MODELLING CHEQUE PROCESSING SYSTEMS: SEARCH FOR EFFICIENCY

HELLEN NYAKERU GATHONI

RESEARCH SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE MASTERS OF SCIENCE IN COMPUTER SCIENCE AT THE UNIVERSITY OF NAIROBI

AUGUST 2011

DECLARATION

This project, as presented in this report, is my original work and has not been presented for any other institutional award.

Signature: ..... Date 18.10.11

GATHONI HELLEN NYAKERU

Reg. No: P58/73335/2009

This project has been submitted as part fulfillment of the requirement for Masters of Science in Computer Science with my approval as the University Supervisor

Signature: ..... Date 18/10/2011

Mr. Elisha Opiyo

School of Computing & Informatics

ACKNOWLEDGEMENT

I would like to gratefully acknowledge God for the far I have come; it took his grace for all I managed to do. I would also wish to appreciate the people who made this project a success, first my supervisor Mr. Opiyo who really made sure I understood the concepts behind the project and whose guidance made it a success. Thanks a lot Mr. Opiyo and the panelist of the group, God bless.

Secondly I appreciate my family for a helping hand and also encouragement to undertake MSC computer science; it was not an easy Job but I thank God as its all now behind.

Thirdly to my classmate Ronoh, who made sure I had all the materials I need for the class.

Thanks a lot

Contents

LIST OF FIGURE

LIST OF ABBREVIATION

BEJ: - Branch Electronic Journal

CBK: -Central Bank of Kenya.

CPC:--cheques processing centre

CTS: - cheque truncation system.

DMMU: - Domestic Money Market Unit.

EJ: -Electronic Journal.

EOD:- End of Day.

IRD: - Image Returned Document

J: -- Journal / file.

KBA: - Kenya Bankers Association.

MICR: - Magnetic Ink Character Reader.

T-is a clearing term used to refer to today.

RTGS:-Real Time gross Processing

ABSTRACT:

Cheque clearing process takes a long time thus lagging behind the country's economy. This is even worse for cheques collected from Upcountry's and remote areas as clearing takes 10 and 14 days respectively. The existing cheque clearing system takes 4 days for a cheque to clear and 6 days for a dishonoured cheque to get to the presenting branch within the local areas and 15 days to 21 days for upcountry and remote areas respectively. This called for need to adopt cheque truncation that has been implemented in many countries. In Kenya the process will reduce clearing cycle to two from four days taken to process cheque issued in major towns and to 4 days from 10 and 14 days respectively the number of days for clearing upcountry and remote cheques [Kenya Bankers Association (KBA) chief executive Habil Olaka said in an interview]. This has called the need for an efficient clearing system that will reduce clearing days to 1 irrespective of geographical locations of bank branches within the country. Thus the project aims at modelling cheque processing in search for efficiency.

To model a modified model to achieve efficiency the researcher used data gathering techniques such as document scan, interviews and observation to understand the existing processes from the time a cheque is deposited to the time its cleared or returned. Simulation technique was used to model both the existing and the modified model which was implemented using MATLAB simulation software and hence implementation of computer science concepts.

The modified models allows for image processing by truncating cheques at the branch level thus controlling processing of physical cheques and truncation of cheques when they get to CPC thus eliminating redundancy of capturing images which slow cheque processing. Optical character readers (OCR) also introduced at CPC allows for auto reconciliation of masked amount and code lines unlike before where it was done manually. This is reduced error rate of processed cheque from 12.89% to 4.04% as most the clearing errors previously detected on the second day are worked on at the time of cheque presentation thus an improved measure of efficiency.

Chapter 1: INTRODUCTION

1.01 Background.

Cheques are a type of bill of exchange and were developed as a way to make payments without the need to carry around large amounts of gold and silver. They were initially known as 'drawn notes' as they enabled a customer to draw on the funds they held on account with their banker and required immediate payment. These were hand written and one of the earliest known still to be in existence was drawn on Messrs Morris and Clayton, scriveners and bankers based in the City of London, and dated 16 February 1659.

