www.thefreedictionary.com/biometric+identification>>biometric identification.)

2.5.5 The biological identification of a person.

Examples are iris and retinal patterns, hand geometry and voice. Increasingly built into laptop computers, fingerprint readers have become popular as a secure method for identification. Biometrics not only deals with static patterns, but action as well. The dynamics of actually writing a signature can be analyzed, not just the resulting pattern. Biometrics may be used as a secondary mechanism for authentication.

2.5.6 More Secure than Passwords.

Biometrics is a more secure form of authentication than typing passwords or even using smart cards, which can be stolen. However, methods can be circumvented; for example, fingerprints can be captured from a water glass and fool scanners. Several reasons for using a biometric device for tracking employee time include access control in high security environments, and protection from employee dishonesty, or "buddy punching".
<http://encyclopedia.thefreedictionary.com/access+control>.

2.5.7 Some Examples of Biometric Fingerprint Softwares

1-The M2SYS suite of Bio-Plug-in solutions allows software developers to rapidly integrate a complete, server-based, turn-key fingerprint software system with hardly any development effort. Bio-Plug-in is not tied to any specific biometric SDK or hardware device; these can be

easily interchanged in the system. M2SYS works with leading biometric technology providers to support their algorithms and devices with Bio-Plug-in. Bio-Plug-in enables software engineers that are interested in a particular SDK to avoid the headache and hassle associated with low level integration. Instead of having to spend countless hours and dollars learning and developing a robust biometric system, engineers can rapidly integrate Bio-Plug-in in less than a day, and are immediately provided a fully scalable system that also works in Citrix and Terminal Server.

M2SYS offers three versions of its Bio-Plug-in technology:

Bio-Plug-in Appserver: For integration of a seamless fingerprint software module into a Windows based application.

Bio-Plug-in Webserver: For integration of a seamless fingerprint software module into a web based application.

Bio-Plug-in Workstation: For usage of the integrated fingerprint software on a single PC.

This version embeds the fingerprint comparison engine into the client side software.

The integration methodology eliminates any system dependencies between your application and Bio-Plug-in, saving the hassle of continually recompiling or even changing code as updates are made to system libraries.

Bio-Plug-in Features/Benefits:

- Integrate complete fingerprint recognition system in less than a day.
- Biometric software operates outside of host program run-time.
- Avoid burdensome internal development and ongoing maintenance requirements.
- Remain focused on core competencies.
- Includes verification and robust identification server software.

-Compatible with WAN and CITRIX environments.

-Rely on biometrics R&D partner for continued best-of-breed development.

System Capabilities:

-Compression algorithm reduces size of stored records and improves speed.

-Enroll fingerprints at 0.2 - 0.4 seconds and match 30,000 per second.

-Multi-threaded, multi-processing, scalable system performance.

-Adaptive image filtration eliminates "noise" and allows minutiae extraction from even poor quality prints.

-Does not require presence of fingerprint core or delta points.

-Fully tolerant to fingerprint translation and rotation.

-Unique global feature categorization increases effective matching speed.

-Feature generalization improves reliability of enrolled fingerprints.

LTHTS100KIT TS100 TouchStation Biometric Sensor Time System with PayClock EZ

Software

Other products by LATHEM

5 used & new from \$398.89

Technical Details

Manufactured By :. Lathem Time Company

Time Recorder - Biometric - LCD Display - 3-3/4"x7-1/2"x3-3/4" - LGY

Product Details

Product Dimensions: 2 pound. Shipping Weight: 4 pounds .ASIN: B000GR9RSI

Item model number: TS100.

Average Customer Review: No customer reviews yet. Be the first.

Date first available at Amazon.com: July 6, 2006.

Product Description

Time Recorder - Biometric - LCD Display - 3-3/4"x7-1/2"x3-3/4" - LGY - ^.^- TouchStation is the perfect solution for any office environment. Employees simply touch the biometric sensor to clock in and out. Instant identification eliminates buddy punching. The large easy-to-read LCD display always shows the current time, and provides employees with their in/out status and total hours worked after each transaction. Connects to the host computer through a single plug-n-play USB cable which also provides power to the unit. Comes complete with easy-to-use PayClock EZ software that automatically calculates worked hours including overtime, tracks sick and vacation time, and provides dozens of standard time and labor reports. Software exports hours directly to most major payroll providers including ADP and Paychex. PayClock EZ software offers seamless integration with the latest QuickBooks accounting products for a complete punch-to-paycheck solution. Optional remote finger/sensor allows employees to clock in and out at their own PC over existing local area network. - Product #: LTHTS100KIT
Manufactured By: Lathem Time Company

Q-See QSX628 Fingerprint Time&Attendance System

List Price: ~~\$349.99~~

Price: \$319.99

You Save: \$30.00 (9%)

Technical Details

User Capacity: 1,500. Transaction Storage: 50,000.

Communications: RS232, RS485, TCP. Supports TCP/IP, with power network function.

Adopts double identification high technology.

Product Details

Product Dimensions: 14 x 11 x 5 inches; 5 pounds. Shipping Weight: 5 pounds.

ASIN: B000PRTZJK. Item model number: QSX628.

Date first available at Amazon.com: April 24, 2007.

Product Description

Q-See T&A System is a feature rich standalone, robust, cost effective, fingerprint recognition based time attendance recorder. It is suitable for medium and large offices, banks, factory or site. Q-see T&A system is ready to use, easy to install device. With Biometric Technology it gives accurate verification that ensures secure employee recognition. Also with Biometric solutions, it reduces the cost of cards and badges. Q-See T&A system support TCP/IP LAN networking and plugs directly into network HUB/Switch. It can store 50,000-120,000 transactions. Q-See T&A System has its own IP address and can communicate with a central server anywhere in the network. Q-See T&A System is available in 1,000-2,800 fingerprints versions. It comes with free server software which can manage hundreds of Q-See T&A System units in the network. . It can be accessed from the web also in case static IP address is allocated. It can register; store, match fingerprints and send transactions log record to the central server. In case the server is not available, it can back up logs in its memory. Access control is central to biometric market development. The driving market forces for commercial biometric

fingerprint systems relate to demand for more granular intelligent security systems that provide more access control. Carriers and systems users need security granularity to offer customization for users (Roberto Moscoso; 2007). A very advanced feature set is implemented as software in combination with biometrics security systems. Middleware software has highly evolved voice feature systems that complement software systems that implement over 1,000 different functions for the desktop. The Internet security industry is composed of hardware tokens, software tokens, and biometrics. All are used for authentication. The hardware token segments are the most widely used authentication devices set to be replaced by fingerprint identification systems as they become more cost efficient. NEC, Motorola, and Sagem Morpho are the market leaders. Report: Biometric Fingerprint Equipment Market Opportunities, Market Forecasts, and Market Strategies, 2006-2012. Published by: WinterGreen Research, Inc (Global Information, Inc 2008, the infoshop.com by Global Information, Inc).

3-The Cost Effective Powerful Time & Attendance Software Solution

Fingerprint-IT: supplies, and maintains world class quality products relating to access control, time and attendance, CCTV, and other security monitoring systems. Head Office, is based in Johannesburg, and has a nation-wide network of authorized installation and support dealers throughout South Africa, offering nation-wide installation, implementation, support and maintenance.

Fingerprint-IT: strives to provide only the best products, with installers offering a high level of workmanship, backed by high levels of support, all important in a live business critical environment. Making use international and locally developed hardware and software, allows for powerful, cost efficient high value

solutions.

Features & Benefits

- Interfaces into multiple access control and clocking devices
- True 32-bit Windows SQL version
- Network Ready for Multiple Users
- Security for Multiple Users through User Name and Password
- Each Manager/User can Print/View their own dedicated reports
- Reports can be exported to Excel, CSV, HTML and PDF formats for 'eMail'
- All Reports can be produced in Hours/Minutes or Decimals
- MS Excel look-alike clocking and editing screen
- Detailed clocking and hour summary reports
- Absenteeism / Late Arrival and Early Departure exception reports
- Employee and Machine costing reports are available
- User definable system codes (Company, Grades, Occupation, Department) .
- Employee Master File has personnel notes and employee photo linking
- Secure Backup and Restore feature. (Local or Network drives)
- Time Manager has 26 standard payroll package exports VIP Classic, VIP Job Costing, & VIP Premier ready and Customized payroll exporting.

Market

Time Manager services the following markets:

- Government & High Security ;Corporate ;Mines ;Factories
- Small to Medium Enterprises (SME) ;Guarding Companies
- Payroll Administrators ;Human Resources Administrators

Supported Payroll Packages

- Accfin ;Accsys ;Brilliant ;Impact ;Pastel ;Paywell
- Payslip ;Paywise ;VIP ;Spectrum .

Time and Attendance Software

- Data input directly from Impro access control system/s
- Can be integrated into different types of access control systems
- Separate Company, Department, Cost Center, Occupation and Grade splits
- Define your own rules
- Auto Shift detect
- Straight Shifts, Rolling Shifts or Shift Recognition
- Shift balancing and rounding options
- Unlimited work patterns
- Variable or fixed lunch breaks
- Handles unlimited/remote sites
- Process Reports: Daily, weekly, monthly - emailed to management in PDF format (management can receive while away or of remote branches)
- Reports: Full details(Hours & minutes), early departures, lost time, late arrivals, absenteeism, total hours worked summary, balanced hours, overtime, lost time, missing clocking, customized.
- Early Overtime, Standard Work Time and Late Overtime patterns
- Data can be amended(original data tagged)
- Earnings and Deductions export to payroll

Installation and Implementation

Value Add-Authorized Installers, trained by the originators of TIME

MANAGER, are able to implement TIME MANAGER into the many variables with different business rules demand in different businesses. No two businesses are alike.

