

MOSHI CO-OPERATIVE UNIVERSITY

**EFFECT OF BIOMETRIC FINGERPRINT TECHNOLOGY ON
ORGANIZATIONAL PERFORMANCE: A CASE OF
KILIMANJARO CHRISTIAN MEDICAL CENTRE**

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ORGANIZATIONAL PERFORMANCE: A CASE OF
KILIMANJARO CHRISTIAN MEDICAL CENTRE**

BY

AZIZI BAKARI MRISHA

**A DISSERTATION SUBMITTED IN FULFILMENT OF THE
REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF
BUSINESS MANAGEMENT OF MOSHI CO-OPERATIVE UNIVERSITY,
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SEPTEMBER, 2022

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AND
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I, **AZIZI BAKARI MRISHA**, declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other higher learning Institution for similar or any other academic award.

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CERTIFICATION

The undersigned certify that he has read and hereby recommend for acceptance by the Moshi Co-operative University a dissertation titled “Effect of Biometric Fingerprint technology on Organisational Performance: A case of Kilimanjaro Christian Medical Centre” in partial fulfillment of the requirements for the award of a degree of Master of Business Management of Moshi Co-operative University.

(Supervisor’s Name)

(Supervisor’s Signature)

Date: _____

DEDICATION

This work is dedicated to my beloved parents, my father Bakari D. Mrisha and mother Mary Ruhakwa, who laid the foundation of my education.

ACKNOWLEDGEMENT

Firstly, I would like to thank Almighty God for his grace to enable me to complete this research paper. Secondly, I wish to appreciate the commitments of my supervisor Dr. Alban Mchopa, for his tireless support for me to make this paper a success throughout the period of this work. Thirdly I wish to thank Dr. Gideon Sikawa, the lecturer at Moshi Cooperative University, for his guidance, technical advice, and for unleashing the potential in me to complete this work, through his encouragement and tireless support. It would have been impossible to make it without his assistance. Special thanks also go to Mrs. Festa Lyakurwa, Mrs. Beatrice Lyatuu and Sophia A. Uisso for availing me with KCMC annual reports from which I extracted data for the success of this research. I also wish to thank Mr. Benson Mtesha, the statistician at Kilimanjaro Christian Research Institute, for spending hours with me in data analysis. Lastly, I wish to express my appreciation to all KCMC staff who participated in this study, and to the entire management of KCMC for their permission and support to conduct this research in their institution. It's my sincere hope that this research report will be found useful and beneficial to the management of KCMC in their decision making processes for their current and future progress.

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LIST OF ABBREVIATIONS AND ACRONYMS

ATMs	Automatic Teller Machines
BAS	Biometric Attendance Register
CJAS	Canadian Journal of Administrative Sciences
HEI	Higher Education Institutes of India
ICT	Information and Communication Technology
IJAIS	International Journal of Applied Information System
IJARCCCE	International Journal of Advanced Research in Computer and Communication Engineering,
KCMC	Kilimanjaro Christian Medical Center
NICE	National Institute for Health and Care Excellence
PEOU	Perceived ease of use
PU	Perceived usefulness
RBT	Resource Based Theory
ROE	Return on Equity
TAM	Technology Acceptance Model (This theory is based on the Theory of Reasoned
TCRA	Tanzania Communication Regulatory Authority
TRA	Theory of Reasoned Action
VRIO	Acronym for a four-question framework focusing on value, rarity, imitability, and Organisation

ABSTRACT

In a recent world, governments and non-governmental organisations have increasingly been adopting biometric fingerprint technology as a move to effectively monitor employee attendance in order to promote workforce productivity. However, despite the deployment of this technology, its contribution to organisational performance in many organisations has not been evident. The objectives of the study was to examine the effect of biometric fingerprint technology on organisation's performance indicator, to examine perception of employees toward the adoption of the technology, to assess the effectiveness of biometric devices in recognising users, and to examine the contribution of biometric fingerprint system in controlling extra hour payments. A Cross-sectional study design was used. A sample of 93 respondents was selected from 1,176 hospital staff using Stratified sampling technique. Data was gathered by using questionnaires, interview to key personnel and documentary review. Qualitative data analysis was employed in this study using the content analysis method. Findings show increase in Admission by 2.3% between 2016 and 2017, and 3.98% between base year and 2018. Discharges increased by 2.66% and by 5.79% between 2016-2017 and 2016-2018 respectively. Average length of stay increased by 10.22 days between base year and 2017 and improved by -3.21% between base year and 2018. However, deaths increased by 12.91% from 2016 to 2017 and by 15.59%, bed occupancy rate increased by 1.88% between base year and 2017 and by 9.46% between base year and 2018. A total of 57.6% of respondents said that it is possible to report to work on time and abscond during working hours without management knowing. Forty 43% responded that biometric device response is not instant, and test showed that there is no association between old age and response of biometric device. Hourly pay showed significant rise from 2016 to 2019 despite the deployment of this technology at the hospital. The study concludes that there is appositive result brought about by deployment of the technology. The research came up with conclusion that management should investigate the increase in death and bed occupancy rate despite presence of biometric, design mechanism to ensure staff are working during working hours, design alternatives for those to whom device fails to recognise and do further studies to understand why labor cost keep rising despite deployment of biometric technology.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

The impact of absenteeism and late arrival of employees at their working place is certainly a big problem that organisations should understand how it affects individual, team and organisational performance. It can weigh heavily on productivity, employee experience and ultimately profits.

Absenteeism can affect individual productivity. If someone works less, they're likely to be less productive. If an employee is frequently absent from workplace or frequently arrive late that could potentially affect employee's productivity. As missed work time increases, employees in the office are left making up for the work not performed by employees who are absent. According to the Society for Human Resource Management (SHRM) of 2013, overtime is used to cover 47 percent of employee absences and co-workers are perceived to be 29.5 percent less productive when covering for absent employees.

Absentees can negatively impact profitability of the concern. For example, increased costs reduce profit margins unless revenues increase. If organisations are spending more money on overtime pay and contract workers, direct costs go up and profit margins are likely to shrink. Similarly, absenteeism can decrease revenue if employees with specific roles aren't present. Employees such as workers in manufacturing, service delivery, consulting or sales, who simply have less time to hit their goals due to absence, potentially decrease revenue.

Therefore, the impact of absenteeism and reporting late to work is felt directly by individuals, teams and the organisation as a whole, putting pressure on productivity and profitability.

The object of management of any organisation is to ensure that they efficiently realise the optimal performance in all aspects through utilisation of a bundle of valuable resources that are at their disposal. Among these resources are human resource and time. According to Barney (1991) firms can attain and achieve a sustainable competitive advantage through their employees. Similarly, Hitt *et al.* (2009) state that firms can use the resources and capabilities at their disposal to enhance their

operational performance. Organisations are therefore expected to make optimum use of time and the human resources that they have by ensuring that employees work fully for the scheduled time, to the end that the organisation realises a desired level of organisational and operational performance. This can be achieved by applying proper controls that will help to eliminate staff absenteeism and late arrival to work. A variety of tools are available to enable employers to monitor employee attendance.

Years back the process of registering and tracking records of employees has been done manually. This old fashion method contributed to companies' loss on hourly pay, poor performance of the company's productivity through the impact of staff absenteeism and staff running late, like what was stated by Kisame (2016) that:

“Where employee identification is not done effectively employees who are expected to be on duty may fail to report and their colleagues sign for them if manual attendance registers are used instead of the computerised biometric clocking system”

Also, according to Nucleus Research ROI Evaluation Report (2006) 74% of organisations experience payroll losses that are directly related to cheating in reporting to work. In order to put an end to that challenge, management now days deploy biometric attendance system as one method to provide assurance on the management of employees and time in order to confirm attendance and ensure a timely and effective delivery of services (Cupido, 2011).

Biometric has long been touched as a powerful tool for solving identification since it relies on unique, immutable physical characteristic of any individual. The oldest method of all the biometric techniques is fingerprint-based, and it has been successfully used in numerous applications. Security breaches and transaction fraud are among factors leading to the need for secure identification and personal verification technologies. Similarly, growing needs for fast, accurate and dependable secure biometrics technology has recently begun to enter into public consciousness (Hiremath and Thorat, 2013).

According to Makanjuola and Olatinwo (2014) the use of biometric technology in attendance management cannot be overemphasised. This automated attendance systems provide employers with tools that ease burdensome task of manually

recording time and applying other wage and hour rules, such as those regarding overtime, breaks and meals on a per-employee basis; and has also been most successful to employers with primary advantage of avoiding fake punching, which for long time has been a loophole of the traditional attendance system (Josphineleela and Ramakrishnan, 2012). Biometric system help managers in terms of effective personnel and time management, especially for institutions that have large number of employees (Unal and Tecim, 2018).

Effective application of biometric fingerprint technology will ensure that staff arrive at work on time and is present during working hours. The end result of this is that their presence at work will positively affect individual productivity because staff is expected to be aware that their punctuality and presence during working hours are being monitored thus will highly likely work required number of hours. If someone works more, they're likely to be more productive. The awareness that they attendance are being tracked will prompt them to arrive at work on time. As a result, this could potentially affect positively employee's productivity. Number of fraudulent overtime claims will fall as the biometric technology will prompt staff to work correct hours, and whenever they need to work extra hours, record of extra worked will be readily available in a biometric server.

Since employees are now aware and conscious of the fact that their entry and presence and exit at work are monitored they will work correct hours and this will led to more profitability of the concern, cost reduction increase revenue, as well as better performances in other performance indicator of the organisation, depending on the sector, industry in which the firm operates.

Globally the biometric fingerprint technology has gained popularity amongst many employers in organisations. In Asia, for example, Yuen (2013) reports that Hong Kong contractors are increasingly turning to biometric fingerprint technology to help them quickly give access to authorised workers and accurately deny entry to people who should not be on site. With biometric technology, worker's permit and safety training records, along with expiration dates, can be entered into a database that not only verifies an employee's identity, but instantly checks to see if that employee is authorised to be there. Biometric Hand-Readers are mostly the choice in Hong Kong.

According to Mbuh *et al.* (2020) the Nigerian government has set up biometric

identification registrars across the country in order to combat the problem of ghost workers. Biometric devices have been included at 300 payroll distribution centers. Through biometric registration, thousands of non-existent or absent workers have been identified and removed from the database. As a result, Nigerian government saved 118.9 billion naira which is equivalent to over 11.5 million U.S. dollars, by removing roughly 23 846 ghost workers from the employment system through the use of biometric fingerprint technology (Olumuyiwa, 2018).

In Tanzania, biometric technology is increasingly adopted by many institutions. For example, effectively in May 2019 network operators in Tanzania were ordered by the Tanzania Communication Regulatory Authority (TCRA) to commence fresh biometric fingerprint registration of all SIM card holders in the country (Michael, 2020). According to the regulatory body, the move seeks to address key issues like forgery and other criminal activities that threaten honest subscribers and society and to protect vulnerable subscribers who use mobile money services. In addition, Tanzanian institutions like hospitals, banks and colleges have now been noted to adopt the use of biometric fingerprint technology for controlling attendance, access and securities.

An interview with one of the key personnel of Kilimanjaro Christian Medical Centre reveals that the centre officially introduced biometric finger prints attendance system on January 1, 2017. The objective was to keep abreast of the new technology in private health sector, cost reduction in terms of allowances paid to workers, revenue collection due to punctuality of staff to attend in their respectively department timely and efficiency in operation of hospital activities. Prior to the deployment and adoption of the biometric attendance system at the KCMC, manual attendance book registers were in use. This old attendance management process was slow, prone to manipulation and less accurate. Employees often complained and disputed the records relating to their attendance. In addition, the productivity of individual employees and thus organisation performance could not be easily determined on the basis of legitimate hours worked. This study therefore aims to analyse the effectiveness of deployment of biometric fingerprint technology on organisational performance at KCMC.

1.2 Problem Statement

To keep abreast of technologies governments and non-governmental organisations use biometric fingerprint technology to provide a more comprehensive system in monitoring employee attendance and therefore to improve manpower management and productivity of workforce in their operations. Despite the introduction of this technology, its contribution to organisational performance in many organisations has not been evident. According to Ami-Narh *et al.* (2014) in spite of valuable benefit of fingerprint attendance management system a number of resistances have been recorded against adoption of the system in work place. He further states that adoption of this system in Ghana is very low. Similarly, in a study done in Indonesia Yudiatmaja *et al.* (2018) concluded that policy makers should review the implementation of fingerprint to improve its impact on public sectors.

A study done by Villaroman *et al.* (2018) showed that the use of biometric attendance system has a positive impact on the work performance of the employees of selected government organisation. It appeared that, using descriptive analysis, majority of the respondents believed that it has a significant effect on the level of performance. However, the study did not include explanatory variables of biometric attendance on employee`s performance. Verma and Khan (2016) conducted a study to determine the biometric attendance that can be used to enhance traditional staff attendance system which presently affects the productivity of the organisation. The same study highlighted work productivity factor of employees that are there as a result of implementing a biometric system in the organisation. The findings of the study indicated that the biometric technology system is the best system that can sustainably solve the lingering problem of staff attendance in the organisation. However, the study did not show the perception towards biometric attendance system. Verma and Khan (2016) and Afolalu *et al.* (2016) conducted researches on benefits of biometric attendance systems. Sanchita *et al.* (2016) focused on the employee`s perception towards its impact at higher education. This study did not analyse the impact of biometric fingerprint technology on organisational performance.

The researcher conducted interviews with some organisations which have already adopted biometric fingerprint technology at Moshi municipal in Kilimanjaro region. The interview responses show that Mawenzi regional hospital introduced biometric fingerprint register in 2019, Moshi Cooperative University (MoCU) introduced in

2018 and Kilimanjaro Christian Medical Centre (KCMC) deployed the technology in 2017. On the basis of recent introduction of biometric fingerprint register in these institution at Kilimanjaro region the researcher deemed it needful to analyse the contribution of the technology to performances, taking the case of KCMC.

Many studies on this area were conducted in Western and Asian countries using samples from those counties, and a few studies dealt with educational based organisation, thus making the current study enjoy geographical, methodological and industrial (health industry) gaps. This study, therefore, aims to bridge this gap by assessing the effect of biometric finger print technology on organisational performance at Kilimanjaro Christian Medical Centre (KCMC), Moshi Municipality in Kilimanjaro Region by taking into account explanatory variables of biometric attendance on employee's performance, perception of participants towards the use of biometric attendance system and by taking into consideration the health-based organisation.

1.3 Research Objectives

1.3.1 General objective

The main objective of this study was to assess the effect of biometric fingerprint technology on organisational performance.

1.3.2 Specific objective

This study focused on four specific objectives, which are:

- i. To examine the effect of biometric fingerprint technology on performance indicators used by KCMC;
- ii. To examine the perceptions of employees towards the adoption of biometric fingerprint system for staff monitoring;
- iii. To assess the effectiveness of biometric devises in recognising workers, and determine whether there is an association between age of biometric users and false rejection of biometric devises; and
- iv. To examine the contribution of biometric fingerprint system in controlling extra hour payments.

1.4 Research Questions

The study aimed to answer the four questions, which are:

- i. How has the performance indicators of KCMC been affected by biometric fingerprint technology?
- ii. What are perceptions of hospital employees towards the adoption of biometric fingerprint technology?
- iii. Does the biometric devices respond instantly when applied?
- iv. Is the false rejection of biometric device associated with the age of respondents?
- v. What is the contribution of biometric fingerprint technology in controlling extra hour payments?