In 1717 the Bank of England pioneered the first use of a pre-printed form. These forms were printed on 'cheque' paper to prevent fraud and customers had to attend in person and obtain a numbered form from the cashier. Once written the cheque would have to be brought back to the bank for settlement. Although cheques have been around since at least the 9th century, it was during the 20th century that cheques became a highly popular non-cash method for making payments and the usage of cheques peaked. Up until around 1770 an informal exchange of cheques took place between London Banks, clerks of each bank visited all of the other banks to exchange cheques, whilst keeping a tally of balances between them until they settled with each other. Daily cheque clearings began around 1770 when the bank clerks met at the Five Bells, a tavern in Lombard Street in the City of London, to exchange all their cheques in one place and settle the balances in cash. See bankers' clearing house for further historical developments.

In 1811 the Commercial Bank of Scotland is thought to have been the first bank to personalize its customer's cheques, by printing the name of the account holder vertically along the left-hand edge. In 1830 the Bank of England introduced books of 50, 100 or 200 forms and counterparts, bound or stitched. These **cheque books** became a common format for the distribution of cheques to bank customers.

In the late 19th century a number of countries formalized laws around cheques. The UK passing the *Bills of Exchange act* in 1882, India passed the *Negotiable Instruments Act (NI Act)* 1881 which both covered cheques.

As cheque usage increased during the 19th and 20th century's additional items were added to increase security or to make processing easier for the bank or financial institution. A signature of the drawer was required to authorize the cheque and this is the main way to authenticate the cheque. Second it became customary to write the amount in words as well as in numbers to avoid mistakes and make it harder to fraudulently alter the amount after the cheque had been written. It is not a legal requirement to write down the amount in words, although some banks will refuse to accept cheques that do not have the amount in both numbers and words.

An issue date was added, and cheques may not be valid a certain amount of time after issue. In the US a cheque is typically valid for six months after the date of issue, after which it is a *stale-dated cheque,* but this depends on where the cheque is drawn; in Australia this is typically fifteen months. A cheque that has an issue date in the future, a post-dated cheque, may not be able to be presented until that date has passed, writing a post dated cheque may simply be ignored or is illegal in some countries. Conversely, an antedated cheque has an issue date in the past.

A cheque number was added and cheque books were issued so that cheque numbers were sequential. This allowed for some basic fraud detection by banks and made sure one cheque was not presented twice.

In some countries such as the US, cheques contain a memo line where the purpose of the cheque can be indicated as a convenience without affecting the official parts of the cheque. In the United Kingdom this is not available and such notes are sometimes written on the reverse side of the cheque.

A cheque has some common features. Below are the main Parts of a cheque based on a UK example and also the common features of a cheque leaf in Kenya are **payee, date of**

issue, currency type, amount, drawer (the person or entity making the cheque), signature of drawer and **machine readable routing information**. For a cheque to be considered for clearing, there are key features that need to drawn on a cheque are **drawer** (the person or entity who draw the cheque), **payee** (the recipient of the money), **drawee** (the bank or other financial institution where the cheque can be presented for payment) and **amount** that need to be paid.