These Dealers integrate TIME MANAGER into the Access Control and or Clocking Systems implemented at each company

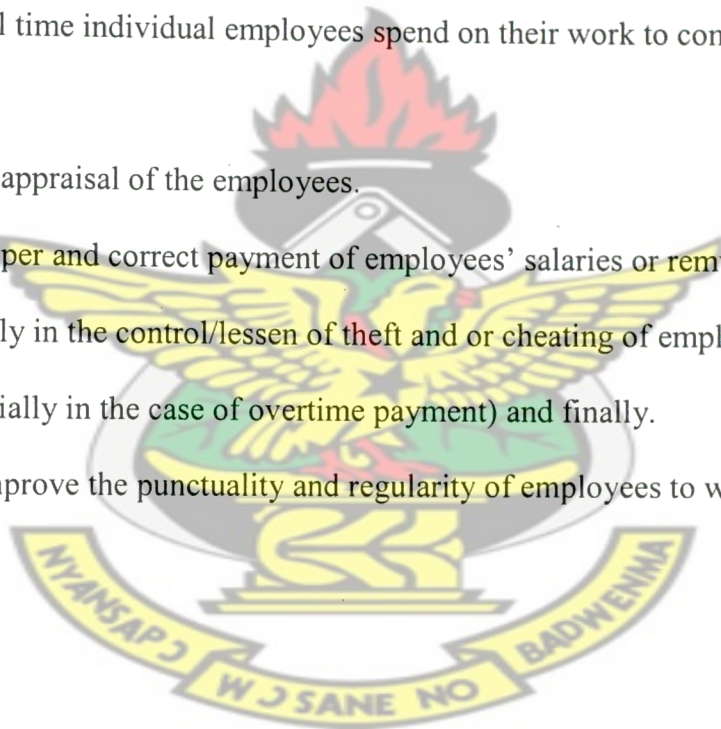
(Fingerprint Identification Technology, 2005)

2.5.8 Biometric vs. Non-Biometric Fingerprinting The aura of criminality that accompanies the term "fingerprint" has not significantly impeded the acceptance of finger-scan technology, because the two authentication methods are very different. Fingerprinting, as the name suggests, is the acquisition and storage of the image of the fingerprint. Fingerprinting was for decades the common ink-and-roll procedure, used when booking suspects or conducting criminal investigations. More advanced optical or non-contact fingerprinting systems (known as live-scan), which normally utilize prints from several fingers, are currently the standard for forensic usage. They require 250kb per finger for a high-quality image. Finger-scan technology also acquires the fingerprint, but doesn't store the full image. It stores particular data about the fingerprint in a much smaller template, requiring from 250-1000 bytes. Biometrics may be the next major technology after the internet enabling further value and productivity enhancements for those firms that know how to harness its power (Wirtz and Heracleous; 2005).

Several reasons for using a biometric device for tracking employee time include access control in high security environments, and protection from employee dishonesty, or "buddy punching". <http://encyclopedia.thefreedictionary.com/access+control+Biometric>

Fingerprint has equally given us more parameters that are beneficial in administration of workers in the mining companies. These are some of the other reasons that we have identified and tabulated in our conceptual framework why the use of Biometric Fingerprint could be very necessary as a Fit for employees' Time& Attendance Management for any company with the intention of profit maximization:

- Check absence or truancy of workers.
- Check the prevalence of ghost workers among the miners.
- Seek to manage the time and attendance of the workers.
- Could reveal the total time individual employees spend on their work to commensurate their remunerations.
- Could be used in the appraisal of the employees.
- Could help in the proper and correct payment of employees' salaries or remunerations.
- Could help extensively in the control/lessen of theft and or cheating of employees by Management (especially in the case of overtime payment) and finally.
- Could also greatly improve the punctuality and regularity of employees to work.



CHAPTER THREE: METHODOLOGY

3.0 General

The research focuses on timekeeping in some mining organizations in the Western Region of Ghana; precisely Tarkwa. The study is limited to three largest gold mining companies in and around Tarkwa.

3.1 Research Methods and Design

The study was a descriptive cross-sectional one supported with records review

3.2 Data collection techniques and tools

Respondents' knowledge about biometric Fingerprint in timekeeping. Three (3) main approaches were employed for data collection. These are:

a. Record Review

This comprised the analysis of some company journals, documents and information from the internet about the three most important or biggest mines in Tarkwa and its environs.

.b. Facility survey

By visits to the mining company sites using checklist of selected key indicators, interactions with some employees, IT facilities were surveyed to assess the level of computerization of the various organizations and their systems of timekeeping.

c. Interviews

A company survey using close-ended questionnaire was conducted to assess respondents' knowledge about some types of timekeeping systems, respondents' knowledge about biometric fingerprint in timekeeping, some challenges & benefits of the system and preference to the various timekeeping systems from the respondents. The employees' knowledge about information technology was also assessed.

3.3 Study Population

The study population for the organizations to be studied consisted of employees at post at all the various shifts in the three companies in question irrespective of sex, age, and some other profile indicators of the employees.

3.4 Profile of Study Area

3.4.1 Profile of the Organization.

Goldfields Ghana Ltd., formally Amalgamated Banquet Areas (A.B.A.), started operation in the 1930's. In those periods, Aladdin lamps were used to provide light for the miners whilst carbide and chisels and hammers were used for blasting of the hard rocks underground, as imitated today by the Galamsey, (Gather am and sell) operators. The miners went to the underground using shafts. The shafts are passages (holes) through which miners went to the underground. Miners were lowered underground by the use of machines known as Winches. A winch carried about 50 miners at a time. Some of those shafts still existing are: AVS which is a vertically dug shaft and Ferguson an inclined type. Other shafts are Fanti, Apinto and Amantrim. Among all these shafts, the only viable one was AVS shaft on which Goldfields Ghana Ltd. depended a great deal for the birth of the surface mining today. From the onset, A.B.A. was operating all alone. Mines Legislative activities, new reforms, difficulties in ordering resources coupled with bargaining problems forced A.B.A. to go into joint venture business in the 1970's with its three sister mines namely: Dunkwa, Prestea and Tarkwa to ease their administration by the Government. About the 1980's, due to more complications and problems, the ties were broken and goldfields had to stay on its own. The Government decided to privatize the company since it could not meet its target for there was loss of labour and insufficient

ore underground and government could no more sponsor the company due to the nature of the economy at the time. Few of these problems are how to get capital to run the company, haulage of the ore from underground coupled with electricity problems and a drastic fall in the international gold price.

Goldfields South Africa won the tender came to take over in 1993 when A.B.A. was still underground operational. Formal feasibility studies were conducted by the late DR. Baako as early as about 1975 so that A.B.A. started open pit mining. The areas surveyed are: Teberebie, G.A.G., Akontase, Pepe, Huniso, Gotraverchi, etc. In 1996, construction of civil work started on the concession and was completed in the year 1997. Surface Mining started in 1998 and consequently the old underground mine was closed down in August 2000 due to better prospects in the open pit mining by the company. Initial production was about 750 tons daily with the single Phase-Mine. Production quickly doubled from about 1600 to 1800 tons daily. The General Manager at the time was G.T. Lewis with Kruckshank as his Engineering Manager. Now, the workforce has tremendously increased to about 1500 with 10 local and foreign sub contractors such as: Liebhier, CAT, Process & Planning, Mobil, Shell, Hyspec, Consar, etc. whose contributions enhance substantially the immense production of the ores into gold. Good gold recovery made the company to be able to buy about 50% of the Teberebie Mines and the remaining by Ghana-Australia Goldfields Gh. Ltd. now AngloGold Ashanti. The fourth phase of the Tarkwa Project is the Carbon in Leach (C.I.L.) plant which has come into existence. The Goldfields has been able to acquire Damang Mines at Damang near Tarkwa. Noticeable is the commendable sponsorship of The Black Stars in the recent World Cup Football matches in Germany where they bit great teams like the U.S.A. etc.

The fifth phase of the mines is underway as the preparation of the Ball Mill etc is seriously started by Consar Company.

3.4.2 Gold Fields Classified Mineral Resource and Ore Reserve Statement

International Operations-31 December 2006

Resources					Reserves						
Classification	2007			2006		Classification	2007			2006	
	Tons (Mt)	Grade (g/t)	Gold (Moz)	Gold (Moz)	Tons (Mt)		Grade (g/t)	Gold (Moz)	Gold (Moz)		
TARKWA											
Measured	144.1	1.5	6.790	8.607	Proved	153.6	1.3	6.468	7.611		
Indicated	191.0	1.3	8.122	8.769	Probable	152.1	1.2	6.054	6.692		
Inferred	51.1	2.4	3.879	2.736							
Total	386.2	1.5	18.792	20.112	Total	305.7	1.3	12.521	14.303		
Measured Stockpiles	6.2	0.8	0.154	0.128	Proved Stockpiles	5.9	0.7	0.141	0.122		
Grand Total	392.4	1.5	18.945	20.240	Grant Total	311.7	1.3	12.662	14.425		

Resources					Reserves						
Classification	2007			2006		Classification	2007			2006	
	Tons (Mt)	Grade (g/t)	Gold (Moz)	Gold (Moz)	Tons (Mt)		Grade (g/t)	Gold (Moz)	Gold (Moz)		
DAMANG											
Measured	10.0	2.0	0.644	0.423	Proved	6.0	2.2	0.434	0.350		
Indicated	28.5	1.6	1.471	1.032	Probable	16.5	1.7	0.902	0.721		
Inferred	12.5	3.4	1.381	1.135							
Total	51.0	2.1	3.496	2.590	Total	22.6	1.8	1.336	1.071		
Indicated Stockpiles	6.8	1.2	0.263	0.327	Probable Stockpiles	6.8	1.2	0.263	0.327		
Grand Total	57.8	2.0	3.759	2.917	Grand Total	29.3	1.7	1.599	1.398		

Goldfields Ghana is presently the largest gold producer in Ghana, with annual production in excess of 900,000 ounces from its operating mines at Damang and Tarkwa (*Suleiman*

Mustapha, 2007)

3.4.3 About The Computerization- Goldfields Ghana Limited

About the year 1999 Goldfields Ghana Ltd. started automating with five computers, its finance department that was hitherto operated manually. The e-mail address was hooked then to Africa-online. Information, at the time, passed through only one person in the Finance Department, printed in form of a fax message and distributed to the officials who matter most. Telecommunication was not easy, for to call any external line was a mission involving a re-location. Only the Human Resource department had access to telephone and calls were made on appointment. A lot of improvement came thereafter as the number of computers increased day in day out. The computerization started with the Minerals Resources, Surveyors, Mining and Geological Departments. The Finance Department is fully automated using Curpact Software for its operations. Accpact software is the new system it is using now for its operations. In addition to the mentioned systems, Akatua, a programme written by a Ghanaian is used for payment. Today, all the functional areas of the company are automated. The Mining Operation Department is fully automated, using modular system. The control room can track the trucks at work-for speed, loading, fuel, air in the tyres etc and can be controlled from the control room. Carbon-in-Leach (CIL) - Plant, Heap Leach System, Chemical Spray, Hard Rock Crushing Systems are all automated and controlled from the control room. The address is goldfields.com, hooked to a British Company at Accra, but hosted by a local GS Telecom. Over 400 computers are now used on the mines, with the fixed assets and depreciation managements using d-bit, a component of Accap for operations. AKATUA is also now replaced by Persol and used by Human Resources Management and for

payment as well. However, time and attendance is done by signing IN and OUT in notebooks or using time sheets. This organization is selected for the study in that it is the biggest, oldest, richest etc. as compared to the rest and for that matter is expected to be more advanced technologically.