1.4.1 Hypotheses

In tackling objective (iii) to understand if there is any relationship between age of respondents and the instant response of biometric devices the researcher considered it needful to perform hypothesis test of relationships. The following hypothesis was developed:

H₀: biometric response to user is not affected by old age of users

H₁: Biometric response to users is affected by the old age of users

1.5 Justification of the study

This study is found to be useful for three main reasons. Firstly, the study findings would suggest to managements the possible measures of improving organisational performance through the uses of biometric fingerprint technology by highlighting challenges and recommendations. Secondly the study is also in line with the Tanzania's government policy on management and employment in public service No. 2(2008). In analysing the perception of staff towards the adoption of biometric technology the study focused on its effects towards productivity of individual staff, and also truancy. This government policy, among other things, puts emphasis on responsibility and accountability of public servants. Therefore, findings of this study relating to truancy and individual productivity are expected to contribute much towards the objective of the policy. Lastly this study would be helpful to researchers for further studies on related subject that may be carries out at a national and local level, including in the health sector.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of the Key Terms

2.1.1 Biometric technology

Biometric technologies refer to technologies for measuring and analysing a person's physiological or behavioral characteristics (Verma and Ojha, 2019). It is also defined as “the use of computers to recognise people, despite all of the across-individual similarities and within-individual variations” (Wayman *et al.*, 2005). In this study biometric technology means the computerised system of identifying staff identity and monitoring their attendance and presence at their work places through the use of their unique physical characteristics.

2.1.2 Fingerprint

According Verma *et al.* (2019) a fingerprint is a combination of ridges and valleys on the surface of fingertips. They are graphical flow-like ridges present on human fingers. Their formations depend on the initial conditions of the embryonic mesoderm from which they develop (Jain 2012). In this study finger prints connote the prints that are unique to every individual that identifies a person distinctively when they press a finger on the biometric scanner.

2.1.3 Biometric Fingerprints Technology

According to Dastbaz and Wright (2013) Biometric technologies generally refer to the use of technology to identify a person based on some aspect of their biology. Fingerprint recognition is one of the first and original biometric technologies that have been grouped loosely under digital forensics. Therefore in the context of this study Biometric Fingerprint Technology means an automated system that verifies employee's identity when signing in or out of workplace by scanning the unique fingerprints of that individual employee.

2.1.4 Fingerprint Attendance Register

Biometric attendance is software which manages the huge data related to the attendance of staff, students or similar group of people (Kirmani, 2017). The fingerprint attendance system solves the attendance issues by ensuring no time waste

as the attendance is taken during reporting time and leaving time. It also helps help managers in terms of effective personnel management, especially for institutions that have large number of employees to ensure management and evaluation level of the attendance is automated, and that there is no chance for fake attendance marking (Unal and Tecim, 2018). Fingerprint attendance register, in the context of this study, means the digital register systems that identify staff and time they check in to work, and out after work, by them pressing their fingers on the biometric scanner.

2.1.5 Bed Occupancy Rate

It is a measure of hospital efficiency calculated as the number of hospital bed days divided by number of available hospital beds multiplied by the number of days in a year. The lower the rate means better performance. Higher rate suggests slow patient turnover or lack of enough beds. Although there is no general consensus about the “optimal” occupancy rate, but according to the National Institute for Health and Care Excellence (NICE) of 2018, a rate of about 85% is often considered a maximum to reduce the risk of bed shortages.

2.1.6 Average Length of Stay

In the context of this study the term defined as the length of an in-patient episode of care, calculated from the day of admission to day of discharge, and based on the number of nights spent in hospital. Patients admitted and discharged on the same day have a length of stay of less than one day. The lesser the days the more the performance, assuming other factors are constant. According to KCMC strategic plan 2015/2020 average length of stay was targeted to be reduced to 8 days regardless the nature of disease or condition of patient.

2.1.7 Discharges

In the context of this study discharges means number of live patients turn over i.e. those whose conditions doesn't need them to be confined in hospital bed for close monitoring. *Ceteris paribus*, the more staff the higher the discharge rate. In the context of this study discharge can mean the situation whereby the recovery of a patient is medically considered so satisfactory that the patient can now be released from the hospital bed.

2.1.8 Deaths

Deaths in this study mean those patients that are discharged dead. Assuming external factors are constant, the lesser the number of dead patients the better.

2.1.9 Hospital admission

Means the period between the time of a participant's entry into a hospital as a bed patient and the time of discontinuance of bed-patient care or discharge by the admitting physician or other professional provider, whichever first occurs. The day of entry, but not the day of discharge or departure, shall be considered in determining the length of a hospital admission. Other factors being constant, the more the staffing, and the more the number of admissions. In the context of this study hospital admission means a situation by which it is medically considered imperative that a patient be immediately assigned a hospital bed for a close medical treatment and management.

2.2. Organisational Performance

The concept of organisational performance denotes how efficient the organisations achieve their intended objectives and outcomes compared to actual results or outputs. Organisational performance also means the success or fulfillment of organisation at end of program or projects as it is intended. According to Richard *et al.* (2009) organisational performance encompasses three specific areas of firm outcomes i.e. financial performance (profits, return on assets, and return on investment); product market performance (sales and market share); and shareholder return (including total shareholder return and economic value added).

This study defines organisational performance in a perspective of deployment of biometric technology as one of the managerial measures to assure performance through management of human resource. Therefore, in the context of this study organisational performance can be defined as:

“The outcome of the intended objectives of the institution through the deployment of Biometric Fingerprint Technology as a staff monitoring tool”

2.3 Factors affecting organisational performance

The multitude of factors identified by various literatures as relevant determinants of organisational performance results is extensive, and to identify and discuss them one by one would be far beyond the scope of this study.

However, there are factors known to exercise considerable influence on the organisational performance of public institutions. Hunnes, *et al.* (2008) have identified organisational culture as a major factor affecting performance results in an organisational environment. Cera and Kusaku, (2020) have found additional relevant factors affecting organisational performance, i.e. leadership/managerial practices, training and development, as well as working environment (Brewer and Selden, 2000).

2.3.1 Organisational culture

Organisational culture is one of the most relevant components of an organisation, despite the ownership status of an organisation (i.e., whether it is publicly, privately or co-owned). Generally, culture is defined very broadly. Tharp (2009) has defined culture as: “a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems”.

Some scholars suggest that organisations that have developed a culture with attributes appropriate to their operational context generate higher financial performance (Barney, 1991; Martin *et al.*, 2004). Thus, the organisation enhances its performance through culture if it implements managerial practices that promote job security, fair remuneration, appropriate incentives, hence enabling it to attract those employees that are best aligned with existing organisational values.

2.3.2 Training and development

On-the-job training is also considered as a set of activities planned by the organisation to enhance on-the-job knowledge and skills or modify members' attitudes and behavior in ways that are consistent with the organisation's goals and job requirements (Cera and Kusaku, 2020). One defines training and development as the process by which people acquire or absorb skills and knowledge that enhance their effectiveness. The effectiveness of training can also be determined based on the amount of training that an individual has achieved.

Training plays a key role in the development of organisational objectives and accomplishes this by incorporating organisational interests with those of its

workforce. Training will provide a very important service to employees, equipping them with an expertise that is necessary and very convenient. The quality of training is also capable of having a direct impact on the level of income and financial performance of the unit or organisation.

Managing public organisations requires a certain amount of skills and professionalism for attaining effective and efficient results (Cera and Kusaku, 2020). One of the strongest arguments in favor of employee training is that it helps in the proper and effective development of organisational resources.

2.3.3 Work environment

Work environment has been defined as the organisational dimension that encompasses all aspects affecting employees' minds and bodies (Jain and Kaur, 2014). People work individually but at the same time, they interact with others in the shared work environment, which requires different workplace solutions. Thus, the work environment is inevitably linked to employees and the dynamics of relationships created in the shared work environment in which people shape professional and personal interconnections. The term workplace performance implies a workspace whose fundamental objective is to clearly support work performance and transform it into an environment that optimises employee productivity levels (Cera and Kusaku, 2020). However, multiple studies have come to conclusions stating that the level of productivity varies depending on the suitability and effectiveness of the work environment of an organisation (Robbins *et al.*, 2008).

2.3.4 Management/leadership

Frederick Taylor defines management as "the art of knowing and recognising what one desires to achieve, and seeing how something can be done effectively and efficiently" (Taylor, 1914). Taylor focused on productivity, as indicated by the definition brought above, which he attached to management in general. However, management has been considered as one of the key components affecting performance (Aguinis, 2013). Furthermore, scholars in the field, emphasising the importance of following effective management practices in generating high levels of performance, argue that trust in management is just as important, as a psychological component, in improving effort and achieving higher performance levels.

Performance management is a specific term that intrinsically refers to the management process related to performance output. According to Hossein and Vicheth (2011) organisational performance means the study of processes, activities and practices of how organisations achieve their intended objectives and outcomes through a range of variables at the micro (industry and organisational) levels and at a macro (sociopolitical environment) levels. It encompasses three specific areas of firm outcome i.e. financial performance, product market performance and shareholder return.

In a study by Rahimi *et al.* (2016) there are list of key performance indicators of hospitals and health facilities that could be used health sectors as yard stick to measure performance. The list can be found in annex III of this study. Since this research is being done in health sector, the scope the study was to focus on six key performance indicators which are admission, mortality, discharges (live), bed occupancy, length of stay, and hourly labor cost.

This research acknowledges that factors discussed above i.e. organisational culture, training and development, work environment and management leadership are the factors that can also affect the performance indicators being discussed in this study. For example, increase in patients discharged dead, bed occupancy rate and average length of stay, can also be attributable to lack adequate training. Similarly, with proper management and leadership the hospital is able to reduce length of stay of patients, and in-patient census average, reduction of hourly pay etc.

For economic analysis, “*ceteris paribus*” means that when considering the effect of one economic variable on another, all other factors that may affect the second variable are held constant. Since the broad objective of this study is to measure the effectiveness of biometric deployment at KCMC and how it influences performance indicators, the concept *ceteris paribus* was also included due to the extreme difficulty of analysing at once several dynamic factors that can affect organisational performance.

2.4. History of Biometric Attendance System

The term “biometrics” is derived from the Greek words “bio” (life) and “metrics” (to measure). Automatic biometric technology has only become available over the last few years, as a result of significant advancement in technology especially in the field

of computer science. The automated technique behind this, however, is based on ideas that are originally many years ago. One of the oldest and most basic examples of a characteristic that is used for recognition by humans is the face. Since the beginning of civilisation, humans have used face to identify known (familiar) and unknown (unfamiliar) individuals (Verma and Khan, 2016).

Of late, Biometric Attendance Recording System (BARS) is deemed necessary as the new system of recording attendance of the city staff as it is proven to facilitate the strict observance of the prescribed working hours and intensively implement the existing policies on attendance tardiness. The adoption of this will replace the old manual method which has long been used as attendance monitoring tool. The use of biometric attendance registers in the workplace creates diverse perception of its effect to work performance and productivity in general. The usability and development of biometric time and attendance system has seen drastic advancement recently during which the technology has moved from a single method (fingerprint) to more than ten prudent methods. Fingerprint authentication is one of the well-known and publicised biometric technologies.

Everyone is known to have unique, immutable fingerprints. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is increasing (Adewole *et al.*, 2014).

Biometrics has long been used as a powerful tool for solving identification. It involves measuring one or more psychological characteristics. In addition to growing needs for fast, accurate and dependable security, biometrics technology has recently begun to enter into public consciousness. In some countries, governments have made it mandatory to install biometrics machine for their offices (Hiremath and Thorat, 2013).

Acceptance of biometric security services may be affected by the context of use, with two important contextual factors being the perceived benefit to the user and the discerned privacy risks. Application context with obvious, apparent benefits and lows risks may lead to eminent perception of usability and higher acceptance opinion of

biometrics than contexts where there are little apparent benefits and high risks (Gladys *et al.*, 2018).

According to Chen *et al.* (2011) as quoted in the research work of Oloyede *et al.* (2013), the origin of biometrics has been in the public sector; however, biometrics is used for the identification and verification in other areas e.g. of criminals and health and banking.

Traditionally, staff attendance is taken using the manual method, which involves pen and paper register. The implementation of an electronic biometric-based method of attendance management system will have greatly assisted institutions thereby preventing time-consuming processes.

Time and attendance systems are in place to record when staff start and stop work, in addition to the department where the work is performed. However, for some organisations it is also common to track meals and breaks, the type of work performed, and the number of items produced, when staff is not working as a part of their workforce management strategy. These records can be kept manually with pen and paper or they can be automated. Modern day automated time and attendance systems are largely used with biometric technology, whereas staff provides their credentials to log in or log out of the system (Cupido, 2011).

Staff biometric attendance systems provide the administrator with easy access to staff attendance records and it simplifies monitoring of monthly attendance summaries. If the system is reliable, secure, efficient, and capable of replacing the traditional manual and unreliable method of attendance management, it ensures security of staff's records; eradicates fake attendance records, saves time as well as reducing the amount of work done by the administrator in gathering staff attendance records. The ultimate result will be improved productivity of institutions and performance of the staff. The system can be improved through the integration of multimodal biometric technologies to provide more security for the staff attendance management system (Adewole *et al.*, 2014).

Fingerprint scans convert people's fingerprints into digital codes or numerical data that can be recorded in a database. Fingerprint scanning matches an enrolled individual's code in a computer server against an existing database of codes in order to

confirm the identity of the individual. The conversion of fingerprints into digital data is a privacy protection measure.

2.5 Theoretical Framework

2.5.1 The Technology Acceptance Model (TAM)

The adoption of biometric technology for ensuring efficiency and effectiveness in any organisation may involve several factors, and these factors are identified in various adoption theories. One of these theories is the Technology Acceptance Model (TAM) which is based on the Theory of Reasoned Action. The model suggests that actual system use is determined by both perceived usefulness and perceived ease of use of the technologies. Therefore, in order to be used at any organisation biometric technologies should offer usefulness for all users.

2.5.1.1 Theoretical Assumption

A critical assumption of the technology acceptance model (TAM) is that its belief constructs - perceived ease of use (PEOU) and perceived usefulness (PU) - fully mediate the influence of external variables on IT usage behavior. According to Davis *et al.* (1989), the model assumes that when users perceive that a type of technology is useful and also easy to use, they will be willing to use it. Consequently, the more staff recognises that the systems will make their tasks easier to perform; the higher is the probability that they will use it and accept the new technology as being useful (Dillon and Morris, 1996).

2.5.1.2 Criticism to the Theory

According to Ajibade (2018) TAM model is more appropriate for individual use and acceptance of technology rather than in a corporate or institutional application that requires integration of information technology.

Bashange (2015) suggests that a great deal of the relevant available literature which refers to the TAM tends to regard it as a dependent variable, rather than a means of determining the factors which influence behavior. The criticism which is advanced by Zahid *et al.* (2013) suggests that the TAM does not consider factors such as age and education as external variables which could influence acceptance of and willingness to use technology. Conversely, it could be contended that it is extremely problematic to measure behavior, as hidden personality traits often motivate behavior.

Accordingly, potential users of technology may not necessarily base their acceptance of and willingness to use new technology on their perceptions of the usefulness of IT and how easy it is to use, although the model does suggest that there may be other external factors which could be responsible for their acceptance of the technology.

Basing of the strength of this theory, the researcher finds it useful in this study as it helps to establish the pattern of response and behavioral aspects of staff toward the deployment adoption of biometric fingerprint technology.