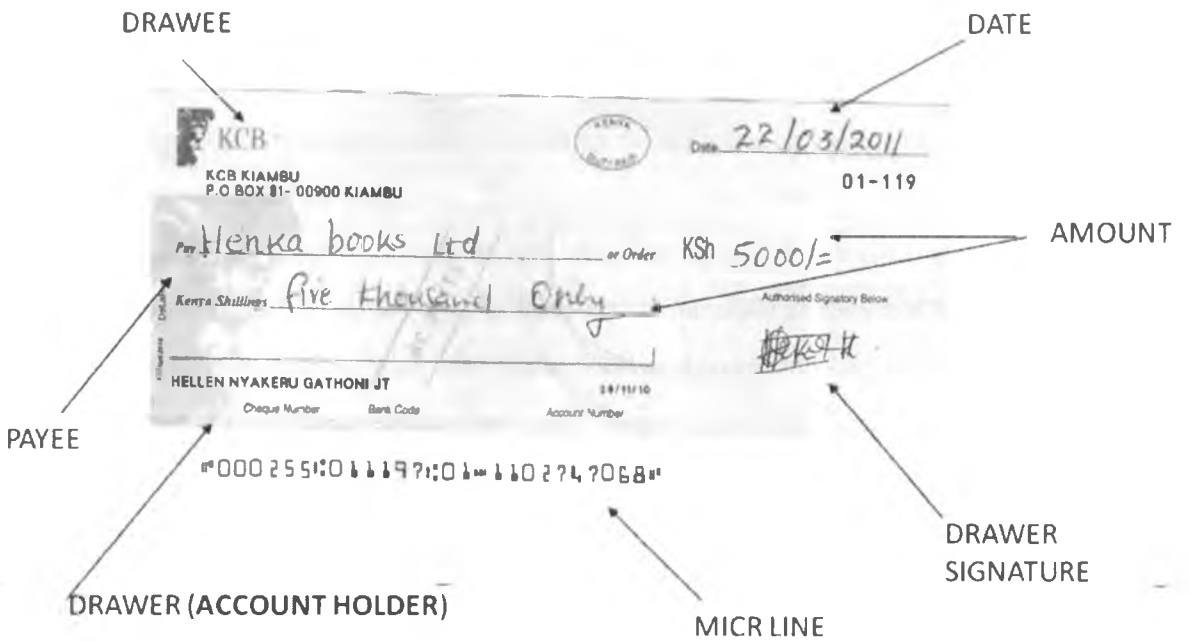


Fig 1. Cheque sample

In 1959 a standard for machine readable characters (MICR) was agreed and patented in the United States for use with cheques. This opened the way for the first automated reader/sorting machines for clearing cheques. The following years saw a dramatic change in the way that cheques were handled and processed as automation increased. Cheque volumes continued to grow, and in the late 20th century cheques became the most popular non-cash method for making payments, with billions of them processed each year. Most countries saw cheque volumes peak in the late 1980s or early 1990s, after which electronic payment methods started to become popular and cheques usage started to decline. Electronic payments such as credit card, Wire transfer (local and

international) have become more competitive in most countries i.e. Such as US, UK but in some countries such as Kenya cheque plays a major role and thus why thus why the study seeks to select Kenya as a study guide on cheque clearing systems.

From the mid 1990s, many countries enacted laws to allow for cheque truncation, in which a physical cheque is converted into electronic form for transmission to the paying bank or clearing house. This eliminates the cumbersome physical presentation and saves time and processing costs.

However, currently in many African countries settlement of cheques is performed by physical presentation of paper-based cheques to the clearing house for transmission to the drawee banks and for payment thereafter. In Kenya 68% of payments is done through cheques, however MICR system was adopted in 1968 as a basis for automation of the clearing process but cheque amount are input manually as they are not encoded. Finally Kenya through central bank and Kenya Banker Association has announced to go the way of cheque truncation by June 2011.

1.02 Problem statement:

Currently cheque clearing model used in many African is ACH (automated clearing house), Kenya being among them. According to a focus group held on 19th march 2011 at KCB leadership Centre in Karen, it was noted that although the clearing process (outward clearing) takes (T+3), T (today) means the date from when a bank clearing centre i.e. for KCB its' CPC receives the cheque. It was also noted that for I.e. banks whose cheque from the branches get to their headquarters the same day upon deposit bby the customer takes at least 3-4 days but for remote branches such as Mandela and Lamu, cheque clearing takes at least 14 working days(Monday to Friday) from the time the customer deposit in the branch.

Cheque truncation is meant to increase efficiency of cheque clearing process. Currently African countries are still lagging behind in cheque clearing process. The research aims

at studying both the ACH (automated clearing house) that is currently in use in Kenya and many African countries and cheque truncation model as well as how RTGS knowledge can be used to reduce the number of clearing days to one. According to a focus group on 19th march 2011 at KCB leadership Centre in Karen, Kenya Bankers Association wish to reduce clearing day from 4 to 2 and 14 to 4 days for remote branches respectively.

Though the process is said to start either in June 2011 (piloting stage), there is need to study both system in order evaluate how turnaround time can be improved and harmonized across the country.

An RTGS (real time gross settlement) is a clearing model that clear amount above value cap (1,000,000) in hours and hence the research aim is to see, using the simulation techniques, how this technology can be incorporated to increase efficiency of cheque clearing models.