Table 3.4.3 COMPANIES' EMPLOYEE POPULATION.

VARIABLE (N=151)	CLASSIFICATION	FREQUENCY	PERCENTAGE
Company	Goldfields	52	34.4
	Anglogold	47	31.1
	Golden Stars	52	34.4
Total		151	100

Source: Author's fieldwork 2008.

3.5 Sampling Technique and Sample Size

3.5.1 Company Survey

3.5.1.1 Technique and Sample Size

The calculated minimum sample size was 150 to obtain an estimate that falls within $\pm 6\%$ points of the true proportion with 95% confidence (Lwanga and Lemeshow, 1991). The anticipated population was 3500 for the three mines. One hundred and fifty-one (151) respondents were however interviewed during the survey. Although the sampling unit is the individual subject, the sampling was conducted on the selected companies' level.

3.5.1.2 Sampling method

A three-stage cluster sampling method was utilized for the company based survey.

Three (3) companies Goldfields Ghana Ltd., AngloGold Ashanti-Iduapriem and Golden Stars Ltd. were selected out of the six (6) by simple random sampling. For each company as many departments were chosen by random sampling. All employees who became respondents were picked at random to answer the questionnaire. In all, 151 respondents were interviewed. Data collectors were employees from the respective organizations mostly from the department of administration educated on the right thing to do. They were strictly taught how to administer the questionnaire. Completed questionnaires were checked for completeness and consistency. Data was then entered into a template designed using SPSS.

3.6 Ethical Consideration

Approval to conduct the study was officially received from the managements of the various mining organizations. The consent of the Ethical Committee of the KNUST School of Business was obtained after the selected topic was approved and a letter of introduction was granted and sent to the various companies. Verbal consent was obtained from some of the study population before the questionnaire was administered.

3.7 Limitation of the Study

. One of the limitations of the study is the legal protocol one has to follow before one is allowed to enter the companies' working places. Since gold is valuable and implicitly money the mining places are treated as security zones which call for request for some studies to be rejected when researchers seem to look like having questionable characters.

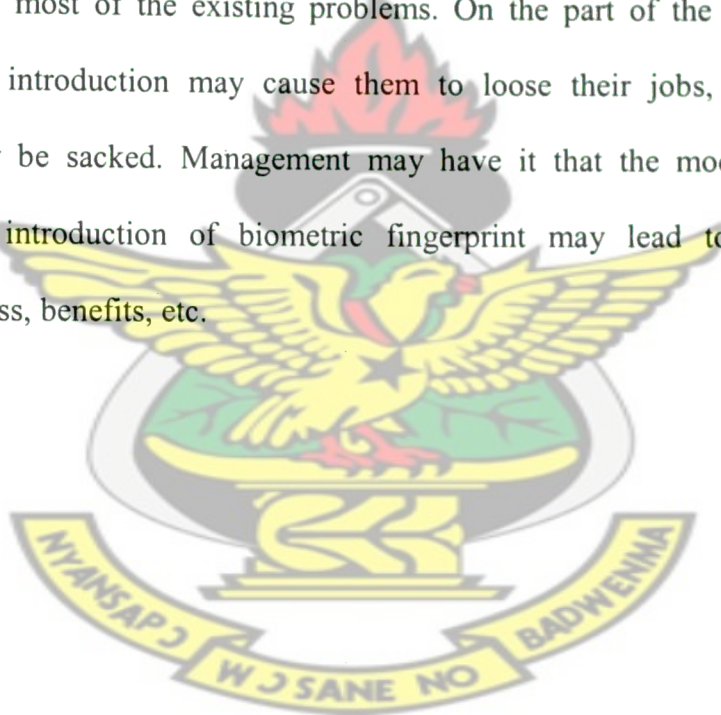
. Employees do not understand the reason why they should engage their precious time that they need to use to gain bonuses to answer questionnaire that will yield no benefits to them. Some educated employees infer from the topic in question to make them redundant

or unemployed in future when suggestions and results of the research are implemented. So they reject responding to the questionnaires to avoid signing their own death warrant.

. Financial resources are some of the main constraints and limitations for the study as it is very difficult to get money to do the several shuttles between the mines at Tarkwa and its environs and Kumasi.

3.8 Assumption

The study presumes that: Employees may have problems with the existing method of timekeeping in their respective companies. Hence the introduction of biometric fingerprint may solve most of the existing problems. On the part of the workers the biometric fingerprint introduction may cause them to loose their jobs, make them redundant and finally be sacked. Management may have it that the modification of timekeeping by the introduction of biometric fingerprint may lead to reliability, efficiency, effectiveness, benefits, etc.



CHAPTER FOUR: ANALYSIS OF FINDINGS OF THE STUDY

4.1 Socio-demographic characteristics of the study population

TABLE 4.1.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

VARIABLE (N=151)	CLASSIFICA- TION	FREQUEN- CY	PERCENTA- GE
a. Company	Goldfields	52	34.4
	Anglogold	47	31.1
	Golden Stars	52	34.4
Total		151	100
b. Age of employee	Below 20 yrs	1	0.7
	20-30 yrs	94	62.3
	40-50yrs	50	33.1
	Above 55yrs	6	4.0
Total		151	100
c. Employee's marital status	Married	79	52.3
	Divorced	2	1.3
	Separated	4	2.6
	Bachelor	54	35.8
	Spinster	12	7.9
Total		151	100
d. Number of employee's children	None	60	39.7
	1-3	57	37.7

	4-6	25	16.6
	7&Above	9	6.0
Total		151	100
e. Employee's gender	Female	44	29.9
	Male	106	70.1
Total		151	100
f. Employee's educational status	None	5	3.3
	Elementary	20	13.2
	Secondary	20	13.3
	Technical	11	7.3
	Teacher training	31	20.5
	First degree	51	33.8
	Post graduate	13	8.6
Total		151	100.0

Source: Author's Field Work, 2008

In total, 151 respondents were interviewed from the following three mining companies. These are: Goldfields and Golden Stars each producing 52 respondents representing 34.4% respectively and AngloGold giving 47 respondents being 31.1%. Out of the 151 respondents, only 1, is 20 years old, being 0.7% of the total. About 94 which is 62.3% are in the range of 21-30 years, whilst 50 being 33.1% fall within the range of 40- 50 years. Those who are above 55 years are only 6 or 4.0%. Around 79 respondents representing 52.3% are married, 54 are bachelors being 35.8%, 12 are spinsters equalling 7.9% and 2 or 1.3% are divorcees. As 39.7% have no children, 37.7% have between 1-3 children, 16.6%

fall in the range of having between 4-6 children and 6.0% have above 7 children. There are 29.9% or 44 respondents that are female as against 106 or 70.1% who are male. There are also 8.6% post graduates, 33.8% first degree holders, 13.2% and 13.3% of elementary and secondary school graduates respectively and 3.3% have no education at all and 20.5 were teachers.

4.2 Departments/ Status of Respondents

TABLE 4.2.1 DEPARTMENTS/ STATUS OF RESPONDENTS (151)

VARIABLE (151)	CLASSIFICATION	FREQUENCY	PERCENTAGE
a. Department in which employee works	Administration	76	50.3
	Haulage/transport	8	5.3
	Production	9	6.0
	Security & Health	4	2.6
	Computer/elec/engn	36	23.8
	Others	18	11.9
Total		151	100.0
b. Number of years with company	0-5 yrs	82	54.3
	6-10 yrs	27	17.9
	11-15 yrs	15	9.9
	16-20 yrs	6	4.0
	21 & above yrs	21	13.9
Total		151	100.0

c. Rank of employee in the company	Worker	83	55.0
	Forman	8	5.3
	Supervisor	44	29.1
	Manager	6	4.0
	Senior manager	10	6.6
Total		151	100.0
d. Distance of residence from workplace	0-5 km	36	23.8
	6-10 km	50	33.1
	11-20km	47	31.1
	21-30 km	4	2.6
	31& above km	14	9.3
Total		151	100.0

Source: Author's Field Work 2008

According to the study, the respondents work in the following departments: administration, 50.3%, haulage/transport 5.3%, production 6.0%, security and health 2.6%, computer/electrical engineering 23.8% and others 11.9%. Furthermore, 54.3% are between 0 - 5 years old in the organization, 17.9% fall within the range of 6 -10 years, 11-15 years and 16-20 years ranges represent 9.9% and 4.0% respectively. Above 21 years therefore represent 13.9% possibly needed for their experience and technical know-how. Whereas the lower ranked employees are 55.0% of the total working staff and forming the majority, there are few foremen 5.3%, supervisors 29.1%, managers 4.0% and senior

manager being6.6%.This goes to confirm the fact that though the organization is computerize, mining is labour intensive hence the percentage of the lower ranked.

4.3. Computerization of company and timekeeping systems used

TABLE 4.3.1 COMPUTERIZATION & TIMEKEEPING IN THE ORGANIZATION

VARIABLE (151)	CLASSIFICA- TION	FREQUEN- CY	PERCENTA- GE
a. Company’s timekeeping is by...	Using computer	38	25.2
	Using time card	18	11.9
	Using register	90	59.6
	By biome.fingerpri.	5	3.3
Total		151	100.0
b. Company’s computerization level	80-100%	62	41.1
	50-70%	47	31.1
	30-40%	23	15.2
	10-20%	9	6.0
	1-5%	10	6.6
Total		151	100.0
c. Company’s computerized department	Haulage& transports	7	4.6
	Production& mining	28	18.5
	Administration	57	44.4
	Hospital	12	7.9

	Security	24	15.9
	Others	13	8.6
Total		151	100.0
d. Knowledge about biometric fingerprint in timekeeping	Yes	67	44.4
	No	84	55.6
Total		151	100.0

Source: Author’s Field Work 2008

Even though the mining organization is 80-100% computerized it is revealed that timekeeping is still 59.6% done by marking registers and the computer ironically is only 25.2% used for timekeeping. And the departments are computerized as follows: administration 44.4%, production & mining 18.5%, security 15.9%, others 8.6%,hospital 7.9%, and haulage & transports4.6% respectively. However, only 44.4% of the respondents have knowledge about the use of biometric fingerprint in timekeeping while 55.6% do not.