2.5.2 The Theory of Reasoned Action (TRA)

Theory of Reasoned Action propounded by Lule *et al.* (2012) is the theoretical foundation for most of the research that investigated user acceptance of information technologies and it provides a basis for tracing the impact of external factors on internal beliefs, attitudes and intentions.

The theory of reasoned action aims to explain the relationship between attitudes and behaviors within human action. It is mainly used to predict how individuals will behave based on their pre-existing attitudes and behavioral intentions. An individual's decision to engage in a particular behavior is based on the outcomes the individual expects will come as a result of performing the behavior. TRA states that a person's intention to perform a behavior is the main predictor of whether or not they actually perform that behavior (Doswell *et al.*, 2011). Additionally, the normative component (i.e. social norms surrounding the act) also contributes to whether or not the person will actually perform the behavior (Glanz *et al.*, 2015). The theory derived from previous research in social psychology, persuasion models, and attitude theories. However, critics estimated that attitude theories were not proving to be good indicators of human behavior.

2.5.2.1 Limitation of TRA

Although the scope of TRA is wide, the theory still has its limitations and like any other theory, needs constant refinement and revision particularly when extending to choice and goals. The distinction between a goal intention and a behavioral intention concerns the capability to achieve one's intention, which involves multiple variables thus creating great uncertainty (Sheppard *et al.*, 1988). Ajzen (1985) acknowledged that "some behaviors are more likely to present problems of controls than others, but

we can never be absolutely certain that we will be in a position to carry out our intentions. Viewed in this light it becomes clear that strictly speaking every intention is a goal whose attainment is subject to some degree of uncertainty.

According to Eagly and Chaiken (1993) TRA does not take into account that certain conditions that enable the performance of a behavior are not available to individuals. Since the TRA focuses on behaviors that people decisively enact, the theory is limited in terms of being able to predict behaviors that require access to certain opportunities, skills, conditions, and/or resources. Additionally, certain intentions do not necessarily play a role in terms of connecting attitudes and behavior. According to a study conducted by Bagozzi (1989) the performance of a behavior is not always preceded by a strong intent. In fact, attitudes and behaviors may not always be linked by intentions, particularly when the behavior does not require much cognitive effort (Bagozzi, 1989).

Basing on the strength of these theories, the researcher finds them useful in this study as they help to establish the pattern of response and behavioral aspects of staff toward the deployment adoption of biometric fingerprint technology especially when analysing objective number two.

2.5.3 Resource Based Theory (RBT)

Resource Based Theory (RBT) argues that organisations compete in dynamic and changing business environment (Crook *et al.*, 2008). Firms can attain and achieve a sustainable competitive advantage through their employees according to Barney (1991). This can be realised when organisations have a pool of human resources that cannot be imitated or substituted by its rivals or competitors. The RBT as a foundation of competitive advantage is embedded in the utilisation of a bundle of valuable resources that are at the disposal of the firm. It is important that firms have to identify the major potential resources. These resources should be valuable, rare inimitable and non-substitutable among the competitors of the firm in the field that they operate in (Galbreath, 2005). The key aspect of the Resource Based Theory is that firms have to identify their main resources that can make the firms to achieve and sustained a competitive advantage against their competitors (Barney, 1991). A resource has to be valuable to organisations like KCMC are expected to make optimum use of time and the human resources that they have by ensuring that

employees work fully for the scheduled time to enable enhancement of its operational performance.

2.5.3.1 Theoretical Assumption

The RBT makes an assumption that an organisation is made up of unique capabilities and resources as a foundation for a firm's strategy to compete and be profitable and also have competitive advantage over its competitors. According to Hitt *et al.* (2009), firms can use the resources at their disposal and capabilities to enhance their operational performance. In order to be competitive, firms should ensure that they carry out their activities in an integrated approach. Firms should also adopt strategies that distinguish them from other firms in the areas that they operate in. As a result, organisations need to explore their frameworks if they envisage remaining relevant in the context of the competitive global environment. Organisations are striving to achieve competitive advantage, they should put into consideration that true competitive advantage requires the resources of an organisation to be valuable, rare, inimitable and non-substitutable as pointed out by (Crook *et al.*, 2008).

2.5.3.2 Criticism of Resource-based Theory

The most crucial criticism of this theory is that when a groundbreaking innovative technology arrives in the market, this theory does not hold its ground. This theory clearly says that the organisation should always look for internal resources and use them to gain a competitive advantage.

However, if the market brings a groundbreaking technology, then the organisation has to resort to incorporate it. Practically, it is challenging to rely only on internal resources. Further, the theory is criticised for the framework used to evaluate an organisation's resources and capabilities (i.e. VRIO framework). Every product in every organisation cannot pass this framework accurately. The term resources itself is ambiguous and does not clarify which part of the resource it refers to.

This theory will be useful as it will help to understand and draw conclusion on perception of staff towards adoption of biometric system in the context of individual productivity and truancy rate. It will also contribute in focusing on objective four (IV) to analyse the efficiency in payment of hourly benefits to staff.

2.6 Empirical Literature Review

Monitoring staff attendance can be an overwhelming task for employers. The accuracy of biometric attendance system (BA) is as important as it has been associated with solution to many challenges ranging from the cumbersome nature of the paper sheets used in recording, manipulation of the attendance record to time consuming. According to Beyda and Jefferis (2011) advances in software and data collection devices help employer track hours worked, reduce calculation errors and improve payroll processing time.

Little studies have been conducted to investigate the impact of biometric attendance on staff's performance. For example, Villaroman *et al.* (2018) in their study on the use of biometric attendance recording system and its impact on the work performance of Cabanatuan city government employees, the result of the study showed that the use of biometric attendance system has a positive impact on the work performance of the employees of selected government organisation. It appeared that, using descriptive analysis, majority of the respondents believed that it has a significant effect on the level of performance but they did not include explanatory variables of biometric attendance on staff's performance.

Verma and Khan (2016) conducted a study to determine the biometric attendance identifier that can be used to enhance traditional staff attendance system which presently affects the productivity of the organisation. The study was conducted using exploratory approach, where detailed knowledge of biometrics, biometrics attendance system and its usage in human resource practices is been shared. Also, the study highlighted work productivity factor of staff that are there as a result of implementing a biometric system in the organisation. The findings of the study indicated that the biometric technology system is the best system that can sustainably solve the lingering problem of staff attendance in the organisation as it will eliminate fake punching and increase staff productivity. However, the study did not show the perception towards biometric attendance system and did not measure or see the performance of staff at work before and after attendance system is implemented in their sample studies.

White *et al.* (2018) conducted a mixed-methods study to understand feasibility, acceptability, and adoption of digital fingerprinting for patient identification in a

study of household TB contact investigation in Kampala, Uganda. They tested associations between demographic, clinical, and temporal characteristics and failure to capture a digital fingerprint. Findings showed that clinical and demographic characteristics were not significantly associated with fingerprint capture. The study concluded digital fingerprinting to be feasible and acceptable for individual identification, but problems of implementing the hardware and software led to a high failure rate.

A study has been conducted by Activenanda (2016) indicated that many institutions adopted biometric attendance systems to increase the staff work efficiency and workforce administration. In contrast to those manual procedures, biometric system of attendance is free from errors, accessible and greatly corrects. While previous studies have attempted to establish a relationship between biometric attendance management systems and an organisation's performance (Akinduyite *et al.* 2013; and Cupido, 2011); most of the empirical studies have shown a more positive relationship of biometric attendance systems and organisational performance. Actual attendance scheduling in the place of work supports in increasing staff or workers' productivity, which leads to overhead cost saving that enhances an organisation's operational performance (Ononiwu and Okorafor, 2012).

Sanchita and Swin (2016) conducted a study on the impact of biometric attendance system in higher educational institutes of India (HEI). The paper considered two educational institutes of Ranchi (India) which have already introduced Biometric Attendance System (BAS), to assess the projected impact of new technology in increasing organisation's productivity and efficiency. On the basis of findings of the study, it has inferred from the perspectives of the students and staff that BAS will have positive impact on the performance of HEIs. The respondents perceive that BAS will promote discipline and reduce payroll disputes for staff as well as reducing barring issues from appearing in exam for students. BAS will play vital role in removing favoritism and making the local leaders as well as faculty members more punctual and make the functioning of the system smoother and better.

Findings of a research conducted at Afe Babalola University, Nigeria that assessed the performance of staff after installation of Biometric Attendance System (BAS) show that, it improved work potential, the dedication of work among staff and

provide a base to promote unbiased dedicated workers and have been observed working potential of staff. The supervisor can also be able to recognise the areas of non-attendance in the office which can be used to re-organise of work. This technology regularised the staff, but their effort in their jobs remained unchanged and it may be at risk of exclusion. It was also observed that there are some challenges during the identification or the attendance process like time inaccuracy and lack of awareness that how to operate the machine (Afolalu *et al.*, 2016). Simultaneously, another study shows that some fields gained discipline, punctuality, and efficiency, which simply has a positive effect on its uses. But at the same time some negative impacts were observed that BAS technology is one of the expensive on the economic point of view, secondly, it has been used for formality rather than performance. A research work argued that the system may be efficient both in educational institutions and offices to boost up the work, punctuality as well as work dedication (Gelb and Clark, 2013).

Afolalu, *et al.* (2016) and Verma and Khan (2016) conducted researches on benefits of biometric attendance systems. Sanchita *et al.* (2016) focused on the staff's perception towards its impact at higher education. These studies did not analyse the impact of biometric fingerprint technology on organisational performance. However, many studies on this area were conducted in Western and Asian countries using samples from those countries, thus making the current study enjoy geographical and methodological gaps. This study, therefore, aims to bridge this gap by assessing the impact of biometric finger print technology on organisational performance at Kilimanjaro Christian Medical Centre (KCMC), Moshi Municipality in Kilimanjaro Region.

Literatures show that the use of biometric time and attendance system has enormous benefits. It helps to improve performance and promote healthy labor relation by reducing the risk of potential human error of time recording keeping. However, despite the benefits of the system to the employer and employees, the use of biometric finger print time and attendance devices by observation, seems to have been negatively perceived by the employees (Cupido, 2011). Without biometric identification technology, companies will still have to rely on manual methods of payroll calculation which are not only extremely time consuming, but also come with risk of errors. Unlike manual methods, biometric attendance system is comparatively

error free, quick to install, user friendly and highly accurate.

Biometric is the science and technology of measuring and analysing biological data. It is an automated method of recognising a person based on a physiological or behavioral characteristic. Among the features measured are face, fingerprints, hand geometry, handwriting, iris, retinal, vein and voice. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solution (Hiremath and Thorat, 2013).

2.7 Research Gap

The empirical review studies did not include explanatory variables of biometric attendance on employee's performance. Focus on perception of participants towards the use of biometric attendance system was also not included in their studies. In addition, a few studies dealt with educational based organisations. Therefore, the current study aimed to assess the biometric fingerprint technology and organisation performance by including explanatory variable of biometric attendance like time saving, perception of staff, dysfunctionality of devices and cost factor, taking into consideration the health-based organisation.

2.8 Conceptual Framework

Independent Variable

Dependent Variable

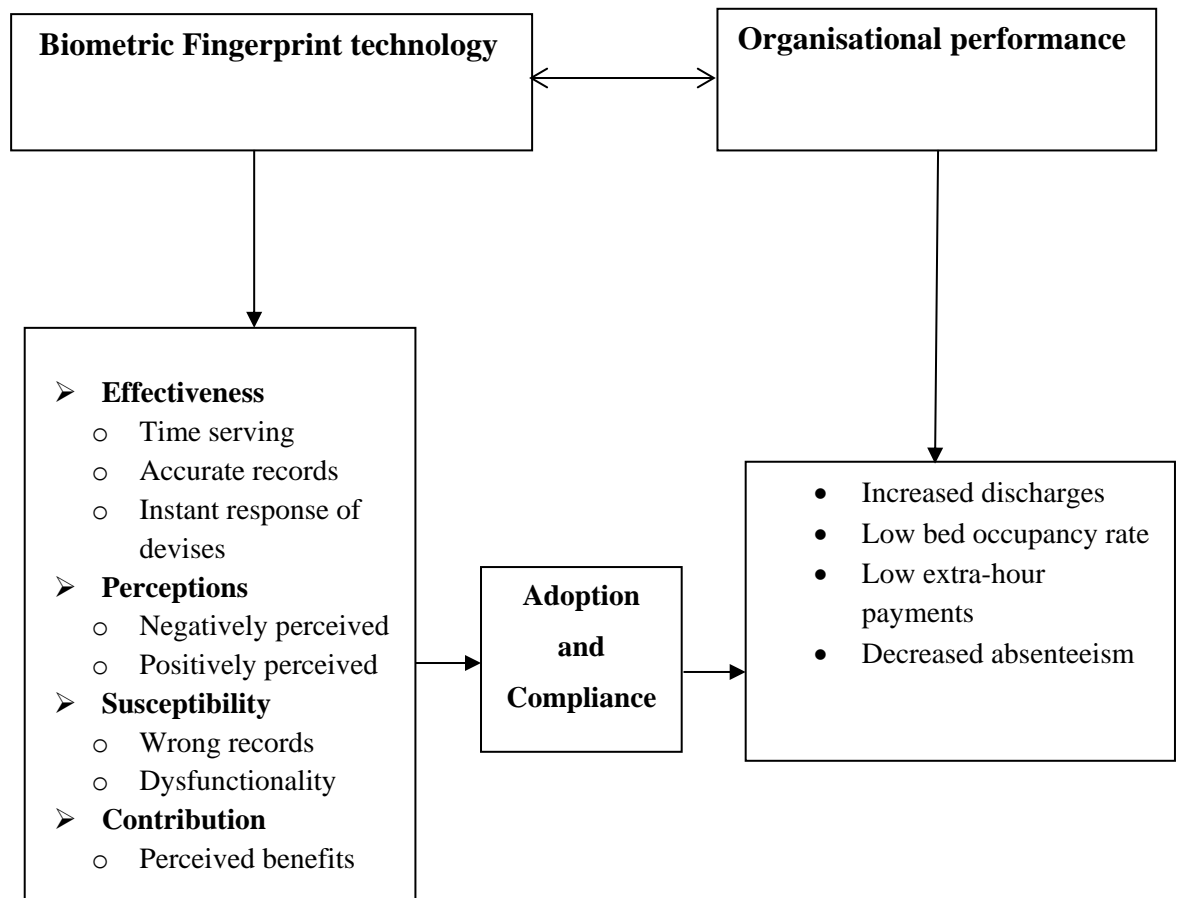


Figure 1: Conceptual framework on assessing the effectiveness of biometric fingerprint technology and organisational performance a case of KCMC.

In this study, independent variable is biometric fingerprint technology of which the indicators of interest are attendance records, device functioning, and timely registering of attendees. Others are Perception of employees, susceptibility of devices to false rejection, and hourly payment. On the other hand, the parameters of dependent variable are organisational performance of which the indicators are discharges, bed occupancy rate, and extra-hour payments and absenteeism.

It is expected that if employee registers timely, records are accurate and devices respond instantly, and provided that employees are compliant to the technology, then the adoption of biometric will lead to decrease in absenteeism and extra-hour payments in terms of overtimes. Discharge rate is expected to increase in a condition when there is enough employees (nurses, physicians etc.) at work on time and at all time

during the working hours. Contrary to that condition, discharge rate is highly likely going to be negatively affected since a few staff available will be overwhelmed by great number of patients to be attended. Bed occupancy rate is also going to be affected in a similar manner, since patient will have to occupy bed unnecessarily longer due to employee either registering late or not available during working hours.