1.03 Objective.

- Understudy and document the existing cheque clearing system in order to identify problems in the clearing system.
- Develop conceptual models for:-
    a. Existing cheque clearing systems
    b. Modified version of cheque clearing system
- Develop computer model (simulator) from the conceptual models.
    a. Existing cheque clearing systems
    b. Modified version cheque clearing system (eliminate couriers manual codeline and masked amount correction, no sorting cheque, balanced process- no cheque is sent to clearing house before they balance).
- Run the simulation of the two systems and record outputs

- Analyze the simulation output and compare the results

1.04 Significance of the study.

By implementing cheque truncation the banks will be able to reap the following benefits:

Reduced cost i.e. since in truncation there no movement of physical cheque but rather the image, the banks will no longer require to hire security companies to transport the cheque and hence reduction in transportation cost.

Reduced fraud; - since no movement of physical cheque, then there will no longer be loss of physical cheque while in transit as it was before.

Improved turnaround time:-Customers will be able to get fund cleared within a day unlike in the other system which is (T+3) and 14 for remote branches.

1.05 Limitation.

Cheque clearing system is categorized into four legs namely **outward clearing, inward clearing**, **outward Unpaid** and **inward Unpaid**.

The research projects aims to cover interbank clearing process (outward clearing cheque and outward return cheque). The project also takes Kenya as a model in which to study how clearing house operates. According to a focus group held on 19th march 2011 at KCB leadership Centre in Karen, Kenya Bankers Association (KBA) which is one of the regulatory body that govern banks together with Central Bank of Kenya, the bodies exercise control between interbank's clearing/ settlement. For the 48 bank to clear effects, they are all registered under the body as incase of dispute between banks they normally report to KBA for arbitration.

The key emphasis is on outward clearing because; different banks have different policies of clearing they in-house (inward clearing cheque) i.e. for Standard Chartered in-house

MODELLING CHEQUE PROCESSING SYSTEMS: SEARCH FOR EFFICIENCY

HELLEN NYAKERU GATHONI

RESEARCH SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE MASTERS OF SCIENCE IN COMPUTER SCIENCE AT THE UNIVERSITY OF NAIROBI

AUGUST 2011

DECLARATION

This project, as presented in this report, is my original work and has not been presented for any other institutional award.

Signature: ..... Date .....

GATHONI HELLEN NYAKERU

Reg. No: P58/73335/2009

This project has been submitted as part fulfillment of the requirement for Masters of Science in Computer Science with my approval as the University Supervisor

Signature: ..... Date .....

Mr. Elisha Opiyo

School of Computing & Informatics

ACKNOWLEDGEMENT

I would like to gratefully acknowledge God for the far I have come; it took his grace for all I managed to do. I would also wish to appreciate the people who made this project a success, first my supervisor Mr. Opiyo who really made sure I understood the concepts behind the project and whose guidance made it a success. Thanks a lot Mr. Opiyo and the panelist of the group, God bless.

Secondly I appreciate my family for a helping hand and also encouragement to undertake MSC computer science; it was not an easy Job but I thank God as its all now behind.

Thirdly to my classmate Ronoh, who made sure I had all the materials I need for the class.

Thanks a lot

Contents

LIST OF FIGURE

LIST OF ABBREVIATION

BEJ: - Branch Electronic Journal

CBK: -Central Bank of Kenya.

CPC:--cheques processing centre

CTS: - cheque truncation system.

DMMU: - Domestic Money Market Unit.

EJ: -Electronic Journal.

EOD:- End of Day.

IRD: - Image Returned Document

J: -- Journal / file.

KBA: - Kenya Bankers Association.

MICR: - Magnetic Ink Character Reader.

T-is a clearing term used to refer to today.

RTGS:-Real Time gross Processing

ABSTRACT:

Cheque clearing process takes a long time thus lagging behind the country's economy. This is even worse for cheques collected from Upcountry's and remote areas as clearing takes 10 and 14 days respectively. The existing cheque clearing system takes 4 days for a cheque to clear and 6 days for a dishonoured cheque to get to the presenting branch within the local areas and 15 days to 21 days for upcountry and remote areas respectively. This called for need to adopt cheque truncation that has been implemented in many countries. In Kenya the process will reduce clearing cycle to two from four days taken to process cheque issued in major towns and to 4 days from 10 and 14 days respectively the number of days for clearing upcountry and remote cheques [Kenya Bankers Association (KBA) chief executive Habil Olaka said in an interview]. This has called the need for an efficient clearing system that will reduce clearing days to 1 irrespective of geographical locations of bank branches within the country. Thus the project aims at modelling cheque processing in search for efficiency.