4.4 Time and attendance type respondents prefer

TABLE 4.4.1.TIMEKEEPING SYSTEM PREFERENCE

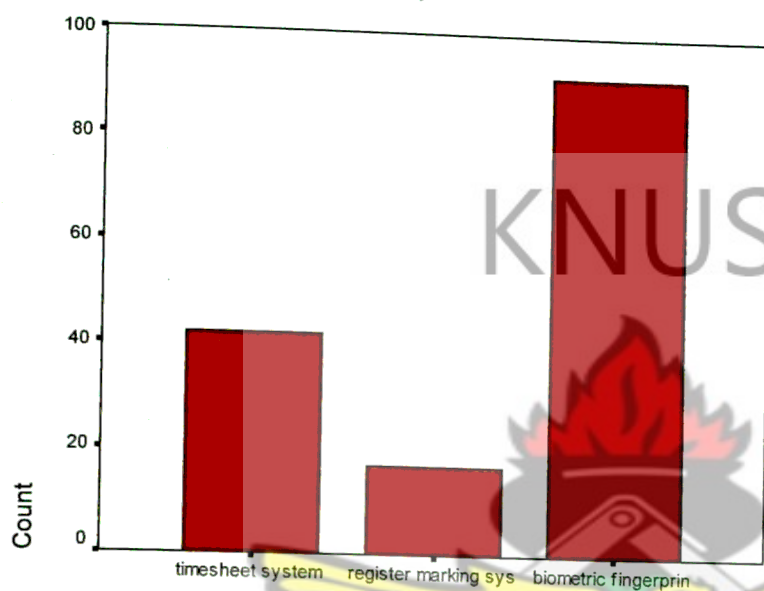
Preference	Frequency	Percentage
Timesheet system	42	27.8
Register marking system	17	11.3
Biometric fingerprint system	92	60.9
Total	151	100.0

Source: Author’s Field Work 2008

Despite the fact that only 44.4% of the respondents are aware of the use of biometric fingerprint in timekeeping, yet 60.9% prefer its usage in timekeeping.

FIG 4.1 TYPE OF TIMEKEEPING PREFERNCE BY RESPONDENTS

Time and attendance system respondents prefer.



which one do you prefer..

Source: Author's Field Work, 2008

Also, 27.8% like booking by timesheet system and 11.3% like the register marking process. This implicitly exposes the displeasure and anomalies associated with the two latter systems.

4.5 Some timekeeping systems known to respondents.

4.5.1 SOME KNOWN TIMEKEEPING SYSTEMS

Some types of Timekeeping systems	Frequency	Percentage
Computer system	38	25.2
Timecard system	18	11.9
Register marking system	90	59.6
Biometric fingerprint system	5	3.3
Total	151	100.0

Source: Author’s Field Work 2008

The majority of the respondents representing 59.6% knows and is familiar with the register marking system in timekeeping. So also 25.2% and 11.9% form those who know more about computer and timecard usage systems respectively.

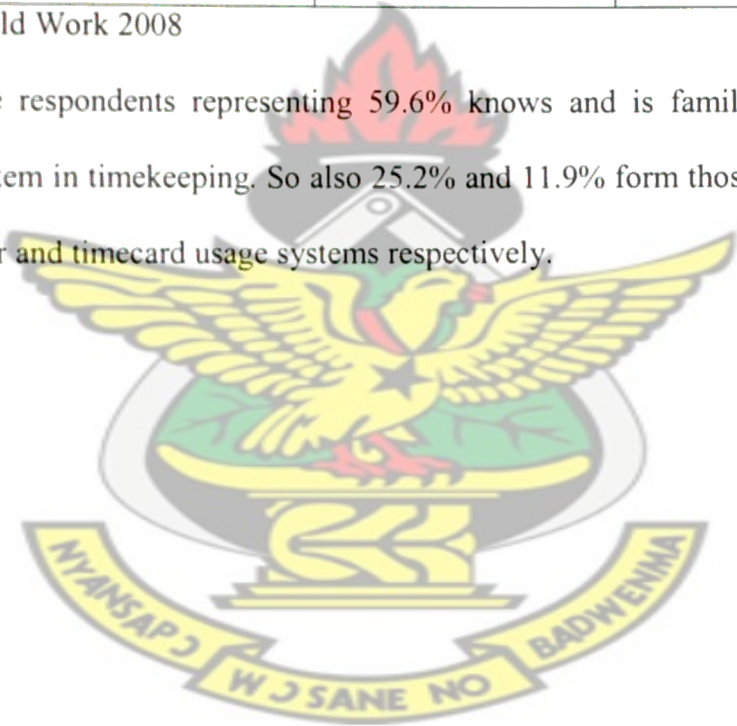
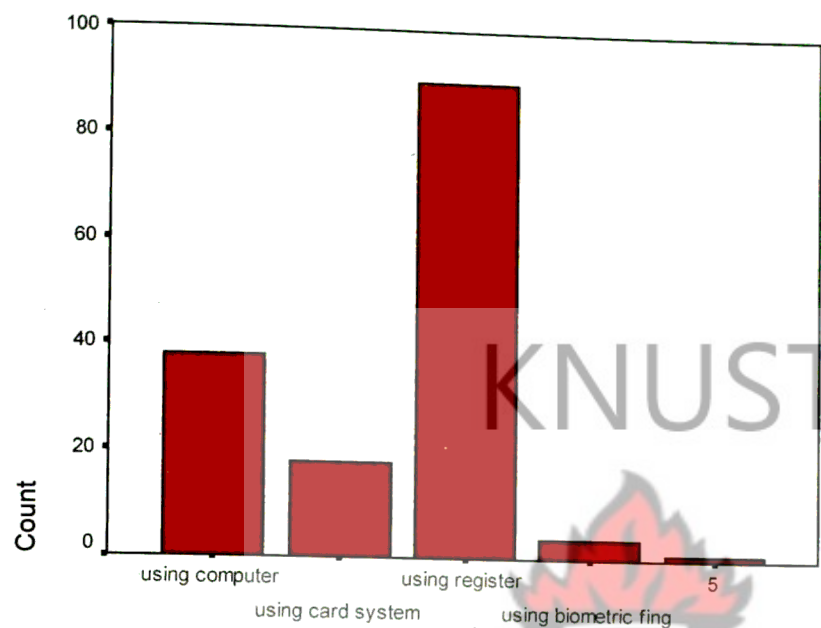


FIG 4.2 TYPES OF TIMEKEEPING SYSTEMS USED IN THE ORGANIZATION

Kinds of timekeeping systems known in the organization



timekeeping in the company is by...

Source: Author’s Field Work, 2008.

While just a very minimal 3.3% is aware of the existence of biometric fingerprint in timekeeping. This proves the lack of knowledge of the benefits of its usage or that the organization is not yet advanced in this in this process.

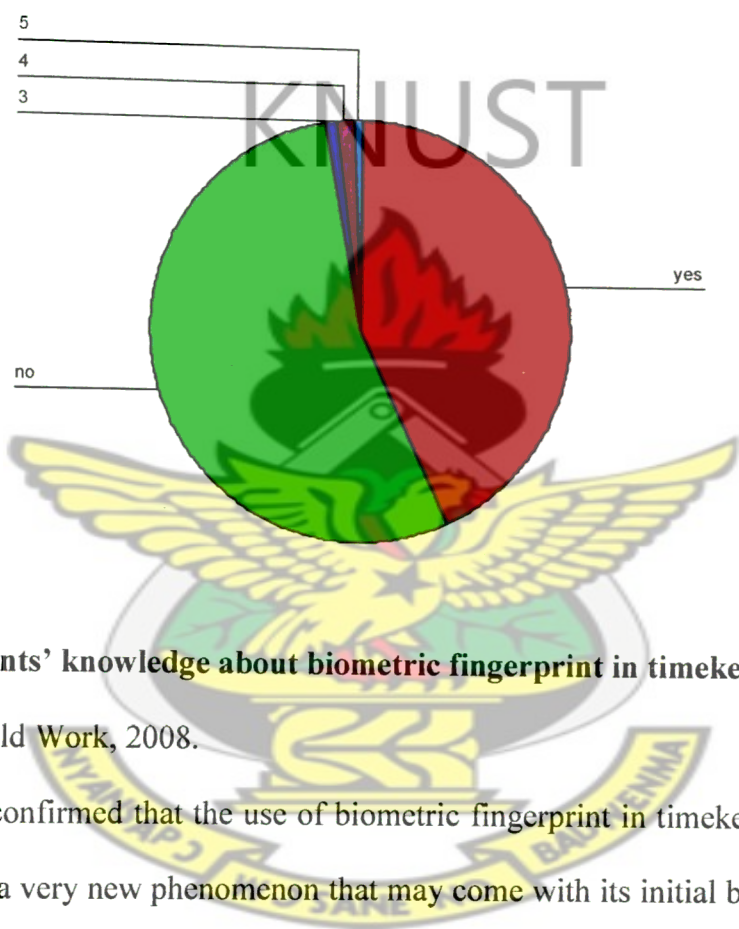
4.6 Do respondents know about biometric fingerprint in timekeeping?

4.6.1 KNOWLEDGE ABOUT BIOMETRIC FINGERPRINT IN TIMEKEEPING

Respondents’ knowledge about biometric Fingerprint in timekeeping	Frequency	Percentage
Yes	67	44.4
No	84	55.6
Total	151	100.0

A few respondents, just 44.4% have any knowledge about the usage of biometric fingerprint in timekeeping as against 55.6% who do not know any thing at all about it

FIG 4.3 RESPONDENTS KNOWLEDGE ABOUT BIOMERTIC FINGERPRINT IN TIMEKEEPING



Results of respondents' knowledge about biometric fingerprint in timekeeping.

Source: Author's Field Work, 2008.

It can therefore be confirmed that the use of biometric fingerprint in timekeeping in the organization will be a very new phenomenon that may come with its initial bottlenecks if its introduction is not tactically handled.