Similarly, the positive perception of staff toward the system would lead to their commitment to compliance, thus increased assurance that staff work correct hours and hourly payments are correct. In addition, if devices falsely reject user recurrently, it would frustrate users since it would be wasting their time, and this will attract non-compliance to usage. Consequently, these will led to deceitful attendance record, and payment of overtime is likely going to be unauthentic.

According to Davis *et al.* (1989) the TAM model assumes that when users perceive that a type of technology is useful and also easy to use, they will be willing to use it. Consequently, the more staff recognises that the systems will make their tasks easier to perform; the higher is the probability that they will use it and accept the new technology as being useful (Dillon and Morris, 1996). Similarly, the theory of reasoned action states that a person's intention to perform a behavior is the main predictor of whether or not they actually perform that behavior (Doswell *et al.*, 2011). In this study the variables such as perception of staff towards the biometric system, and the effectiveness of biometric devises in recognising workers, will be benefited from these theories in a sense that the theories will provide a basis on which to analyse how useful and how easy to use the technology is perceived, and the attitudes (compliance or non-compliance) of staff towards the usage of biometric devises, thus let us conclude whether its negatively or positively perceived.

Resource Based Theory postulates that, as organisations are striving to achieve competitive advantage, they should put into consideration that true competitive advantage requires the resources of an organisation to be valuable, rare, inimitable and non-substitutable (Crook, *et al.*, 2008). The key aspect of the Resource Based Theory is that firms have to identify their main resources that can make the firms to achieve and sustained a competitive advantage against their competitors (Barney, 1991). A resource has to be valuable, and organisations are expected to make optimum use of time and the human resources that they have by ensuring that

employees work fully for the scheduled time to enable those organisations to enhance their operational performances. In this study the dependent variables like organisational performance indicators will be benefited from this theory in a sense that it will provide a basis on which to understand the relationships between of biometric technology as staff monitoring tool and the positive or negative performance results.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

A cross-sectional design was used in conjunction with both qualitative and quantitative methods for data collection. Qualitative method was used in order to get in depth opinions of the study participants regarding introduction and implementation biometric fingerprint technology. It was a cross-sectional study design it allowed researcher to compare many different variables at the same time. It was possible to look at age, education levels and performance of respondents in various departments and units, in relation to effectiveness and usage of biometric attendance register with little minimum resource.

3.2 Description of the Study Area

The study was carried out at Kilimanjaro Christian Medical Centre (KCMC). KCMC is located in the foothills of Mount Kilimanjaro, along Sokoine road at Moshi district, Kilimanjaro region in Tanzania. KCMC is one among the four Zonal Consultant hospitals in Tanzania with 500-800 inpatients in 630 official beds, 90 canvas, 40 baby Incubators, 1852 students, and 1176 employees. Like other neighbour hospitals such as Mawenzi hospital, St. Joseph hospital, and Kilimanjaro hospital which are in Moshi district, KCMC effectively deployed biometric finger print technology as a staff monitoring tool in 2017 to replace manual system which has been in place for many years. The size of the hospital, its location and the fact that it introduced biometric fingerprint technology effectively 2017 was the reason for choosing it as a study area as it was deemed potential for availability of useful data for the success of this study.

3.3 Population, Sample and Sampling Procedure

3.3.1 Target Population

According to the hospital payroll of December 2020, there is a total of 1176 staff which is made up of 837 health staff and 339 supporting staff from all departments and units.

3.3.2 Sample size

Sample size was determined from the N=1176 staff by using sample size formula developed by Yamane (1967), arriving at 93 respondents. Matata *et al.* (2001) observed that 80-120 respondents are adequate for most socio-economic studies in Sub-Saharan Africa. Also, Dillman *et al.* (2009) adds that sometimes even 10% margin of error is fine if you want to deduce trends or infer results in an exploratory manner.

The sample size was thus drawn as follows:

$$\text{Sample size } n = N/(1+N(e)^2)$$

Whereby:

N is the population size

e is a desired level of precision (margin of error =0.1)

n is sample size

Therefore: $1176 / (1 + 11.76) = 93$ respondents.

The table1 shows distribution of population department-wise with their respective selected sample:

Table 1 : Distribution of study population with respective selected sample size

Department	Population	Sample
Endoscopy	8	1
Cancer Care Centre	30	2
Internal Medicine	77	6
General Surgery	29	2
Paediatrics	26	2
Orthopedic/Trauma	33	3
Eye	124	10
Ear Nose &Throat	46	4
Obstetrics & Gynecology	53	4
Urology	32	3
Dermatology	17	1
Kilimanjaro Clinical Research Institute	62	5
Anaesthesia	55	4
Community Health	13	1
Central Sterile Supplies	11	1
Radiology	27	2
Outpatient/Causality/Emergency	70	6
Child Centered Family Care Clinic	18	1
Clinical Laboratory	27	2
Labour Ward	15	1
Main Theatre	26	2
Nurse Administration Department	38	3
Supporting Staff	339	27
Total	1176	93

3.3.3 Sampling Technique

Stratified sampling technique was used in this study. Although this technique is not without disadvantages, it was still deemed useful due to the nature of the study case which comprises multiple departments. Stratified random sampling was therefore preferred because it enables to obtain a sample population that best represents the entire population being studied; making sure that each subgroup (i.e. departments) of the case is represented. The population of study was divided into strata and sample was selected from each stratum using proportionate sampling technique. The number of participants from each stratum was determined by their number relative to the entire population. A choice of participants based on qualities respondent possesses, and his/her willingness to provide useful information. Departments were used as strata from which random sampling was made to select participants.

3.4 Data Collection Methods

3.4.1 Key informant interview

In this study interview guide was used to interview four key personnel of senior positions which are head of Human Resource and Administration department, heads of Finance department, head of Nursing Services, head of Hospital Services and head of Clinical Research. These are key personnel involved in a day-to-day supervision operations of the hospital due to their qualifications skills and work experience, hence they were expected to issue information regarding the objective of adopting the biometric technology at KCMC, management actions toward latte attendees, evaluation of staff performances, detective measure to identify late staff, the overall performance of the hospital and other information deemed to be useful for the success of this study and that could otherwise not be obtainable through questionnaires administered to respondents.

3.4.2 Documentary review

Documentary review method was used to go through various documents in order to extract information that could be useful to meet research objective. Pre and post biometric implementation information was reviewed from these documents, and these included KCMC annual reports 2014 to 2018, finance information, and electronic attendance data.

3.5 Data Collection Tools

3.5.1 Questionnaire

Pre-coded open ended and closed ended questions were designed to constitute the questionnaires that were distributed to sampled respondents. The questionnaire was used as a method of collecting primary data based on research questions and hypotheses as a frame of reference. The questionnaire was preferred since it gave participant ample time to think and respond, and also it enhanced anonymity of respondents. The data questionnaire was tested before being administered to respondent in order to verify whether the tool would be suitable and adequate to collect the desired information and also to ensuring consistence of the questions. Questionnaires were then distributed to participants for them to fill and return. Participants were given ample time of 14 days to fill questionnaires.

3.6 Data Analysis

Both qualitative and quantitative data analysis was used, whereby qualitative data was analysed using content analysis. To objective (i) qualitative data analysis was used. On the other hand, objective (ii) and (iii) the use of quantitative technique was used utilising descriptive statistics and other non-parametric methods to analyse and present data while determining the level of statistical significance and variables' correlations. The techniques used included cross-tabulation, mean, standard deviation and chi-square to determine the significance of the variable relationship.

3.7 Validity and Reliability

Cronbach's alpha, which is a measure of coefficient of reliability, was used to test reliability and validity of data. It is an estimate of the reliability based on the correlations between different items on the same test. As proposed by George and Mallery (2003), the study will be reliable if a Cronbach's alpha scale of 0.7 and above will be obtained. Thus, in this study reliability and validity of data was judged as excellent ($a \geq 0.9$); good ($0.8 \leq a < 0.9$); acceptable ($0.7 \leq a < 0.8$); questionable ($0.6 \leq a < 0.7$); and poor ($0.5 \leq a < 0.6$). Also, in order to establish consistency, test and re-test method was used to measure validity on questions to respondents over a period of time to ensure that results of data reflect the same outcome. The pre-test confirmed that the tool contains valid questions thus would reflect the intended purposes under study.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Demographic Information

Table 2 provides demographic information of participants of this research in terms of their age and education levels:

Table 2 : Age and Education of respondents

Age	Frequency (n=93)	Percentage (%)
18 – 35	57	61.3
Above 35	36	38.7
Education		
Primary education	4	4.3
Secondary education	14	15.1
College/below bachelor education	66	71
Above bachelor education	9	9.7

In this study 61.3% staff ranged between 18-35 years old which can be viewed as a class of young employable groups. The rest 38.7% were participants aged above 35 years old. Studies show that as the age of a person increase the biological characteristic of somebody members also change (Oloyede *et al.*, 2013). Also, according to Hashim (2011) age is one of the factors that can affect biological identification of a person on a biometrically. The aim of inclusion of age element in this study was to understand if at KCMC aged staff would encounter difficulties when registering on biometric devices, thus helping to answer the question in objective number (iii) of this research.

On the part of education 80.7% respondents have some tertiary education i.e. professional certificate, diploma or bachelor degree. The inclusion of education element in this study is due to a common perception that educated people do appreciate the role of technologies and are able to understand and analyse technical issues better than the less educated. Thus, in as much as this study aims to analyse biometric technology, this ratio of participants is expected to bring better result to this study.

4.2 Effect of biometric fingerprint technology on organisation performance indicators

The main target of this objective was to analyse the effectiveness of biometric attendance on the hospital's performance. The effectiveness was operationalised by assessing how performance indicators were behaving years before deployment of biometric technology and years after biometric deployment in order to determine whether there's improvement in performance or not.

According to Rahimi *et al.* (2016) there are number of indicators (see annex III) that are used by health sectors to decide if performance of a health service provider is being attained. KCMC being one of health service providers also uses some of these indicators to measure organisational performance. The scope of this study was to focus on six performance indicators, which are hospital admissions, discharges, deaths, average length of stay, average in-patient census and bed occupancy rate. Table 3 is a summary of total from year 2014 to 2018 respectively.

Table 3 : Summary of performances of KCMC hospital

Variables	Years				
	2014	2015	2016	2017	2018
Admission	24 036.00	21 932.00	24 680.00	25 181.00	25 663.00
Discharge	20 610.00	19 135.00	22 402.00	22 997.00	23 698.00
Death	1719.00	281.00	1828.00	2064.00	2113.00
Average length of stay	237.00	60.30	277.00	305.30	268.10
Average inpatient census	462.00	469.00	512.00	517.80	554.00
Bed occupancy rate	1347.00	238.80	1385.00	1411.90	1516.10

Source: KCMC Annual Reports 2014 - 2018

The biometric attendance system was deployed and effectively operated in year 2017. The purpose of deployment of biometric finger print at KCMC was to increase organisation performance. Analysis of data was done to find out whether or not this objective was attained since the year of deployment by analysing if there are positive changes on the selected performance indicators from the year of deployment of biometric technology. The positive changes would infer that the deployment objective has been effective. On the other hand, the negative changes would suggest that the objective to deploy the technology has not been effective, i.e. the results on the selected performance indicators has not been as expected by the management when embarking on deployment of the technology. The base year in this study (which is

the year immediately before deployment of biometric technology) was 2016. Comparison was done to see changes between 2017 vs. the base year 2016 and 2018 vs. the base year 2016. Findings are as tabulated in table 4:

Table 4: Performance changes since deployment of Biometric Attendance

System Variable	2017-2016		2018-2016	
	Change	% Change	Change	% Change
Hospital admissions	501	2.03(F)	983	3.98(F)
Discharges	595	2.66(F)	1296	5.79(F)
Deaths	236	12.91(A)	285	15.59(A)
Average length of stay	28.3	10.22(A)	-8.9	-3.21(F)
Average in-patient census	5	0.98(F)	42	8.20(A)
Bed Occupancy rate	26	1.88(A)	131	9.46(A)

Note: “F” = Favourable

“A” = adverse

From Table 4 it can be seen that there is a positive change in hospital admission by 2.3% between 2016 and 2017, and 3.98% between base year and 2018. Discharges increased by 2.66% and by 5.79% between 2016-2017 and 2016-2018 respectively. Average length of stay increased by 10.22% between base year and 2017 and improved by -3.21% between base year and 2018. However, data suggest poor performance in terms of death indicator since deaths increased by 12.91% from 2016 to 2017 and by 15.59%. Similarly, bed occupancy rate did not show good sign since it increased by 1.88% between base year and 2017 and by 9.46% between base year and 2018.

Assuming external factors are constant, it can be observed that biometric fingerprint technology has brought a positive effect since there is an increase in hospital admission, discharges, and decrease in patients’ length of stay in the hospital.

However, there is an increase in deaths, average in-patient census and bed occupancy rate despite the deployment of biometric fingerprint attendance register. As stated earlier, biometric technology is a mechanism to control and monitor staff attendance and presence at work place. The effectiveness of this mechanism would ensure that staff are punctual, and at work during working hours. If staff (nurse, physicians etc.) are timely at work place and are always available as needed it means lifesaving rate at

hospital will improve since doctor or nurse is there as and when their services are immediately required. However, increase in deaths could suggest that there is absence of physician, specialty expertise or nursing care and other related caretakers at the time they are required, so that their punctuality and presence at work at the right time could significantly contribute to life saving. Similarly, bed occupancy rate is not expected to increase like data show because if number of staff required in the ward is sufficient a lot of patients will be attended in a lesser timeframe than when a few staff are there. Therefore, this suggests that deployment biometric fingerprint technology has not been effective in those two performance indicators, as is sensibly expected to be.

Empirical studies conducted to investigate the impact of biometric attendance on staff's performance like that conducted by Villaroman *et al.* (2018) show that the use of biometric attendance system has a positive impact on the work performance of the staff. That means it can be assumed that biometric as a staff monitoring tool to ensure staff attendance must bring a positive impact in organisation performance because as a number of staff is adequate services could potentially be performed much faster than when staff at a particular time a few. This case is similar to findings of this study that show that biometric technology has brought a positive effect to increase in admissions, discharges and better performance on length of stay of patients. However, the hospital may revisit the case of increase in deaths, and bed occupancy rate, and average in-patient census to understand why the hospital doesn't perform better despite the deployment of biometric fingerprint attendance register.

4.3 Perception of Staff towards the adoption of biometric fingerprint system

The aim of this objective was to analyse how staff at KCMC perceives about the deployment and adoption of this electronic method of attendance as a monitoring tool in order to identify possible weakness that management could focus to ensure better achievement of their objective to adopt this technology for better organisational performance. Security, individual work productivity and truancy are variables that will be focused in discussion of this objective. The effectiveness of each of these variables was operationalised by setting key questions through questionnaire to participants. Conclusion as to whether biometric has been effective in respect of these three variables was then decided basing on response pattern from the questions asked.

4.3.1 Security

Biometric fingerprint technology is also expected to strengthen security aspects in any organisation deploying it. According to Abdelbary (2011), increased security can be an insurance policy protecting the reputation and long-term viability of the business. This objective therefore aims to find out if the deployment of biometric technology at KCMC has strengthened security i.e. security against bad people, theft etc.