4.7 Respondents’ perception about biometric fingerprint in timekeeping.

4.7.1 EMPLOYEES’ PERCEPTION

Respondents’ knowledge about biometric Fingerprint in timekeeping	RESPONSES		TOTAL
	YES	NO	
Biometric fingerprint can solve punctuality problems in timekeeping.	36 (23.8)	115 (76.2)	151 (100.0)
Biometric fingerprint can correct Attendance and timekeeping.	132 (87.4)	19 (12.6)	151 (100.0)
Biometric fingerprint can be a tool for the Growth of the company.	131 (86.8)	20 (13.2)	151 (100.0)
Biometric fingerprint can minimize truancy In the company.	123 (81.5)	28 (18.5)	151 (100.0)
Biometric fingerprint can add more value To the company.	137 (90.7)	14 (9.3)	151 (100.0)

Source: Author’s Field Work 2008

As low as 23.8% of the respondents perceive that biometric fingerprint can solve punctuality problems in timekeeping, whereas 87.4% believe that it can correct attendance and time management. As much as 86.8% perceive the biometric fingerprint in time and attendance management to be a tool for the growth of the organization. Also, 81.5% of the respondents believe that it can minimize truancy at work in the organization whereas a whopping majority of 90.7% perceives it to give an added value to the company.

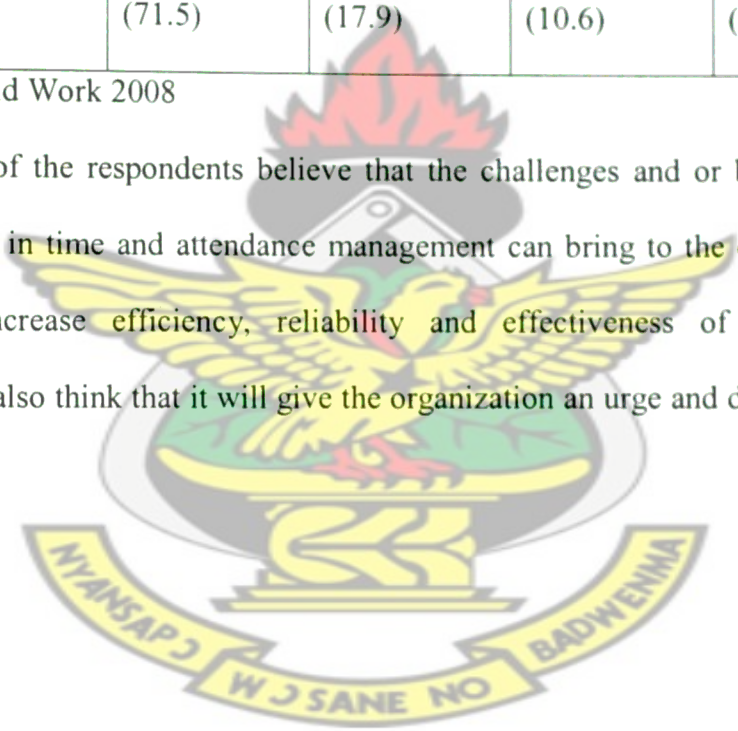
4.8 Benefits and challenges in the usage of biometric fingerprint in timekeeping.

4.8.1 BENEFITS& CHALLENGES

Challenges & benefits of Biometric fingerprint.	RESPONSES			TOTAL
	TRUE	FALSE	NONE	
Increases efficiency, Reliability & effectiveness.	118 (78.1)	24 (15.9)	9 (6.0)	151 (100.0)
Gives an urge & drive over Competitors.	108 (71.5)	27 (17.9)	16 (10.6)	151 (100.0)

Source: Author’s Field Work 2008

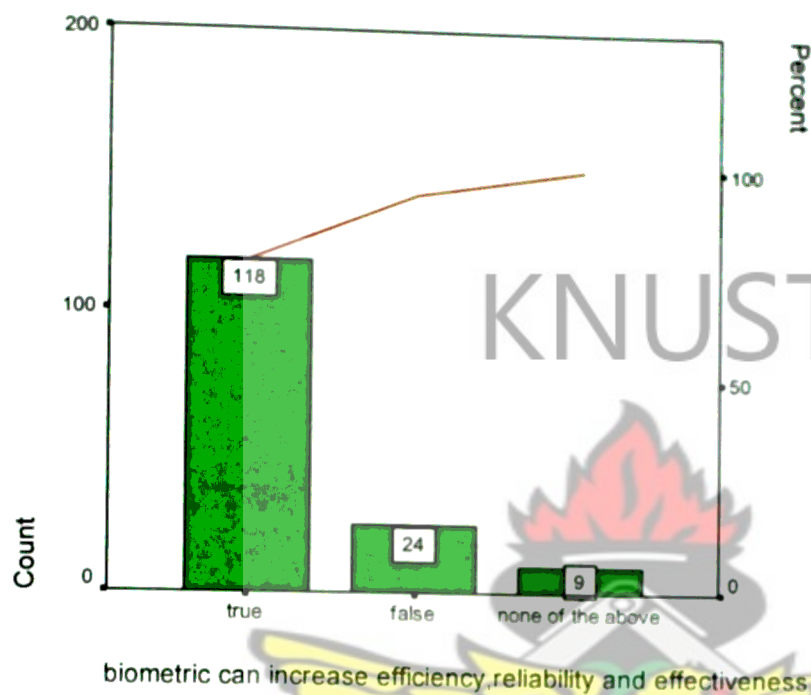
As many as 78.1% of the respondents believe that the challenges and or benefits that biometric fingerprint in time and attendance management can bring to the organization are that it will increase efficiency, reliability and effectiveness of employees. Furthermore, 71.5% also think that it will give the organization an urge and drive over its competitors.



LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

FIG 4.4 SOME BENEFITS & CHALLENGES USING BIOMETRIC FINGERPRINT IN TIMEKEEPING

Some challenges and benefits of biometric fingerprint use in timekeeping



Source: Author’s Field Work, 2008

4.9 Management performance appraisal using biometric fingerprint in timekeeping

4.9.1 MANAGEMENT PERFORMANCE APPRAISAL

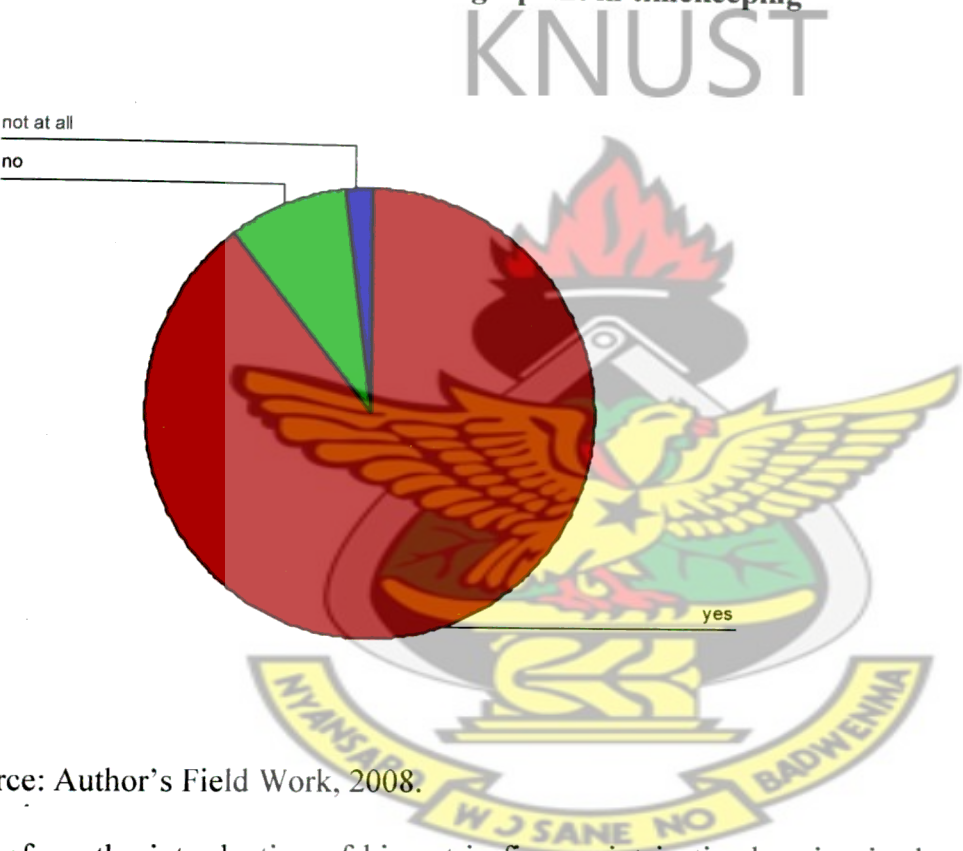
Challenges & benefits of Biometric fingerprint	Frequency	Percentage
No	13	8.6
Yes	135	89.4
None of the above	3	2.0
Total	151	100.0

Source: Author’s Field Work 2008

In the case of management performance appraisal, as many as 89.4% of the respondents acknowledge the fact that it will be efficacious, 8.6% do disagree and 2.0% do not accept any of the two proposed opinions.

FIG 4.5 MANAGEMENT PERFORMANCE APPRAISAL USING BIOMETRIC FINGERPRINT IN TIMEKEEPING

Respondents 'results on management performance appraisal using biometric fingerprint in timekeeping



Source: Author's Field Work, 2008.

Therefore, the introduction of biometric fingerprint in timekeeping in the organization, though it may come with some resistance as its challenges, it is accepted universally by the respondents that it can also be a tool for management performance appraisal.

CHAPTER FIVE: SUMMARY OF FINDINGS, RECOMMENDATIONS & CONCLUSION

5.1 SUMMARY OF FINDINGS

5.1.1 Computerization of company and timekeeping systems in use.

Even though the mining organization is 80-100% computerized, it is revealed that timekeeping is still 59.6% done by marking registers and the computer ironically is only 25.2% used for timekeeping. And the departments are computerized as follows: administration 44.4%, production & mining 18.5%, security 15.9%, others 8.6%, hospital 7.9%, and haulage & transports 4.6% respectively. However, only 44.4% of the respondents have knowledge about the use of biometric fingerprint in timekeeping while 55.6% do not. This proves according to the results got that the organization is highly satisfied with the usual timekeeping system and therefore does not need to research into knowing how advantageous is the use of biometric fingerprint in timekeeping. This is therefore substantiated by this result from the study that the majority of the respondents representing 59.6% know and is familiar with the register marking system in timekeeping. So also 25.2% and 11.9% form those who know more about computer and timecard usage systems respectively. While a very minimal 3.3% is aware of the existence of biometric fingerprint in timekeeping. This proves the lack of knowledge of the benefits of its usage or that the organization is not yet advanced in this in this process

5.1.2 Knowledge about biometric fingerprint in timekeeping

Just 44.4% acknowledge the fact that they have any knowledge about the usage of biometric fingerprint in timekeeping as against 55.6% who do not know any thing at all about it. It is therefore a confirmation that the introduction of biometric fingerprint in

timekeeping in the organization will be a very new phenomenon that may come with its initial bottlenecks if its introduction is not tactically handled. However its advantages over the already known and familiar time and attendance systems may be realized in the medium and long terms respectively.

5.1.3 Perception about biometric fingerprint in timekeeping

As low as 23.8% of the respondents perceive that biometric fingerprint can solve punctuality problems in timekeeping, whereas 87.4% believe that it can correct attendance and time management. As much as 86.8% perceive the biometric fingerprint in time and attendance management to be a tool for the growth of the organization. Also, 81.5% of the respondents believe that it can minimize truancy at work in the organization whereas a whopping majority of 90.7% perceives it to give an added value to the company. Contrary to the positive perception that the respondents have towards the use of biometric fingerprint in timekeeping, the results reveal that the following percentages have their un-encouraging perception that 115 (76.2%) have it that Biometric fingerprint can solve punctuality problems in timekeeping; only 19 (12.6%) believe that biometric fingerprint can correct attendance and timekeeping. Furthermore, as minimal as 20(13.2%) acknowledge that biometric fingerprint can be a tool for the growth of the company. Just as low as 28(18.5%) opined that biometric fingerprint can minimize truancy in the company and 14(9.3%) also acknowledge that biometric fingerprint can add more value to the company. Conclusively, the highest majority of the respondents is of the view that the usage of biometric fingerprint in time and attendance management will be a fit for the organization, taking into cognizance the few advantages listed above.

5.1.4 Benefits and challenges in the usage of biometric fingerprint in timekeeping.

As many as 78.1% of the respondents believe that the challenges and/or benefits that biometric fingerprint in time and attendance management can bring to the organization are enormous that is it will increase efficiency, reliability and effectiveness of employees. Furthermore, 71.5% also think that it will give the organization an urge and drive over its competitors. In the case of management performance appraisal, as many as 89.4% of the respondents acknowledge the fact that it will be efficacious, and only 8.6% do disagree and 2.0% do not accept any of the two proposed opinions. Therefore, the introduction of biometric fingerprint in timekeeping in the organization, though it may come with some resistance as its challenges, it is accepted universally by the respondents that it can also be a tool for management performance appraisal. To conclude, we acknowledge the fact that, the results of the study are very explicit on the fact, that the introduction of biometric fingerprint in timekeeping in the organization will bring enormous advantages to both the employees as well as the organization.

5.2 RECOMMENDATIONS

The most common personal authentication techniques used for identity management employ a secret PIN or password that must be remembered. Fingerprint biometric technology is an ideal alternate solution to the password recall problem. However, fingerprint biometric systems still remain uncommon in public sectors of industry such as banking which have recently started using ATM CARDS and e-zwich- an automated mobile banking system introduced by Bank of Ghana as late as June 2008, healthcare, and education. Two proposed reasons for this lack of deployment are: 1) society's

misunderstanding regarding the personal privacy, security, and function of the technology, and 2) inadequate education regarding the technology. The objective of this research was to test these propositions, and attempt to identify the major societal factors that have limited fingerprint biometric deployment in IT authentication systems. An additional goal was to confirm that education on security issues improves personal confidence in and acceptance of the technology. In the next few years, fingerprinting will continue to find only niche use in corporations, but eventually its advantages compared to traditional security mechanisms will lead to widespread use," ABI Research's Michielsen concluded. We recommend that the mining organizations should introduce biometric fingerprint in timekeeping. For it has many credible and enormous benefits and advantages to the organization hence the Bank of Ghana's e-zwich and remotely the use of the ATM cards by banks could be regarded as a typical examples.

5.3 CONCLUSIONS

Although the mining organization is automated and various departments are computerized very little is known about the use of biometric fingerprint in timekeeping. Many reasons could be given to this phenomenon. It could be that there is no interest shown in it. It could be assumed also that management does not know the numerous problems it could solve. Other reasons could be that management has the notion to avoid employees' resistance in an attempt to have it introduced. And finally, we have the belief that apart from the reasons named above including the forgotten ones, biometric fingerprint in timekeeping both in the medium as well as in the long term. Other reasons necessary for its introduction and implementation are explicitly enumerated our

conceptual framework of this study in conclusion, we believe that the mining organization will adhere to our suggestions, the relevance of the use of biometric fingerprint in timekeeping, the benefits and advantages therein to introduce it into the day to day administration of the organization for a brighter future.

5.4 BIBLIOGRAPHY/REFERENCE.

1. R. Cappelli, D. Maio, D. Maltoni, J. L. Wayman, and A. K. Jain, *Performance evaluation of fingerprint verification systems*, IEEE Trans. Pattern Anal. Mach. Intell., vol. 28, no. 1, pp. 3–18, Jan. 2006
2. Dabbah, M.A., Woo, W. L. Woo, and Dlay, S. S. "Secure Authentication for Face Recognition," presented at Computational Intelligence in Image and Signal Processing Nolan, R.L. (1979), "Managing the crisis in data processing", *Harvard Business Review*, Vol. 57 No. 3/4.
3. Dabbah, M.A., Woo, W. L. Woo, and Dlay, S. S. "Secure Authentication for Face Recognition," presented at Computational Intelligence in Image and Signal Processing, 2007. CIISP 2007. IEEE Symposium on, 2007.
4. Heracleous, L., Wirtz, J. and Johnston, R. (2004), "Cost effective service excellence: lessons from Singapore Airlines", *Business Strategy Review*, Spring, pp. 33-8
5. Heracleous, L., Wirtz, J. and Johnston, R. (forthcoming (a)), "Kung Fu service development at Singapore Airlines", *Business Strategy Review*.
5. Heracleous, L., Wirtz, J. and Pangarkar, N. (forthcoming (b)), *Flying High in Extremely Tough Industries*, McGraw-Hill, Singapore
6. Hill, C.W. (1988), "Differentiation versus low cost or differentiation and low cost? A contingency framework", *Academy of Management Review*, Vol. 13, pp. 401-12.
7. International Biometrics Group (2005), available at: www.biometricgroup.com (accessed July 2005).
8. Jain, A. K. (28-30 April 2004), "Biometric recognition: how do I know who you are?" *Signal Processing and Communications Applications Conference, 2004. Proceedings of the IEEE 12th*: 3 - 5

9. Jain, A. K.; Ross, A. & Pankanti, S. (June 2006), "Biometrics: A Tool for Information Security", *IEEE Transactions On Information Forensics And Security* **1st** (2)
 10. Nolan, R.L. and Crosson, D.C. (1995), *Creative Destruction; A Six-stage Process for Transforming the Organisation*, Harvard Business School Press, Cambridge, MA.
 11. Nolan, R.L. and Koot, W.J.D. (1992), "Nolan Stages Theory today", *Holland Management Review*, No. 31.
 12. Porter, M.E. (1980), *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, NY.
 13. Porter, M.E. (1996), "What is strategy?" *Harvard Business Review*, November-December, pp. 61-78.
 14. Ratha, N. K., Connell J. H. and Bolle, R. M. "Enhancing security and privacy in biometrics-based authentication systems," *IBM systems Journal*, vol. 40, pp. 614-634, 2001.
 15. Teoh, A. B. J., Goh, A. and Ngo, D. C. L. "Random Multispace Quantization as an Analytic Mechanism for BioHashing of Biometric and Random Identity Inputs," *Pattern Analysis and Machine Intelligence*, *IEEE Transactions on*, vol. 28, pp. 1892-1901, 2006
 16. Thomson Reuters, Aberdeen Group, a Hart-Hanks Company, "Evolving Time and Attendance: Foundation for Workforce Management Improvements," (NYSE:2008)
 17. Wirtz, J. and Heracleous, L. (2005), "Biomet Bolle, rics meets services", *Harvard Business Review*, February, p. 48.
- BioAPI Consortium <http://www.bioapi.org/>
Java Card Forum <http://www.javacardforum.org/>
Precise Biometrics white papers <http://www.precisebiometrics.com/>
http://www.timeandattendance.com/data_collection_more.php#
<http://www.adp.com/workforce%2Dmanagement/Time-and-Attendance.asp>
http://starport.okcu.edu/ad/hr/handbook/timekeeping_page.htm#top
<http://www.adp.com/workforce%2Dmanagement/Biometric-TimeClock.asp>
<http://www.timecontrol.com/resources/whitepapers/tcmatrix.php>
<http://www.legiant.com/resources/timeandattendance.htm>
<http://www.technewsworld.com/story/39467.html> <http://www.sciencedaily.com/releases/2006/11/061128084329>.

<http://www.privsecblog.com/archives/biometrics-fingerprint-biometrics-the-future-of-atm-security.htm>.

<http://www.emeraldinsight.com/Insight/ViewContentServlet?Filename=Published/EmeraldFullTextArticle/Articles/28101203>

<http://www.emeraldinsight.com/Insight/viewPDF.jsp?Filename=html/Output/Published/EmeraldFullTextArticle/Pdf/2810120302.pdf>

.Article describing Disney's 2006 biometric initiative replacing hand geometric scanners with fingerprint readers

<http://www.researchandmarkets.com/reports/c4206/>

<http://www.researchandmarkets.com/reports/c4206/>

<http://europa.eu.int/idabc/en/document/4338/194>

<http://europa.eu.int/idabc/en/document/4338/194>

http://www.cilab.upf.edu/biosecure1/public_docs_deli/BioSecure_Deliverable_D10-2-3_b3.pdf

http://www.timeandattendance.com/data_collection_more.php#

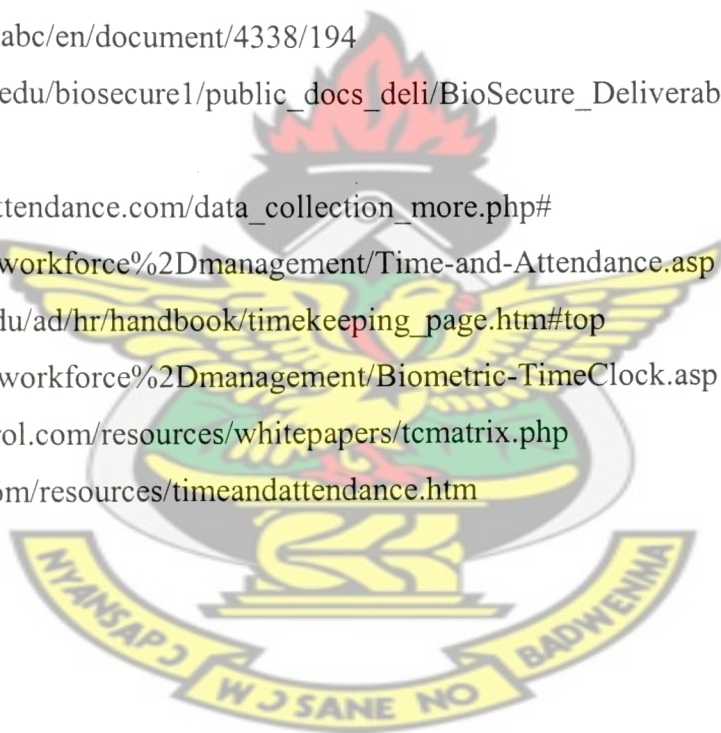
<http://www.adp.com/workforce%2Dmanagement/Time-and-Attendance.asp>

http://starport.okcu.edu/ad/hr/handbook/timekeeping_page.htm#top

<http://www.adp.com/workforce%2Dmanagement/Biometric-TimeClock.asp>

<http://www.timecontrol.com/resources/whitepapers/tcmatrix.php>

<http://www.legiant.com/resources/timeandattendance.htm>



QUESTIONNAIRE FOR FACT FINDING IN THE MINES IN / AROUND TARKWA

INSTRUCTION: Kindly just tick (/) the correct answer selected.