In this study participants were asked if deployment of biometric fingerprint has helped to strengthen security, they were required to select “strongly agree”, “agree”, “disagree” or “strongly disagree”. Findings show that 33.3% strongly agreed, and 38 40.9% agreed making a total of 74.2% who seem to be satisfied with the security brought about by the adoption of biometric technology at KCMC in terms of security. Detailed findings are as per Table 5.

Table 5 : Biometric attendance system has increased security level at KCMC

	Observed	Percentage%
Strongly agreed	31	33.3
Agreed	38	40.9
Disagree	16	17.2
Strongly disagreed	4	4.3
No opinion	4	4.3

These statistics imply that the objective of establishing and adopting biometric technology to strengthen security at KCMC has greatly been achieved. These findings are supported by the study done by Khan and Aithal (2022) where they concluded that Biometrics technology is used to strengthen the security aspects of organisations in different parts of the world. Its wide implementation can be seen in many health care systems in different countries. The people's concerns i.e. privacy concerns, security concerns and user acceptance issues contribute a lot to biometrics technology deployment.

4.3.2 Work Productivity

Biometric systems completely rule out attendance forging and other fraudulent practices such as staff time theft and staff reporting on behalf of others, and this is because biometric systems identify individuals based on unique biological attributes, thereby providing a direct impact on staff productivity. According to the interview

with one of the key personnel of KCMC, one of the objectives for adopting biometric fingerprint Technology was to increase individual productivity compared to when manual system was in place. Therefore, this objective aims at finding out whether the biometric attendance system at has helped KCMC to improve staff productivity as was expected by the management.

Participants were required in a questionnaire to respond “strongly agree”, “agree”, “disagree”, or; strongly disagree” when asked whether their individual work productivity has improved since the biometric attendance system was deployed at KCMC. In response to this 80.6% agreed whereby 33.3% of them strongly agreed and 47.3% agreed. Detailed responses are as per table 6.

Table 6 : Biometric attendance system has improved individual work productivity

	Observed (n=93)	Percentage%
Strongly agreed	31	33.3
Agreed	44	47.3
Disagree	13	14
Strongly disagreed	4	4.3
No opinion	1	1.1

Findings in Table 6 show that the expectation of the management to introduce biometric attendance system in order to achieve individual staff performance has been met. According to Theory of Reasoned Action (TRA), an individual's decision to engage in a particular behavior is based on the outcomes the individual expects will come as a result of performing the behavior. TRA further states that a person's intention to perform a behavior is the main predictor of whether or not they actually perform that behavior (Doswell *et al.*, 2011). This shows that if employee know that the application of the biometric fingerprint technology will be a factor that can increase their productivity they will highly likely show compliance. The implication in this finding therefore suggests that the adoption and compliance of employee to the technology is adequate and this led to effectiveness of this technology in terms of individual work productivity. The finding of this objective is also supported by Kadry & Smaili (2010) who stated that staff biometric attendance system is an important issue every kind of organisation must take into consideration in order to be productive. Also, Oloyede *et al.* (2013) and Mycroft (2011) have the same conclusion with regard to the contribution of biometric attendance system in

achieving individual work productivity when they conclude that biometric technology helps to increase staff productivity.

4.3.3 Truancy

Truancy, in the context of this study, means staff absenteeism during required working hours without the awareness of the management. This reduces their expected performances and productivity at work. This objective aims to examine whether the adoption of biometric fingerprint technology at KCMC has helped to curb truancy of staff during working hours.

In Table 7, participants were asked to tell whether it is possible for staff to sign –in on biometric fingerprint device and then go out of work without management to know. In response 57% agreed, whereby 21.5% strongly-agreed and 35.5% agreed. Ten 10.8% participants had no opinion.

Table 7 : Staff can abscond during working hours despite the presence of biometric attendance system

	Observed (n=93)	Percentage%
Strongly agreed	20	21.5
Agreed	33	35.5
Disagree	18	19.4
Strongly disagreed	11	11.8
No opinion	10	10.8

The essence of management to establish and adopt biometric finger print technology for staff monitoring was basically to increase organisational performance. Staff plays a vital role to performance of any organisation through working hard and in stipulated number of hours per day. When staff are not present at work place during working hours it will highly affect productivity and consequently organisational performance. For 57% participants to report that it is possible for staff to be out of workplace after checking in, and management being unaware, it connotes that the biometric attendance register at KCMC is able to capture information for in-and-out of staff only, but there is no biometric mechanism at KCMC for monitoring the presence of staff at work during working hours. This gives the loophole for some staff to abscond their work place during working hours and go for their activities out of work. This would consequently cost the employer's working hours.

Findings in this objective can be linked to Clavereau (2011) that the company staff succeeded in stealing the company's productivity without the management even

noticing through truancy. Similarly, finding in this study shows that the objective to reduce truanancies at work place through using biometric technology at KCMC has not been effective enough, unlike the study done by Yudiatmaja (2018) with the result which shows that fingerprint and monitoring have a positive and significant influence on work discipline.

4.4 The effectiveness of biometric devises in recognizing workers, and determination of an association between employees age and false rejection of biometric devises

4.4.1 The effectiveness of biometric devises in recognizing workers

In order to ensure that the performance of an automatic fingerprint identification/verification system is robust with respect to the quality of the fingerprint images, it is essential to incorporate a fingerprint enhancement algorithm in the minutiae extraction module.

This objective aimed to examine the susceptibility of biometric fingerprint technology to frequent failure at KCMC when staff signs in and out, i.e. the likelihood of the attendance registers to instantly recognise users and doesn't falsely reject them. After respondents were asked about how instant the device recognises and responds when signing in or out, 32.3% agreed and 19.4% strongly agreed making a total 51.7% of those agreed. This implies that biometric fingerprint technology responds to signing in and out and thus, does not waste staff's time during registering. This is partly attributable to the quality of the input fingerprint images of the biometric fingerprint technology adopted at KCMC. These findings matches the findings by Adewole *et al.* (2014) who found out that the performance of a minutiae extraction algorithm in the biometric machines relies heavily on the quality of the input fingerprint images.

Table 8 : Biometric Devise responds instantly when used

	Observed (n=93)	Percentage%
Strongly agreed	18	19.4
Agreed	30	32.3
Disagree	27	29
Strongly disagreed	14	15
No opinion	4	4.3

The results above give the implication that biometric fingerprint device at KCMC is not susceptible to frequent failure since 51.7% of respondents agree that the device recognises them instantly and this is similar to the conclusion by Ami-Narh *et al.* (2014) that biometric hardware technologies are not susceptible to frequent breakdown.

However, moving further in to the study it can be noted that from the sample of 93 respondents 48% either disagreed or strongly disagreed or have no opinion at all. Forty eight percent is a significant ratio, given the objective of deploying biometric fingerprint technology. One of the objectives of adopting biometric fingerprint system include time saving and keeping records of staff attendance for decision making on matters including payment of salaries and other benefits. According to Technology Acceptance Theory (Davis *et al.* 1989) biometric machines should be easy to use not wasting time or constant breakdowns. The significance of the 48% is its potential to frustrate the management's objective to adopt biometric fingerprint system in that the constant failure could serve as a loophole for some staff to not comply with requirement to use biometric device especially when they observe that it wastes their time by trying again and again to register. Thus, it should be viewed as an alert to the management of KCMC.

4.4.2 Determination of an association between employees age and false rejection of biometric devices

In this study it was deemed necessary to investigate if people with old age could be facing false rejection and constant failure of the biometric device when using it. This is because, according to Hashim (2011) age is one of the factors that can affect biological identification of a person on a biometrically. Finding sub-objective would let the management to assess the need to re-enrolments biometric features of users who face difficulties in registering biometrically due to age.

According to The National Policy of Youth Development (2007) youth are defined to be those individuals aged between 15 – 35 years old (working age). Therefore, in the context of this study, in old age has been deemed to be that staff aged above 35 years old.

Data related to age were compiled and matched with those related to response to the question asked to individual concerning biometric response. The question asked

whether the biometric device responds instantly when finger is placed, and they were required to choose “strongly agree”, “agree”, and “disagree”, “strongly disagree: or “no opinion”. The results are as per Figure 2.

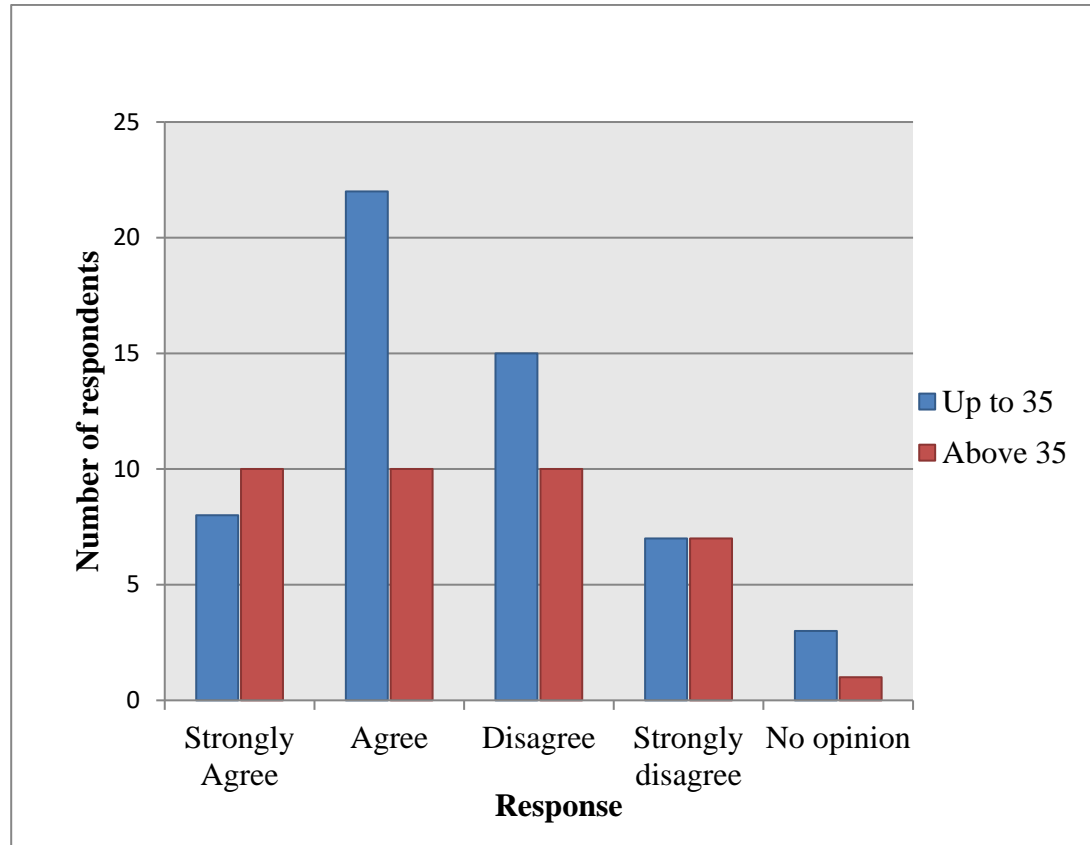


Figure 2 : Distribution of Biometric Response according to Respondents Age

Chi-Square test of association was performed to investigate the null hypothesis that *biometric response to user is not affected by old age of user* and the normal procedures for testing hypothesis was followed. Level of significance was 0.05, degree of freedom was 4, and critical value was 9.488. The test statistic result was that Chi-square = 4.5615 (for workings refer Annex V and VI).

Table 9 : Distribution on biometric response according to age

Response	Observed		Expected	
	Up to 35	Above 35	Up to 35	Above 35
Strongly agree	8	10	11	7
Agree	22	10	19	13
Disagree	15	10	15	10
Strongly disagree	7	7	8	6
No opinion	3	1	2	2

Since the test statistic does not fall within the area of rejection (i.e. within level of significance 0.05) the Null hypothesis is therefore worth accepting. It could therefore be concluded that biometric finger print response to user is not affected by old age of user. Findings of this objective differs with that of Adewole (2013) who states in the International Journal of Applied Information System (IJ AIS) that age is among the factors that might affect biological identification of an individual person on biometric devise. However, this conclusion could be taken cautiously since it depends how the journal defines old age. The scope in this study was between ages 35 to age 60 and not more than 60 years old since age 60 is a retirement age.

4.5 Contribution of Biometric Fingerprint System in controlling extra hour payments

It is expected by any organisation which adopts biometric attendance system that the system will help in reducing labor and other hourly costs related to staff. This is because they expect to keep track of how and when each individual staff checks in and out of work so that they will understand if staff are paid according to hours they have worked.

This objective aimed at testing whether the objective of minimising staff's costs at KCMC in terms of overtime's payments, which are worked hourly, is achieved through the uses of biometric attendance register. The objective was operationalised by examining the trend of overtime payments year before deployment of biometric technology and year after the deployment of biometric system by collecting records of overtime (extra-hour pavements) in the respective years (Refer Annex II). From the data, the trend line was expected to either be parallel or moving downwards, so that this would tantamount to being that biometric technology has been effective ward reducing extra-hour payments. The upward trend would suggest that hourly payment keeps increasing despite deployment of biometric technology.

Figure 3 shows the trend of total costs of overtimes that KCMC has been paying staff from 2016 when biometric system began to be adopted, up to 2019 (deeper information can be found on annex II).

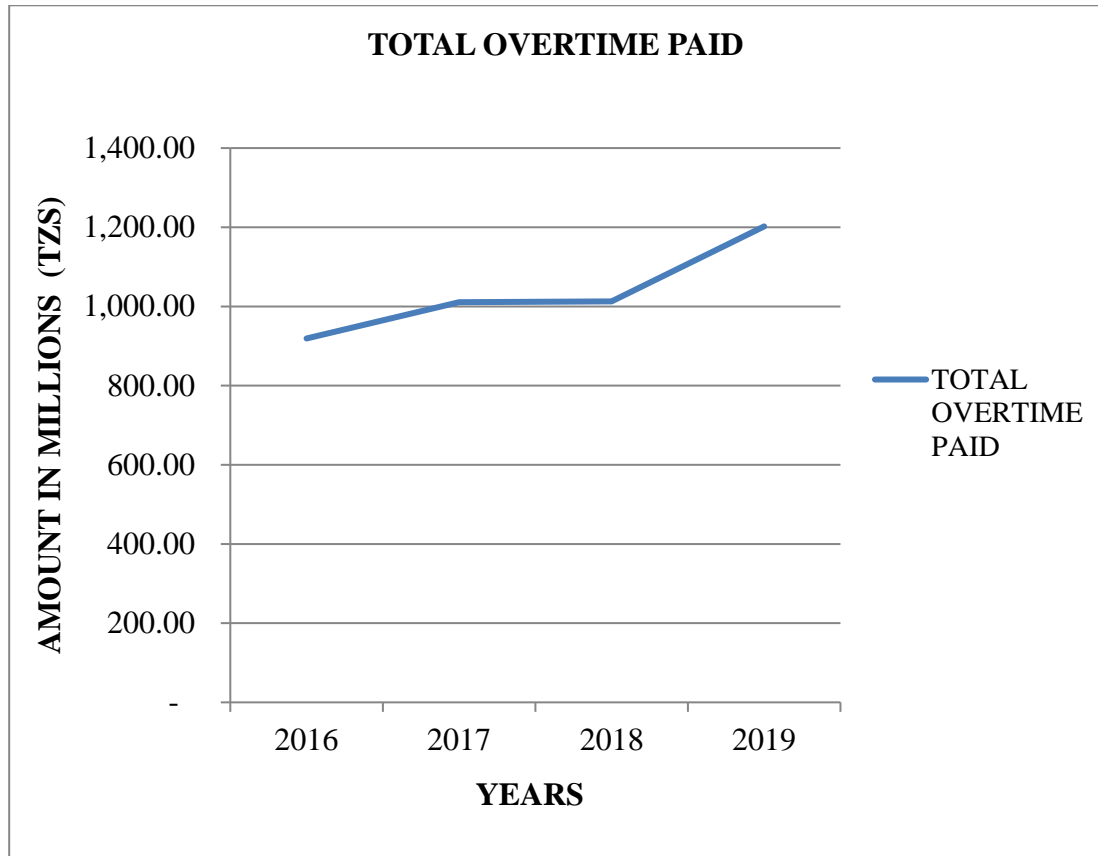


Figure 3 : Trend of payment of overtimes from 2016 to 2019

In Figure 3 above it can be seen that the trend of payment of overtime rose between year 2016 and 2017. It maintained the level of approximately 1000 million from 2017 to 2018 after which it sharply rose to 1200 million between 2018 and 2019. Overtimes are paid hourly for extra hours worked by individual staff. In order to obtain correct data of extra hours worked information would be well obtained from biometric server. It is expected that biometrics would help to track true and correct hours worked since without it staff could claim overtimes which they actually didn't work. This would thus reduce the amount of overtime worked. But data from Figure 3 above shows that there is significant rise between 2016 and 2019. Assuming other external factors (such as new recruitment of staff etc.) remain the same, this rise suggests that the monitoring of extra hour worked by staff by using biometric fingerprint technology has not sufficiently been effective in a move to control the labor costs in terms of overtime payments.