Employees Particulars

1. What is the name of the company?
 1. Goldfields Ghana Limited-Tarkwa.
 2. Golden Star Bogoso/Prestea Ghana limited.
 3. Anglogold Ashanti Ghana Limited-Iduapriem.
2. What is the employee's age?
 1. 20-30 years.
 2. 40-50 years.
 3. Above 55 years.
 4. Below 20 years.
3. What is your marital status?
 1. Married.
 2. Divorced
 3. Separated
 4. Bachelor
 5. Spinster
4. How many children have you?
 1. None
 2. 2-5 children
 3. 6-8 children
 4. 9-10 children
 5. 11 and above.
5. What gender do you belong to?
 1. Female
 2. Male
6. What is your qualification?
 1. None.
 2. GCE.'O'Level-GCE.'A'Level.



3. TEACHERS CERTIFICATE.

4 .FIRST DEGREE.

5. SECOND DEGREE& ABOVE.

7. In which department do you work in the company?

1. Administration
2. Mining, Haulage & Transportation
3. Production
4. Security& Health.
5. Computer, Electricals & Engineering.

8. What is your number of years of experience in the company?

1. 0-5 years.
2. 6-10 years.
3. 11-15 years.
4. 16-20 years.
5. 20 years & above

9. What is your rank?

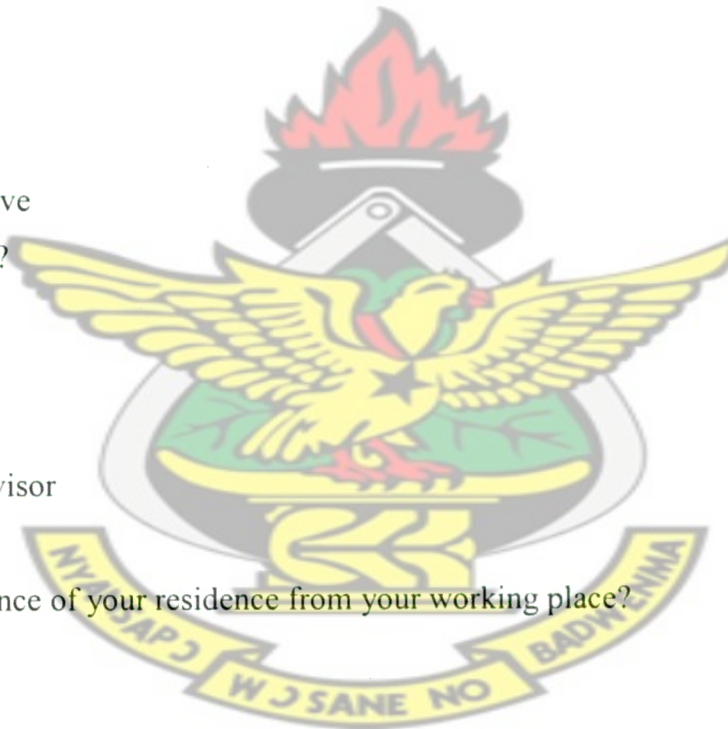
1. Worker.
2. Forman.
3. Supervisor
4. Above a supervisor
5. Labourer

10. What is the distance of your residence from your working place?

1. 0-5 km
2. 5-10km
3. 11-20km
4. 21-30km
5. 31km & above.

11. How is TIMEKEEPING done in your company?

1. By using the computer
2. By using the card system
3. By using the register



4. By using the biometric fingerprint system

12. What is the level of computerization of the company?

1. 100%-80%
2. 70%-50%
3. 40%-30%
4. 20%-10%
5. 1%-5%

13. Which of the departments are computerized?

1. Transportation & Haulage
2. Production & Mining
3. Administration
4. Hospital
5. Security.

14. Do you know about BIOMETRIC FINGERPRINT for TIMEKEEPING?

1. YES
2. NO

(BIOMETRIC FINGERPRINT IS USED FOR TIMEKEEPING WHEN A SOFTWARE IS CONNECTED TO COMPUTERS)

15. Which one do you prefer?

1. Time sheet system
2. Register marking system
3. Biometric fingerprint system

16. Can the Biometric fingerprint system solve all problems of the manual system?

1. YES
2. NO

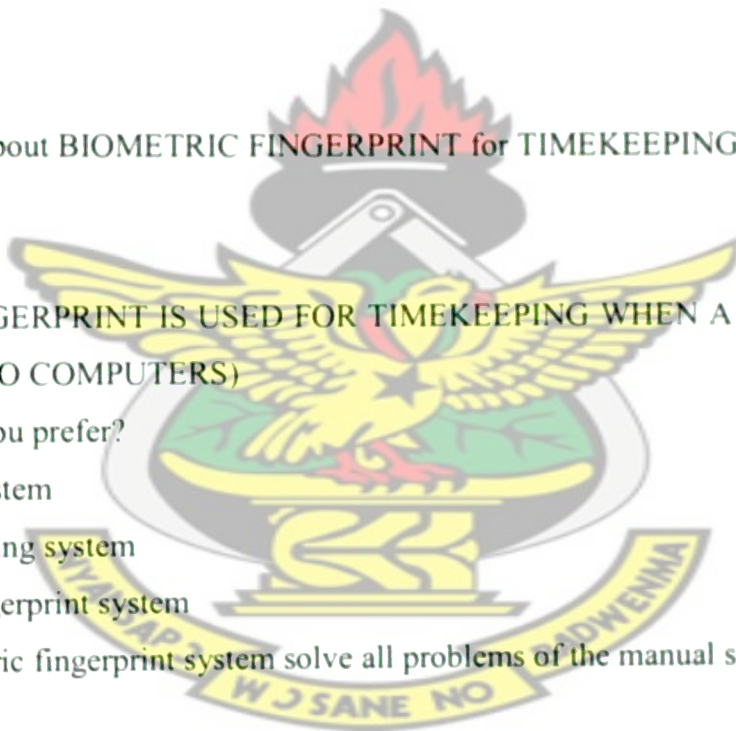
17. Can Biometric fingerprint system solve the problem of punctuality?

1. NO
2. YES

18. Can the Biometric fingerprint system correct attendance and timekeeping?

1. YES
2. NO

KNUST



19. Can the biometric fingerprint be a tool of growth for the company?

1. NO

2. YES

20. Do you think that biometric fingerprint can facilitate the business of the company?

1. NO

2. YES

21. Do you feel that the use of biometric fingerprint will add more value to the company?

1. YES

2. NO

22. Biometric fingerprint can increase efficiency, reliability and effectiveness.

1. FALSE

2. TRUE

3. NONE

25. Using the biometric fingerprint in timekeeping will give your company an urge and

Drive over its competitors.

1. TRUE

2. FALSE

3. NONE

26. Has INFORMATION TECHNOLOGY enhanced the performance of management of your COMPANY?

1. YES

2. NO

3. NOT AT ALL.

WE ARE VERY THANKFUL AND GLAD FOR YOUR HELP AND CO-OPERATION
GILBERT GIDIGLO.

QUESTIONNAIRE FOR FACT FINDING IN THE MINES AROUND BOGOSO/PRESTEA

INSTRUCTION: Kindly just tick (/) the correct answer selected.

Employees Particulars

1. What is the name of the company?

Golden Star Bogoso/Prestea Ghana limited.

2. What is the employee's age group?

1. 20-30 years.
2. 40-50 years.
3. Above 55 years.
4. Below 20 years.

3. What is your marital status?

1. Married.
2. Divorced
3. Separated
4. Bachelor
5. Spinster

4. How many children have you?

1. None
2. 1-3 children
3. 4-6 children
4. 7 and above.

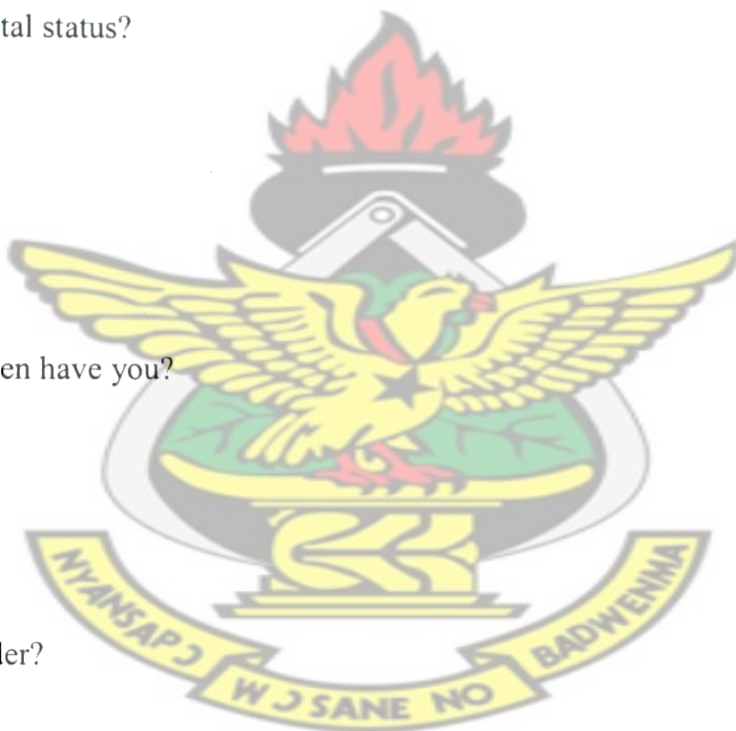
5. What is your gender?