The key aspect of the Resource Based Theory is that firms have to identify their main resources that can make the firms to achieve and sustained a competitive advantage against their competitors. Human and time are among valuable resources that managements of any organisation are expected to make optimum use of by ensuring

that employees work fully for the scheduled time to enable enhancement of its operational performance (Barney, 1991). The upward trend in this study could suggest that employee and time are not effectively managed through the use of biometric by ensuring that employee work and are paid basing on the correct number of hours worked. This finding differs from the conclusion made by Lederer *et al.* (2000) and Ami-Narh *et al.* (2014) where they conclude that the use of biometric timekeeping technologies has better effect on organisation labor cost as compared with traditional method.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The broad objective of this study was to analyse effectiveness of biometric fingerprint technology in attainment of organisational performance. The research intended to analyse four objectives which are to examine the effect of biometric fingerprint technology on organisation's performance indicators, to examine the perceptions of staff towards the adoption of biometric fingerprint system for staff monitoring, to assess the effectiveness of biometric devices in recognising workers, and determine whether there is an association between age of biometric users and false rejection of biometric devices, and to examine the contribution of biometric fingerprint system in controlling extra hour payments. The study was guided by the theory of Technology Acceptance, Theory of Reasoned Action and Resource-Based theory.

The research identified and analysed performance indicators and how they are affected by adoption of biometric finger print technology. Analysis was done on the response of performance indicators to the adoption of biometric technology to see how they are affected if staff complies on using it. It was seen that there was a positive change in terms of more Admissions, Discharges and Average length of stay, implication being that the biometric technology was successful in terms of the three performance indicators. However, increases in deaths indicate and increase in bed occupancy rate suggests that either beds are not enough or turnover of live patient is poor. This suggests that management's objective to deploy biometric fingerprint technology was not effectively attained in terms of these two performance indicators. This is because turnover of live patient could be higher, provided that the staff-patient ratio is attained using biometric technology to monitor attendance and presence of employee.

Second objective was to analyse the perception of staff toward the adoption and implementation of biometric fingerprint technology the objective being to study the response of participants in terms of Security and Individual productivity of staff and Truancy rate. Majority of participants agreed that biometric technology has contributed to strengthening of security in working place. Similarly, majority of participants responded that their productivity has been positively affected since deployment of biometric technology. This signifies that biometric technology has

been effective as far as the Security and Individual productivity of employees is concerned. In addition, data showed that despite deployment of biometric technology there is still a loophole for staff to report to work by signing in on biometric device and then abscond from work to do their activities during working hours without management's attention. This loophole poses a risk for employee to steal employer's working hours, and thus it is highly likely that hourly payment incurred by management is not authentic.

The third objective was to assess the effectiveness of biometric devices in recognising workers, and determine whether there is an association between age of biometric users and false rejection of biometric devices. Sixty percent of participants responded that they do not encounter frequent failure when signing in or out on biometric device. In addition, it was aimed to understand if there is association between the old age and the biometric devices' success or failure to recognising users. The study concluded that there is no association.

The last objective aimed at assessing the contribution of biometric technology towards reduction of extra hour payment especially in terms of payment of overtimes. The scope was to analyse the trend of payment of overtime to staff who works extra hours immediately before deployment (i.e. year 2017) of biometric technology and after deployment. This study shows that there is a significant rise in payment of overtime between year 2016 and 2019. This suggests management need to revisit the efficacy of biometric adoption in a move to control payment of extra hour worked by staff and ensure that the rise of overtime payments is authentic.

5.2 Conclusion

Based on the major findings of the study, the following conclusions are drawn. When measuring the effect of adoption and deployment of biometric fingerprint technology on the hospital's performance indicators, findings show that there was a positive effect on hospital admission, discharges and in average length of stay. However, there was a negative effect in areas of death/mortality rates and bed occupancy rate indicators since both of them showed an increase from 2016 to 2018. These sums up that time and attendance determined through the use of biometric technology are critical factors that can affect positively or negatively the performance indicator of organisation, depending on the effectiveness of the deployment biometric technology in an organisation.

Employees perceive that the use of biometric attendance system influenced their performance and has strengthened security measured at work place. However there is still a loophole for truancies and late reporting to occur despite the presence of biometric systems. This creates the possibilities of loss in hour worked and can led to inauthentic hourly payments.

The biometric devises are effective and employees do not encounter frequent failure when signing in or out on biometric devise. Although analysis has shown no relationship between age and biometric devises response, there is 47.8% respondents who are dissatisfied due to the false rejection of biometric devises when applied. This creates unnecessary wastage of time to keep trying to register or having to look for alternatives, just to prove that they are at work in a given day.

Extra hour payment has kept rising for the four consecutive years i.e. 2016 – 2019 despite the deployment of biometric attendance technology. This suggests that the technology might not be effective in contributing towards reduction of overtime payment or maintaining the optimal payment of hourly-payments, and thus this can derail the objective of the management to control hourly payments through this technology.

It can therefore be broadly concluded that biometric technology at KCMC has brought a positive effect to the organisational performance as was expected by management when deploying it as a staff monitoring tool. However, it is recommended that some aspects need to be looked upon by management in order to avoid current and potential weaknesses that can derail expectations of management to adopt this technology as a staff management and monitoring tool.

5.3 Recommendations

Despite the success of the objective to adopt and deploy biometric fingerprint technology as a staff monitoring tool at KCMC, there is a need for the management put a gaze on the proportion of respondent whose responses to objectives of this study seem to be unfavorable to management's objective. For example, 47.8% of respondent are not satisfied with how instant the devise responds when using, and productivity are not positively impacted by 19.4%.

One the objectives to adopt biometric technology at KCMC included to ensure that staffs are at work on time; leave the office at a stipulated time, and also that staff is available at work place during all working hours. In chapter 4 above data show that

despite adoption of biometric system there is loophole truanicies without management knowing. In conjunction with this is the fact that some staff starts working without registering. This can be done when staff is late and therefore afraid that if he/she registers it will be known through the machine that he/she came late in a particular date. It is recommended that management set a mechanism that can curb staff from absconding during working hours, and ensures that all staffs must sign in the machine irrespective of whether they came on time or late. This could also be the cause of the upward trend of overtime payments despite the deployment of biometric figure print technology for monitoring staff. Suggestion is that there could be integration of surveillance cameras to the biometric devises (Gohringer, 2004), or proper consultation could be sought from proper experts in that area of expertise.

Findings also show that sometimes biometric devise fails to respond instantly to some users, making them to keep repeating to register. This wastes time of staff due to the malfunction of the biometric devise. In order to ensure more effectiveness management should revisit this problem to ensure it is eliminated so that any staff who signs is immediately recognised by the devise. Management of KCMC could also be advised to do further analysis on why deaths and bed occupancy rate keep rising despite deployment of biometric attendance register as a staff monitoring tool.

Future research works can be carries out on how organisations can ensure there is no possibility of staff to be absent from work place despite the presence of biometric attendance register.

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APPENDICES

Annex I: Interview and Data Collection Guide

PART ONE:

INFORMED CONCENT DOCUMENT

Title of the study

Effect of Biometric Fingerprint technology on Organisational Performance at KCMC

Introduction:

You are invited to participate in this study because you work in Kilimanjaro Christian Medical Centre. The study is designed to explore the effects of biometric attendance system on organisational performance. Your inputs are very important to understand your concerns and issues that could be addressed and will lead to success of this research.

Description of Procedure

Your involvement will take up to 7 minutes only to complete. You may feel free to withdraw from participation in case you so wish and, please feel free to ask any question. You will **NOT** be needed to provide your name or contacts and please rest assured that all information provided by will be treated with highest confidence.

Thank you in advance for your kind participation.

.....

Azizi B. Mrisha

Part A: Demographic Information (Please put a tick in the box provided)

- 1. Which Department do you work in
.....
- 2. What is your gender?
 - Male (1)
 - Female (2)
- 3. What is your age
 - 18-25 (1) 46 – 55 (4)
 - 26-35 (2) Above 55 (5)
 - 36-45 (3)
- 4. What is the highest level of education do you have?
 - Standard Seven (1) Diploma (4)
 - Form Four (2) Bachelor Degree/Advanced Diploma (5)
 - Form Six (3) Above bachelor degree (6)

Part B: General Knowledge (Please put a tick in appropriate answer)

- 5. What is your general interest in technology?
 - Low (0)
 - Medium (1)
 - High (2)
- 6. Did the management educate you about the benefit of biometric attendance system at KCMC?
 - Yes (1)
 - No (2)

If the answer is yes, what you think are the benefits (please explain)

.....
.....
.....

How do you rate the performance of Biometric Attendance System which is currently in use at KCMC?

	Question	Low (1)	Medium (2)	High (3)
7	Accuracy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How do you rate your personal satisfaction level of using Biometric Fingerprint Attendance System which is currently in use at KCMC?

No	Question	Strongly Dissatisfied (1)	Dissatisfied (2)	Neutral (3)	Satisfied (4)	Strongly Satisfied (5)
9	Purpose of Implementation					
10	User-friendliness					
11	Highly Transparent					
12	High security					
13	There is fairness in calculation of Salary, overtime and other monthly benefits					

Part C: How much do you agree with the following statements? (Please put a tick in the relevant space in the table)

No.	Question	Strongly Disagree (4)	Disagree (3)	Agree (2)	Strongly Agree (1)	No opinion (5)
14	Investment of time and effort in biometric attendance system is profitable					
15	Biometric System has increased the Security level at KCMC					
16	Biometric attendance system can improve individuals work productivity					
17	Biometric System has made Employee more punctual than before					

18	The current biometric attendance system has a positive impact to KCMC compared to the previous manual attendance system					
19	Staff can come to work without registering in biometric and management cannot notice that					
20	The biometric attendance system detects late comers					
21	Biometric System has made signing-in process faster than the previous manual system					
22	Whenever I put my finger on KCMC biometric devise, the machine recognises me instantly (no need to repeat)					
23	It is possible for a staff to abscond from work during working hours despite the presence of biometric attendance register					
24	Biometric attendance register has affected my Salary/other employment benefits)					
25	In general, I am satisfied with the functioning of current biometric fingerprint attendance system					

Part D: When applying biometric machine, what concern do you always have among the following:

26. I am concern about security of the information

- Yes (1)
- No (2)
- No opinion (3)

27. I am concerned about my own privacy

- Yes (1)
- No (2)
- No opinion (3)

28. I am concerned about who has access to the information

- Yes (1)
- No (2)
- No opinion (3)

Part E: Management Questions

1. What is the purpose for which KCMC adopted the Biometric Fingerprint Attendance Register?

(i)

(ii)

(iii)

(iv)

2. Does the management make a daily check to identify late attendances?

Yes

No

3. If yes, what is the management's response to late attendances (please explain)

.....
.....
.....
.....

4. Can the management detect the absence of the staff during working hours?

Yes

No

If yes,

(a) What are the detective measures (please explain)

.....
.....
.....
.....
.....
.....

(b) What is the management response to absent employees during working hours?

.....
.....
.....
.....
.....

5. Does the monthly salary of individual employees vary according to their punctuality?

Yes

No

6. Does the fringe benefit (overtime, calls bima etc) of individual employees vary according to their punctuality?

Yes

No

7. Does the Staff Evaluation Committee, during its sessions, incorporate the item of Staff uses of biometric attendance system to evaluate staff?

Yes

No

If yes please explain.

.....
.....
.....
.....

Annex II: Overtime Allowances to KCMC Employees from 2016 – 2019

	2016 (TSHS)	2017(TSHS)	2018 (TSHS)	2019 (TSHS)	AVERAGE
JANUARY	71,295,732.00	71,982,820.00	70,860,980.00	90,872,618.00	76,253,037.50
FEBRUARY	67,401,584.00	73,578,015.00	74,989,620.00	91,767,515.00	76,934,183.50
MARCH	72,742,082.00	74,389,750.00	78,564,297.00	100,180,188.50	81,469,079.38
APRIL	73,474,034.00	69,798,567.00	79,150,138.00	100,989,282.00	80,853,005.25
MAY	73,376,801.00	75,708,690.00	80,798,600.00	101,177,161.00	82,765,313.00
JUNE	73,725,405.00	89,953,561.00	80,092,301.00	100,772,820.00	86,136,021.75
JULY	78,683,380.00	93,337,687.00	93,434,707.00	102,126,749.00	91,895,630.75
AUGUST	79,371,462.00	92,727,420.00	96,838,333.00	103,007,000.00	92,986,053.75
SEPTEMBER	78,862,933.00	96,607,840.00	81,501,897.00	103,094,566.00	90,016,809.00
OCTOBER	83,453,184.00	93,244,971.00	81,090,339.00	101,674,680.00	89,865,793.50
NOVEMBER	81,163,431.00	89,736,907.00	96,407,373.00	101,074,919.00	92,095,657.50
DECEMBER	85,613,105.00	89,900,520.00	98,968,838.00	105,420,848.00	94,975,827.75
TOTAL	919,163,133.00	1,010,966,748.00	1,012,697,423.00	1,202,158,346.50	1,036,246,412.63

Annex III: Key Performance Indicators (KPI) of hospital performance

BSC perspective	Indicators	Indicators
Finance	Ratio of total revenue to total costs	Current cost per bed
	% Deductions of hospitals	the ratio of capital expenditure to current cost
	Average hospitalisation expenditure	the cost of drugs and materials
	Average Outpatient expenditure	% personnel costs of total costs
	Average expenditure per bed per day	Total fixed cost for per bed occupancy
Internal Process	Average Length of stay	Wrong-site surgery
	Bed Turnover Interval	Leaving a foreign object during surgery
	Bed occupancy	Medication error
	Bed turnover	wrong in the type of blood group
	Mortality rate	Patient falls rate
	Cancelled operations	Hospital accidents prevalence rate
	% Repeated surgeries	Sentinel event rate
	Discharge with Personal satisfaction	Needle stick and sharp injuries
	Hospital infection rate	The legal complaint from a hospital
	Clinical Errors	Doctors on call at night
	Readmission rate	Waiting time for admission operations room
	% Occupational accidents	Mean length of stay in emergency department
	Pressure Ulcers rate	Emergency room *ER) waiting time
Medical errors	Waiting time from triangle to see doctor	
Learning and Growth	Staff satisfaction rate	the amount of the electronic medical record
	Staff turnover	number of days of sick leave to total employee ratio
	Training expenditure per capital	Employee absenteeism rate
	key Job constrain substitute	Rate of employee sick leave
	Average hour of internet use	
Customer	The facilities for families and visitors	Another stakeholder satisfaction
	Patients' satisfaction percentage	Social satisfaction
	Rate of patient complaints	

Source: J Health man & Infor. Jan 2017:4(1):21

Annex IV: Formulas

1. Average daily inpatient census = $\frac{\text{Total number of patient days in the period}}{\text{Days in the period}}$
2. Average daily admission = $\frac{\text{Total admission in the period}}{\text{Days in the period}}$
3. Average length of stay (days) = $\frac{\text{Total number of patient days in the period}}{\text{Discharge (live+dead) in the period}}$
4. Percent of occupancy = $\frac{\text{Total number of patient days in the period}}{\text{Maximum number of patient days in the period}}$ x 100
if every bed is occupied

Annex V: Chi square: Workings

	Observed		Expected	
	Up to 35	Above 35	Up to 35	Above 35
Strongly Agree	8	10	11	7
Agree	22	10	19	13
Disagree	15	10	15	10
Strongly disagree	7	7	8	6
No opinion	3	1	2	2
Total	55	38	55	38

Chi-Square: workings

Calculation	(n-x)	(n-x) ²	$\Sigma (n-x)^2/x$
$(8-11)^2/11$	-3	9	0.8182
$(22-19)^2/19$	3	9	0.4737
$(15-15)^2/15$	0	0	0.0000
$(7-8)^2/8$	-1	1	0.1250
$(3-2)^2/2$	1	1	0.5000
$(10-7)^2/7$	3	9	1.2857
$(10-13)^2/13$	-3	9	0.6923
$(10-10)^2/10$	0	0	0.0000
$(7-6)^2/6$	1	1	0.1667
$(1-2)^2/2$	-1	1	0.5000
			4.5616

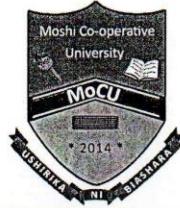
CV=9.488 at df=4 and level of significance =0.05

Chi-square Distribution Table

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
22	8.64	9.54	10.98	12.34	14.04	30.81	33.92	36.78	40.29
24	9.89	10.86	12.40	13.85	15.66	33.20	36.42	39.36	42.98
26	11.16	12.20	13.84	15.38	17.29	35.56	38.89	41.92	45.64
28	12.46	13.56	15.31	16.93	18.94	37.92	41.34	44.46	48.28
30	13.79	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89
32	15.13	16.36	18.29	20.07	22.27	42.58	46.19	49.48	53.49
34	16.50	17.79	19.81	21.66	23.95	44.90	48.60	51.97	56.06
38	19.29	20.69	22.88	24.88	27.34	49.51	53.38	56.90	61.16
42	22.14	23.65	26.00	28.14	30.77	54.09	58.12	61.78	66.21
46	25.04	26.66	29.16	31.44	34.22	58.64	62.83	66.62	71.20
50	27.99	29.71	32.36	34.76	37.69	63.17	67.50	71.42	76.15
55	31.73	33.57	36.40	38.96	42.06	68.80	73.31	77.38	82.29
60	35.53	37.48	40.48	43.19	46.46	74.40	79.08	83.30	88.38
65	39.38	41.44	44.60	47.45	50.88	79.97	84.82	89.18	94.42
70	43.28	45.44	48.76	51.74	55.33	85.53	90.53	95.02	100.43
75	47.21	49.48	52.94	56.05	59.79	91.06	96.22	100.84	106.39
80	51.17	53.54	57.15	60.39	64.28	96.58	101.88	106.63	112.33
85	55.17	57.63	61.39	64.75	68.78	102.08	107.52	112.39	118.24
90	59.20	61.75	65.65	69.13	73.29	107.57	113.15	118.14	124.12
95	63.25	65.90	69.92	73.52	77.82	113.04	118.75	123.86	129.97
100	67.33	70.06	74.22	77.93	82.36	118.50	124.34	129.56	135.81

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Date: 07 Septemba, 2020

Your Ref. No:

Katibu Tawala,
Mkoa wa Kilimanjaro,
KILIMANJARO.

**YAH: KIBALI CHA KUFANYA UTAFTI KWA WANATAALUMA NA WANAFUNZI WA CHUO
KIKUU CHA USHIRIKA MOSHI (MoCU)**

Madhumuni ya barua hii ni kumtambulisha kwako **Ndugu Azizi Bakari Mrisha** mtafiti/mwanafunzi wa Chuo Kikuu cha Ushirika Moshi ambaye kwa sasa anatarajia kufanya utafiti katika eneo lako.

Maombi haya yamezingatia Waraka wa Serikali wenye Kumb. Na. MPEC/R/10/1 wa tarehe 7 Julai, 1980 pamoja na Hati Idhini ya Chuo Kikuu Cha Ushirika Moshi (MoCU). Moja ya majukumu ya Chuo ni pamoja na kufanya utafiti na kutumia matokeo ya tafiti hizo katika kufundishia. Aidha, wanafunzi hufanya utafiti kama sehemu ya masomo yao wakiwa Chuoni.

Ili kufanikisha utekelezaji wa tafiti hizo, Makamu wa Mkuu wa Chuo hutoa vibali vya kufanya utafiti nchini kwa wanafunzi, waalimu, na watafiti wake kwa niaba ya Serikali na Tume ya Sayansi na Teknolojia.

Hivyo basi, tunakuomba umpatie mwanafunzi/mtafiti aliyetajwa hapo juu msaada atakaohitaji ili kufanikisha utafiti wake. Gharama za utafiti atalipia mwenyewe. Msaada anaohitaji ni kuruhusiwa kuonana na viongozi na wananchi ili aweze kuzungumza nao na kuwauliza maswali aliyo nayo kuhusiana na utafiti wake.

Madhumuni ya utafiti wa mwanafunzi/mtaalamu aliyetajwa hapo juu ni: "Effectiveness of Biometric Finger Print Technology on Organizational Performance at Kilimanjaro Christian Medical Centre"


Sehemu atakazofanyia utafiti huo ni: **KILIMANJARO.**

Ikiwa kuna Sehemu ambazo zinazuiliwa, ni wajibu wako kuzuia zisitembelewe.

Muda wa Utafiti huo ni kuanzia tarehe 07/09/2020 hadi 07/09/2021.

Ikiwa utahitaji maelezo zaidi tafadhali wasiliana nami.

Wako katika ujenzi wa Taifa,


Prof. Alfred S. Sife
MAKAMU MKUU WA CHUO

Nakala kwa: Mtafiti



*Vision: To become a Centre of Excellence in Co-operative Education and Practice
Centre of Excellence in Co-operative and Business Management Training of the East Africa Community (EAC)*



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Our Ref No: KCMC/P.I/Vol. XII/ 61

08.10.2020

CPA. AZIZI B. MRISHA,
 P.O.Box 3010,
MOSHI-KILIMANJARO,

RE: PERMISSION TO CONDUCT RESEARCH STUDY "EFFECT OF BIOMETRIC FINGERPRINT TECHNOLOGY ON ORGANIZATIONAL PERFORMANCE: A CASE OF KILIMANJARO CHRISTIAN MEDICAL CENTRE"

In reference to the above heading

I would like to inform you that, permission is hereby granted for your student (Mr. Azizi Bakari Mrisha) to conduct Data Collection at KCMC starting from the date of this letter, 2020.

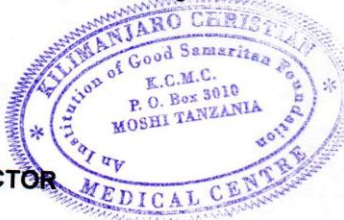
However, you may note in advance that during your study at KCMC you should to adhere medical ethics, procedures, rules and regulations that stipulated at our facility.

However upon completion of your research study at our facility you should to bring a copy of your final report at KCMC Hospital Management.

You're warmly welcome.

Mr. KessyKessale

For: **EXECUTIVE DIRECTOR**



**EFFECT OF BIOMETRIC FINGERPRINT TECHNOLOGY ON
ORGANISATIONAL PERFORMANCE: A CASE OF KILIMANJARO**

CHRISTIAN MEDICAL CENTRE

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**EFFECT OF BIOMETRIC FINGERPRINT TECHNOLOGY ON
ORGANISATIONAL PERFORMANCE: A CASE OF KILIMANJARO
CHRISTIAN MEDICAL CENTRE**

ABSTRACT

In a recent world, governments and non-governmental organisations have increasingly been adopting biometric fingerprint technology as a move to effectively monitor employee attendance in order to promote workforce productivity. However despite the deployment of this technology, its contribution to organisational performance in many organisations has not been evident. The objectives of the study was to examine the effect of biometric fingerprint technology on organisation's performance indicator, to examine perception of employees toward the adoption of the technology, to assess the effectiveness of biometric devices in recognising users, and to examine the contribution of biometric fingerprint system in controlling extra hour payments. A Cross-sectional study design was used. A sample of 93 respondents was selected from 1,176 hospital staff using Stratified Sampling technique. Data was gathered by using questionnaires, interview to key personnel and documentary review. Qualitative data analysis was employed in this study using the content analysis method. Findings show improved performance in Admission, Discharges Average length of stay increased between base year and 2017 and improved between base year and 2018. However, performance was poor in terms of Deaths, Bed occupancy rate and Labor cost per hour. Respondents replied that it is possible to report to work on time and abscond during working hours, and 48% replied that biometric device doesn't recognise them instantly. However test showed that there is no association between old age and response of biometric device. The study concludes that biometric fingerprint technology at the hospital has brought positive result, with recommendation that management should investigate the increase in death and bed occupancy rate, design mechanism to ensure staff are working during working hours, design alternatives for those to whom device fails to recognise and do further studies to understand why labor cost keep rising despite deployment of biometric fingerprint technology.

Key words: Biometric Fingerprint Technology, Attendance Register, Organisational Performance

EFFECT OF BIOMETRIC FINGERPRINT TECHNOLOGY ON ORGANISATIONAL PERFORMANCE: A CASE OF KILIMANJARO CHRISTIAN MEDICAL CENTRE

1.0 INTRODUCTION

1.1 Background information

Absentees can negatively impact performance of the concern. For example, increased costs reduce profit margins unless revenues increase. If organisations are spending more money on overtime pay and contract workers, direct costs go up and profit margins are likely to shrink. Similarly, absenteeism can decrease revenue if employees with specific roles aren't present. Employees such as workers in manufacturing, service delivery, consulting or sales, who simply have less time to hit their goals due to absence, potentially decrease revenue. Therefore the impact of absenteeism and reporting late to work is felt directly by individuals, teams and the organisation as a whole, putting pressure on productivity and profitability.

The object of management of any organisation is to ensure that they efficiently realise the optimal performance in all aspects through utilisation of a bundle of valuable resources that are at their disposal. Among these resources are human resource and time. According to Barney (1991) firms can attain and achieve a sustainable competitive advantage through their employees. Similarly, Hitt *et al.* (2009) state that firms can use the resources and capabilities at their disposal to enhance their operational performance. Organisations are therefore expected to make optimum use of time and the human resources that they have by ensuring that employees work fully for the scheduled time, to the end that the organisation realises a desired level of organisational and operational performance.

Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solution (Hiremath and Thorat, 2013). It provides valuable service to management in helping to gather personal information and monitor employees when they enter and leave from the work place, In Asia, for example, Yuen (2013) reports that biometrics fingerprint in Hong Kong contractors helps them to quickly give access to authorised workers and accurately deny entry to people who should not be on site. It helps to check if a particular employee is authorised to be there. According to Mbuh *et al.* (2020) the Nigerian government has

set up biometric identification registrars across the country in order to combat the problem of ghost workers. Through biometric registration, thousands of non-existent or absent workers have been identified and removed from the database. As a result, Nigerian government saved 118.9 billion naira which is equivalent to over 11.5 million U.S. dollars, by removing roughly 23 846 ghost workers from the employment system through the use of biometric fingerprint technology. White *et al.* (2018) conducted a mixed-methods study to understand feasibility, acceptability, and adoption of digital fingerprinting for patient identification in a study of household TB contact investigation in Kampala, Uganda. The study concluded digital fingerprinting to be feasible and acceptable for individual identification, but problems of implementing the hardware and software led to a high failure rate. In May 2019 network operators in Tanzania were ordered by the Tanzania Communication Regulatory Authority (TCRA) to commence fresh biometric fingerprint registration of all SIM card holders in the country in a move to address challenges like forgery and other criminal activities that threaten honest subscribers and society and to protect vulnerable subscribers who use mobile money services (Michael, 2020).

An interview with one of the key personnel of Kilimanjaro Christian Medical Centre reveals that the centre officially introduced biometric finger prints attendance system on January 1, 2017, the objective being to keep abreast of the new technology in private health sector, cost reduction in terms of allowances paid to workers, revenue collection due to punctuality of staff to attend in their respectively department timely and efficiency in order to improve hospital performance.

1.2 Problem Statement

To keep abreast of technologies governments and non-governmental organisations use biometric fingerprint technology to provide a more comprehensive system in monitoring employee attendance and therefore to improve manpower management and productivity of workforce in their operations. Despite the introduction of this technology, its contribution to organisational performance in many organisations has not been evident. According to Ami-Narh *et al.* (2014) in spite of valuable benefit of fingerprint attendance management system a number of resistances have been recorded against adoption of the system in work place. He further states that adoption of this system in Ghana is very low. Similarly, a study done in Indonesia Yudiatmaja *et al.* (2018) concluded that policy makers should review the implementation of

fingerprint to improve its impact on public sectors.

A study done by Villaroman *et al.* (2018) showed that the use of biometric attendance system has a positive impact on the work performance of the employees of selected government organisation. It appeared that, using descriptive analysis, majority of the respondents believed that it has a significant effect on the level of performance. However the study did not include explanatory variables of biometric attendance on employee`s performance. Verma and Khan (2016) conducted a study to determine the biometric attendance that can be used to enhance traditional staff attendance system which presently affects the productivity of the organisation. The same study highlighted work productivity factor of employees that are there as a result of implementing a biometric system in the organisation. The findings of the study indicated that the biometric technology system is the best system that can sustainably solve the lingering problem of staff attendance in the organisation. However, the study did not show the perception towards biometric attendance system. Verma and Khan (2016) and Afolalu *et al.* (2016) conducted researches on benefits of biometric attendance systems. Sanchita *et al.* (2016) focused on the employee`s perception towards its impact at higher education. This study did not analyse the impact of biometric fingerprint technology on organisational performance.

The researcher conducted interviews with some organisations which have already adopted biometric fingerprint technology at Moshi municipal in Kilimanjaro region. Information shows that Mawenzi regional hospital introduced biometric fingerprint register in 2019, Moshi Cooperative University (MoCU) introduced in 2018 and Kilimanjaro Christian Medical Centre (KCMC) deployed the technology in 2017. On the basis of recent introduction of biometric fingerprint register in these institution at Kilimanjaro region the researcher deemed it needful to analyse the contribution of the technology to performances, taking the case of KCMC.