1. Female
2. Male

6. Your level of education

1. None.
2. Elementary (Primary / Middle)
3. Secondary school.
4. Technical school
5. Teacher training.

KNUST



6. First degree.
7. Post graduate.
7. In which department do you work in the company?
 1. Administration
 2. Mining, Haulage & Transportation
 3. Production
 4. Security& Health.
 5. Computer, Electrical & Engineering.
 6. Others
8. What is your number of years with the company?
 1. 0-5 years.
 2. 6-10 years.
 3. 11-15 years.
 4. 16-20 years.
 5. 21 years & above
9. What is your rank?
 1. Worker.
 2. Forman.
 3. Supervisor
 4. Manager
 5. Senior management
10. What is the distance of your residence from your working place?
 1. 0-5 km
 2. 5-10km
 3. 11-20km
 4. 21-30km
 5. 31km& above.
11. How is TIMEKEEPING done in your company?
 1. By using the computer
 2. By using the card system
 3. By using the register



4. By using the biometric fingerprint system
12. What is the level of computerization of the company?
1. 80%-100%
 2. 50%-70%
 3. 30%-40%
 4. 10%-20%
 5. 1%-5%
13. Which of the departments are computerized to your knowledge?
1. Transportation & Haulage
 2. Production & Mining
 3. Administration
 4. Hospital
 5. Security.
 6. Others
14. Do you know about BIOMETRIC FINGERPRINT for TIMEKEEPING?
1. YES
 2. NO
- (BIOMETRIC FINGERPRINT IS USED FOR TIMEKEEPING WHEN THE FINGERPRINT SCANNER IS CONNECTED TO COMPUTERS)
15. Which one would you prefer?
1. Time sheet system
 2. Register marking system
 3. Biometric fingerprint system
16. Do you think computerizing time keeping system in this company can solve most of the problems related to time keeping?
1. YES
 2. NO
17. Can Biometric fingerprint system solve the problem of punctuality?
1. NO
 2. YES
18. Can the Biometric fingerprint system correct attendance and timekeeping?

1. YES
 2. NO
19. Can the biometric fingerprint be a tool of growth for the company?
1. NO
 2. YES
20. Do you think that biometric fingerprint can minimize truancy in the company?
1. NO
 2. YES
21. Do you feel that the use of biometric fingerprint will add more value to the company?
1. YES
 2. NO
22. Biometric fingerprint can increase efficiency, reliability and effectiveness.
1. FALSE
 2. TRUE
 3. NONE OF THE ABOVE
25. Using the biometric fingerprint in timekeeping will give your company an urge and Drive over its competitors.
1. TRUE
 2. FALSE
 3. NONE OF THE ABOVE
26. Has INFORMATION TECHNOLOGY enhanced the performance of management of your COMPANY?
1. YES
 2. NO
 3. NOT AT ALL.

WE ARE VERY THANKFUL AND GLAD FOR YOUR HELP AND CO-OPERATION
GILBERT GIDIGLO.

QUESTIONNAIRE FOR FACT FINDING IN THE MINES AROUND ANGLOGOLD ASHANTI

INSTRUCTION: Kindly just tick (/) the correct answer selected.

Employees Particulars

1. What is the name of the company?

1. Anglogold Ashanti Ghana Limited-Iduapriem.

2. What is the employee's age group?

5. 20-30 years.
6. 40-50 years.
7. Above 55 years.
8. Below 20 years.

3. What is your marital status?

6. Married.
7. Divorced
8. Separated
9. Bachelor
10. Spinster

4. How many children have you?

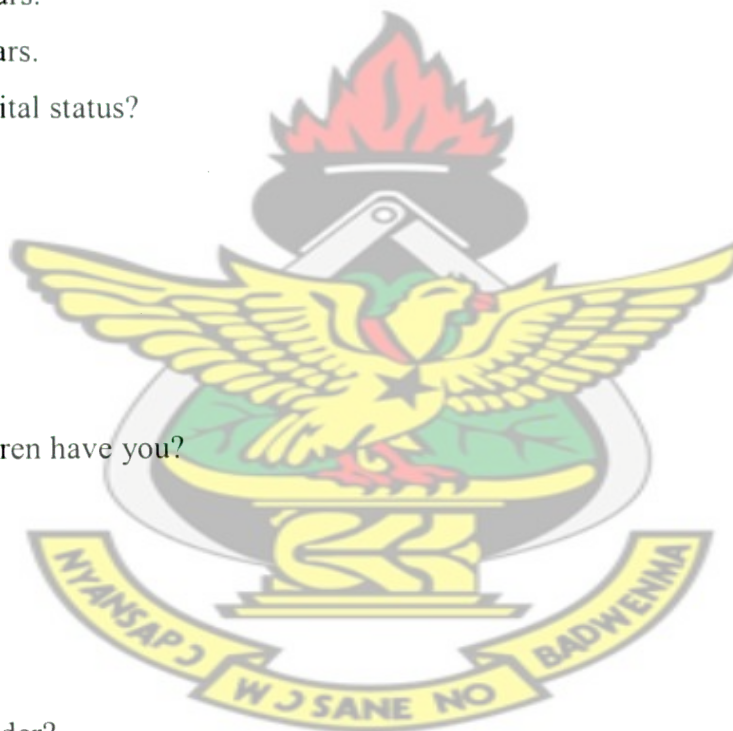
5. None
6. 1-3 children
7. 4-6 children
8. 7 and above.

5. What is your gender?

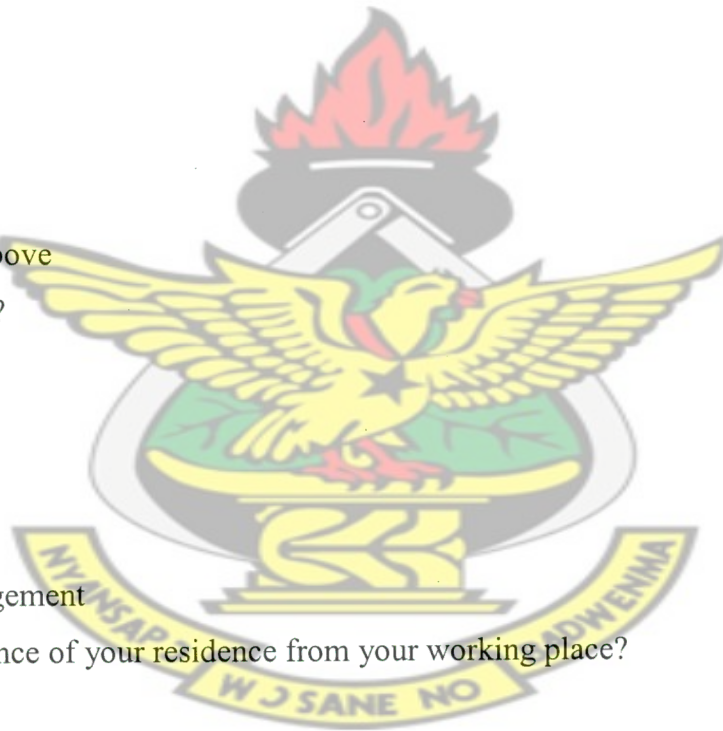
1. Female
2. Male

6. Your level of education

8. None.
9. Elementary (Primary / Middle)
10. Secondary school.
11. Technical school



12. Teacher training.
 13. First degree.
 14. Post graduate.
7. In which department do you work in the company?
7. Administration
 8. Mining, Haulage & Transportation
 9. Production
 10. Security& Health.
 11. Computer, Electrical & Engineering.
 12. Others
8. What is your number of years with the company?
6. 0-5 years.
 7. 6-10 years.
 8. 11-15 years.
 9. 16-20 years.
 10. 21 years & above
9. What is your rank?
6. Worker.
 7. Forman.
 8. Supervisor
 9. Manager
 10. Senior management
10. What is the distance of your residence from your working place?
6. 0-5 km
 7. 5-10km
 8. 11-20km
 9. 21-30km
 10. 31km& above.
11. How is TIMEKEEPING done in your company?
5. By using the computer
 6. By using the card system



7. By using the register
 8. By using the biometric fingerprint system
12. What is the level of computerization of the company?
6. 80%-100%
 7. 50%-70%
 8. 30%-40%
 9. 10%-20%
 10. 1%-5%
13. Which of the departments are computerized to your knowledge?
7. Transportation &Haulage
 8. Production & Mining
 9. Administration
 10. Hospital
 11. Security.
 12. Others
14. Do you know about BIOMETRIC FINGERPRINT for TIMEKEEPING?
3. YES
 4. NO
- (BIOMETRIC FINGERPRINT IS USED FOR TIMEKEEPING WHEN THE FINGERPRINT SCANNER IS CONNECTED TO COMPUTERS)
15. Which one would you prefer?
4. Time sheet system
 5. Register marking system
 6. Biometric fingerprint system
16. Do you think computerizing time keeping system in this company can solve most of the problems related to time keeping?
3. YES
 4. NO
17. Can Biometric fingerprint system solve the problem of punctuality?
3. NO
 4. YES

18. Can the Biometric fingerprint system correct attendance and timekeeping?
- 3. YES
 - 4. NO
19. Can the biometric fingerprint be a tool of growth for the company?
- 3. NO
 - 4. YES
20. Do you think that biometric fingerprint can minimize truancy in the company?
- 3. NO
 - 4. YES
21. Do you feel that the use of biometric fingerprint will add more value to the company?
- 3. YES
 - 4. NO
22. Biometric fingerprint can increase efficiency, reliability and effectiveness.
- 4. FALSE
 - 5. TRUE
 - 6. NONE OF THE ABOVE
25. Using the biometric fingerprint in timekeeping will give your company an urge and Drive over its competitors.
- 4. TRUE
 - 5. FALSE
 - 6. NONE OF THE ABOVE
26. Has INFORMATION TECHNOLOGY enhanced the performance of management of your COMPANY?
- 4. YES
 - 5. NO
 - 6. NOT AT ALL.

WE ARE VERY THANKFUL AND GLAD FOR YOUR HELP AND CO-OPERATION
GILBERT GIDIGLO.