Many studies on this area were conducted in Western and Asian countries using samples from those counties, and a few studies dealt with educational based organisation, thus making the current study enjoy geographical, methodological and industrial (health industry) gaps. This study, therefore, aims to bridge this gap by assessing the effect of biometric finger print technology on organisational performance at Kilimanjaro Christian Medical Centre (KCMC), Moshi municipality

in Kilimanjaro region by taking into account explanatory variables of biometric attendance on employee's performance, perception of participants towards the use of biometric attendance system and by taking into consideration the health-based organisation.

1.3.1 General objective

The main objective of this study was to assess the effect of biometric fingerprint technology on organisational performance.

1.3.2 Specific objective

This study focused on four specific objectives, which are:

- i. To examine the effect of biometric fingerprint technology on performance indicators used by KCMC;
- ii. To examine the perceptions of employees towards the adoption of biometric fingerprint system for staff monitoring;
- iii. To assess the effectiveness of biometric devices in recognising workers, and determine whether there is an association between age of biometric users and false rejection of biometric devices; and
- iv. To examine the contribution of biometric fingerprint system in controlling extra hour payments.

1.3.3 Research Questions

The study aimed to answer the four questions, which are:

- i. How has the performance indicators of KCMC been affected by biometric fingerprint technology?
- ii. What are perceptions of hospital employees towards the adoption of biometric fingerprint technology?
- iii. Does the biometric devices respond instantly when applied?
- iv. Is the false rejection of biometric device associated with the age of respondents?
- v. What is the contribution of biometric fingerprint technology in controlling extra hour payments?

1.3.4 Hypotheses

In tackling objective (iii) to understand if there is any relationship between ages or respondents and the instant response of biometric devices the researcher deemed it necessary to perform hypothesis test of relationships. The following hypothesis was developed:

H₀: biometric response to user is not affected by old age of users

H₁: Biometric response to users is affected by the old age of users

2.0 METHODOLOGY

Cross section design was used to carry out this study at Kilimanjaro Christian Medical Centre (KCMC) which is located at Moshi district, Kilimanjaro region in Tanzania. Stratified sampling technique was used to obtain a sample size of 93 respondents from the population of 1,176 employees. Both qualitative and quantitative data analysis was used, whereby qualitative data was analysed using content analysis. Questionnaires were distributed to respondents and interview guide was used to interview four key informants of the hospital. Pre and post biometric implementation information was reviewed from these documents, and these included KCMC annual reports 2014 to 2018, finance information, and electronic attendance data. Pre and post biometric implementation information was reviewed from KCMC annual reports 2014 to 2018, finance information, and electronic attendance data.

3.0 FINDING AND DISCUSSION

3.1 Effectiveness of biometric fingerprint technology on organisation performance indicators

The aim of this objective was to analyse the effectiveness of biometric attendance on the hospital's performance. There are number of indicators (see annex I) that are used by health sectors to decide if performance of health facility is being attained (Rahimi *et al.*, 2016). The scope of this study was to focus on six performance indicators. Analysis of data was done to find out whether or not this objective was attained since the year of deployment by analysing if there are positive changes on the selected performance indicators from the year of deployment of biometric technology. The positive changes would infer that the deployment objective has been effective. The negative changes would suggest that the objective to deploy the technology has not been effective on selected performance indicators as expected by the management when Summary of performances is tabulated in Table 1:

Table 1: Summary of performances of KCMC hospital

Variable	Years				
	2014	2015	2016	2017	2018
Hospital Admission	24 036.00	21 932.00	24 680.00	25 181.00	25 663.00
Discharges	20 610.00	19 135.00	22 402.00	22 997.00	23 698.00
Deaths	1719.00	281.00	1828.00	2064.00	2113.00
Average Length of Stay	237.00	60.30	277.00	305.30	268.10
Average In-patient Census	462.00	469.00	512.00	517.80	554.00
Bed Occupancy Rate	1347.00	238.80	1385.00	1411.90	1516.10

Source: KCMC Annual Reports 2014 – 2018

The performance changes after deployment of the technology vs. the base year 2016 (the year immediately before the deployment of technology) are tabulated in Table 2:

Table 2: Performance changes since deployment of Biometric Attendance System

Variable	2017- 2016		2018 - 2016	
	Change	% Change	Change	% Change
Hospital Admission	501	2.03(F)	983	3.98(F)
Discharges	595	2.66(F)	1296	5.79(F)
Deaths	236	12.91(A)	285	15.59(A)
Average Length of Stay	28.3	10.22(A)	-8.9	-3.21(F)
Average In-patient Census	5	0.98(F)	42	8.20(A)
Bed Occupancy Rate	26	1.88 (A)	131	9.46 (A)

NOTE: F = Favourable

A = Adverse

The figures above show that biometric technology has brought a positive change with exception to Death, In-patient census, and Bed Occupancy rate, assuming external factors are constant, and findings can be supported by Villaroman *et al.* (2018) that the system has a positive impact on the work performance of the employees of selected government organisation.

3.2 Perception of Staff towards the adoption of biometric fingerprint system

The areas of focus in this objective were on Security, Individual work productivity and Truancy.

3.2.1 Security

Analysis was done to find out if the deployment of biometric technology at KCMC has strengthened security i.e. security against bad people, theft etc. In this study participants were asked if deployment of biometric fingerprint has helped to strengthen security, they were required to select “strongly agree”, “agree”, “disagree”

or “strongly disagree”. Findings show that 33.3% strongly agreed, and 38 40.9% agreed making a total of 74.2% who seem to be satisfied with the security brought about by the adoption of biometric technology at KCMC and these findings are supported by the study done by Khan and Aithal (2022).

Table 3: Biometric attendance system has increased security level at KCMC

Response	Observed N=93	Percentage (%)
Strongly agreed	31	33.3
Agreed	38	40.9
Disagreed	16	17.2
Strongly disagreed	4	4.3
No opinion	4	4.3

3.2.2 Work Productivity

This objective aimed to finding out whether the biometric attendance system has helped KCMC to improve staff productivity as was expected by the management when deploying it. Participants were required in a questionnaire to respond “strongly agree”, “agree”, “disagree”, or; strongly disagree” when asked whether their individual work productivity has improved since the biometric attendance system was deployed at KCMC. In response to this 80.6% agreed whereby 33.3% of them strongly agreed, as per table 4:

Table 4: Biometric Attendance System has improved individual work productivity

Response	Observed N=93	Percentage (%)
Strongly agreed	31	33.3
Agreed	44	47.3
Disagreed	13	14
Strongly disagreed	4	4.3
No opinion	1	1.1

The finding of this objective is also supported by Kadry & Smaili (2010); Oloyede *et al.* (2013) and Mycroft (2011) that staff biometric attendance system is an important issue every kind of organisation must take into consideration in order to be productive.

3.2.3 Truancy

This objective aims to examine whether the adoption of biometric fingerprint technology at KCMC has helped to curb truancy of staff during working hours.

Participants were asked to tell whether it is possible for staff to sign in on biometric fingerprint device and then go out of work without management to know and findings are tabled below:

Table 5: Staff can abscond during working hours despite the presence of biometric attendance system

Response	Observed N=93	Percentage (%)
Strongly Agreed	20	21.5
Agreed	33	35.5
Disagreed	18	19.4
Strongly Disagreed	11	11.8
No opinion	10	10.8

A total of 57% participants reported that it is possible for staff to be out of workplace after checking in, and management being unaware. This leads to loss of employer's working hours. Findings in this objective can be linked to Clavereau (2011) that the company staff can steal the company's productivity without the management even noticing through truancy.

3.3 The effectiveness of biometric devices in recognising workers, and determination of an association between employees age and false rejection of biometric devices.

3.3.1 The effectiveness of biometric devices in recognising workers

This objective aimed to examine the susceptibility of biometric fingerprint technology to recurring failure at KCMC when staff signs in and out. Respondents were asked about how instant the device recognises and responds when signing in or out, 32.3% agreed and 19.4% strongly agreed making a total 51.7% of those agreed. This implies that biometric fingerprint technology responds well to users, does not waste staff's time. Findings match the conclusion by Adewole *et al.* (2014) and Ami-Narh *et al.* (2014) that biometric hardware technologies are not susceptible to frequent breakdown.

Table 6: Biometric Devise responds instantly when used

Response	Observed N=93	Percentage (%)
Strongly agreed	18	19.4
Agreed	30	32.3
Disagreed	27	29
Strongly disagreed	14	15
No opinion	4	4.3

3.3.2 Determination of an association between employees age and false rejection of biometric devices

Further analysis was done to the 48% of respondents who either disagreed or strongly disagreed since the rate is so significant that it has the potential to frustrate the management's objective. According to Technology Acceptance Theory (Davis *et al.* 1989) biometric machines should be easy to use not wasting time or constant breakdowns. Literatures show that age is one of the factors that can affect biological identification of a person on a biometrically Hashim (2011). Chi-square test was performed to see if there is a relationship between aging staff and the response of biometric devices at KCMC. Data related to age were compiled and matched with those related to response as shown in figure 2 and table 7:

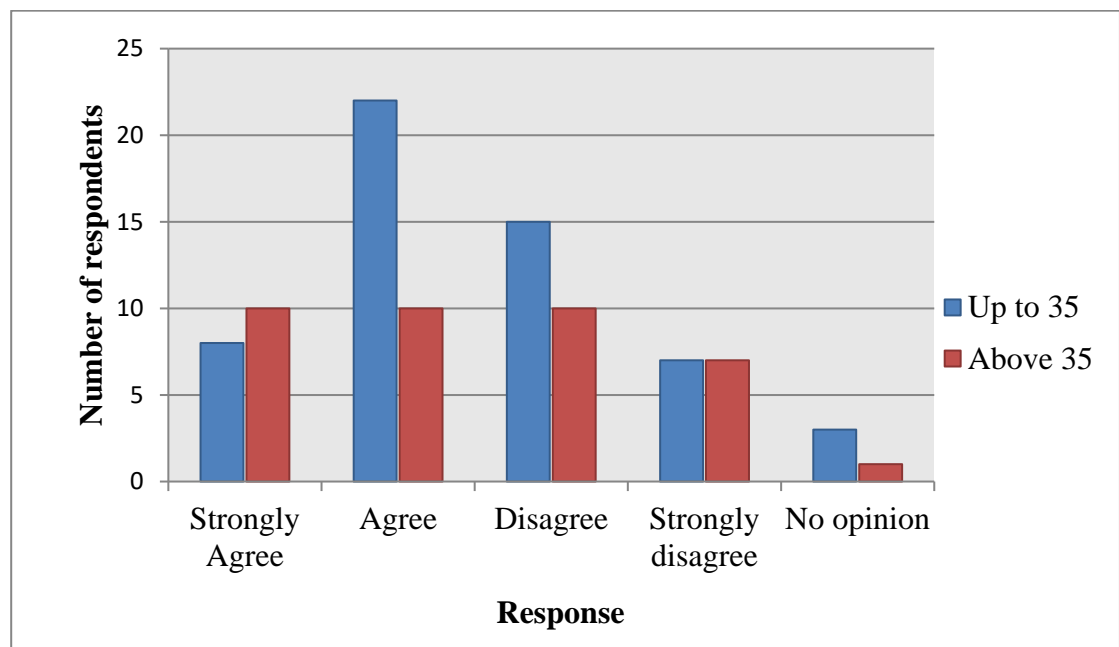


Figure 2: Distribution on biometric response according to respondent's age

Table 7: Distribution on biometric response according to age

Response	Observed		Expected	
	Up to 35	Above 35	Up to 35	Above 35
Strongly agree	8	10	11	7
Agree	22	10	19	13
Disagree	15	10	15	10
Strongly disagree	7	7	8	6
No opinion	3	1	2	2

Findings show that biometric finger print response to user is not affected by old age of user, and this conclusion differs from that of Adewole *et al.* (2014) who states that age is among the factors that might affect biological identification of an individual person on biometric device.

3.4 Contribution of Biometric Fingerprint System in controlling extra hour payments

This objective aimed to test whether the objective of minimising staff's costs at KCMC especially overtimes, which are worked hourly, is achieved through the uses of biometric attendance register (refer annex II). Figure 1 shows the trend of total costs of overtimes that KCMC has been paying staff from 2016 when biometric system began to be adopted, up to 2019.

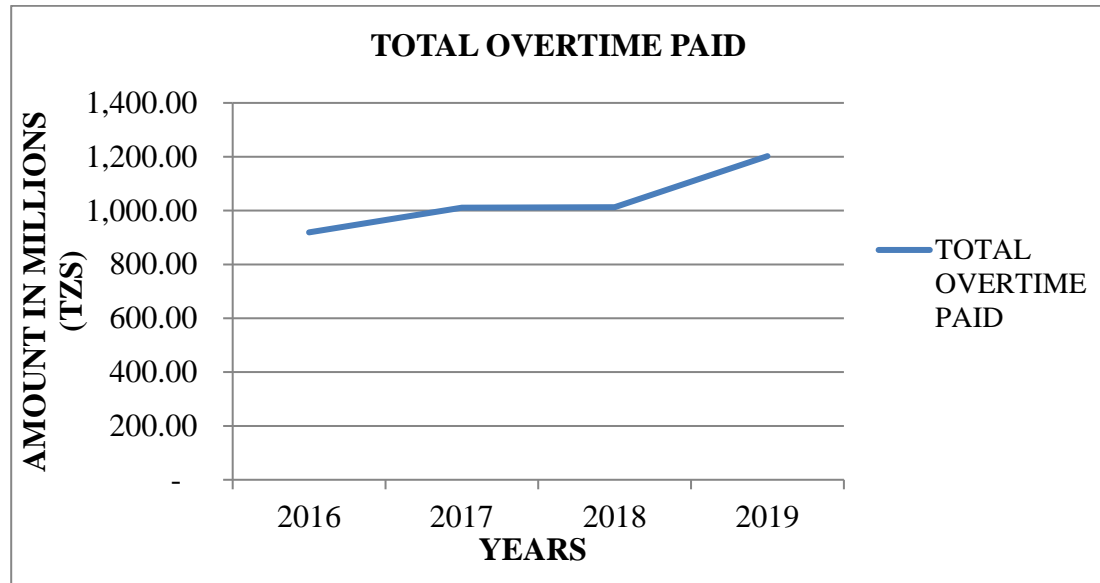


Figure 1: Trend of payment of overtimes from 2016 to 2019

Assuming other external factors (such as new recruitment of staff etc.) remain the same, this rise suggests that the monitoring of extra hour worked by staff by using biometric fingerprint technology has not sufficiently been effective in a move to control the labor costs in terms of overtime payments. This finding differs from the conclusion made by Lederer *et al.* (2000) and Ami-Narh *et al.* (2014) where they conclude that the use of biometric timekeeping technologies has better effect on organisation labor cost as compared with traditional method.

4.0 CONCLUSION

It is concluded, with recommendations, that biometric fingerprint technology has been effective in attaining organisational performance. These recommendations are: Management to set mechanism that can curb staff from absconding during working hours, and ensures that all staffs must sign in the machine irrespective of whether they came on time or late; Management to ensure that biometric devises recognised users instantly in order to avoid unnecessary delays during registering; and

Management of KCMC to do further analysis on why deaths and bed occupancy rate keep rising despite deployment of biometric attendance register as a staff monitoring tool.

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