To model a modified model to achieve efficiency the researcher used data gathering techniques such as document scan, interviews and observation to understand the existing processes from the time a cheque is deposited to the time its cleared or returned. Simulation technique was used to model both the existing and the modified model which was implemented using MATLAB simulation software and hence implementation of computer science concepts.

The modified models allows for image processing by truncating cheques at the branch level thus controlling processing of physical cheques and truncation of cheques when they get to CPC thus eliminating redundancy of capturing images which slow cheque processing. Optical character readers (OCR) also introduced at CPC allows for auto reconciliation of masked amount and code lines unlike before where it was done manually. This is reduced error rate of processed cheque from 12.89% to 4.04% as most the clearing errors previously detected on the second day are worked on at the time of cheque presentation thus an improved measure of efficiency.

Chapter 1: INTRODUCTION

1.01 Background.

Cheques are a type of bill of exchange and were developed as a way to make payments without the need to carry around large amounts of gold and silver. They were initially known as 'drawn notes' as they enabled a customer to draw on the funds they held on account with their banker and required immediate payment. These were hand written and one of the earliest known still to be in existence was drawn on Messrs Morris and Clayton, scriveners and bankers based in the City of London, and dated 16 February 1659.

In 1717 the Bank of England pioneered the first use of a pre-printed form. These forms were printed on 'cheque' paper to prevent fraud and customers had to attend in person and obtain a numbered form from the cashier. Once written the cheque would have to be brought back to the bank for settlement. Although cheques have been around since at least the 9th century, it was during the 20th century that cheques became a highly popular non-cash method for making payments and the usage of cheques peaked. Up until around 1770 an informal exchange of cheques took place between London Banks, clerks of each bank visited all of the other banks to exchange cheques, whilst keeping a tally of balances between them until they settled with each other. Daily cheque clearings began around 1770 when the bank clerks met at the Five Bells, a tavern in Lombard Street in the City of London, to exchange all their cheques in one place and settle the balances in cash. See bankers' clearing house for further historical developments.

In 1811 the Commercial Bank of Scotland is thought to have been the first bank to personalize its customer's cheques, by printing the name of the account holder vertically along the left-hand edge. In 1830 the Bank of England introduced books of 50, 100 or 200 forms and counterparts, bound or stitched. These **cheque books** became a common format for the distribution of cheques to bank customers.

In the late 19th century a number of countries formalized laws around cheques. The UK passing the *Bills of Exchange act* in 1882, India passed the *Negotiable Instruments Act (NI Act)* 1881 which both covered cheques.

As cheque usage increased during the 19th and 20th century's additional items were added to increase security or to make processing easier for the bank or financial institution. A signature of the drawer was required to authorize the cheque and this is the main way to authenticate the cheque. Second it became customary to write the amount in words as well as in numbers to avoid mistakes and make it harder to fraudulently alter the amount after the cheque had been written. It is not a legal requirement to write down the amount in words, although some banks will refuse to accept cheques that do not have the amount in both numbers and words.

An issue date was added, and cheques may not be valid a certain amount of time after issue. In the US a cheque is typically valid for six months after the date of issue, after which it is a *stale-dated cheque,* but this depends on where the cheque is drawn; in Australia this is typically fifteen months. A cheque that has an issue date in the future, a post-dated cheque, may not be able to be presented until that date has passed, writing a post dated cheque may simply be ignored or is illegal in some countries. Conversely, an antedated cheque has an issue date in the past.

A cheque number was added and cheque books were issued so that cheque numbers were sequential. This allowed for some basic fraud detection by banks and made sure one cheque was not presented twice.

In some countries such as the US, cheques contain a memo line where the purpose of the cheque can be indicated as a convenience without affecting the official parts of the cheque. In the United Kingdom this is not available and such notes are sometimes written on the reverse side of the cheque.

A cheque has some common features. Below are the main Parts of a cheque based on a UK example and also the common features of a cheque leaf in Kenya are **payee, date of**

issue, currency type, amount, drawer (the person or entity making the cheque), signature of drawer and **machine readable routing information**. For a cheque to be considered for clearing, there are key features that need to drawn on a cheque are **drawer** (the person or entity who draw the cheque), **payee** (the recipient of the money), **drawee** (the bank or other financial institution where the cheque can be presented for payment) and **amount** that need to be paid.

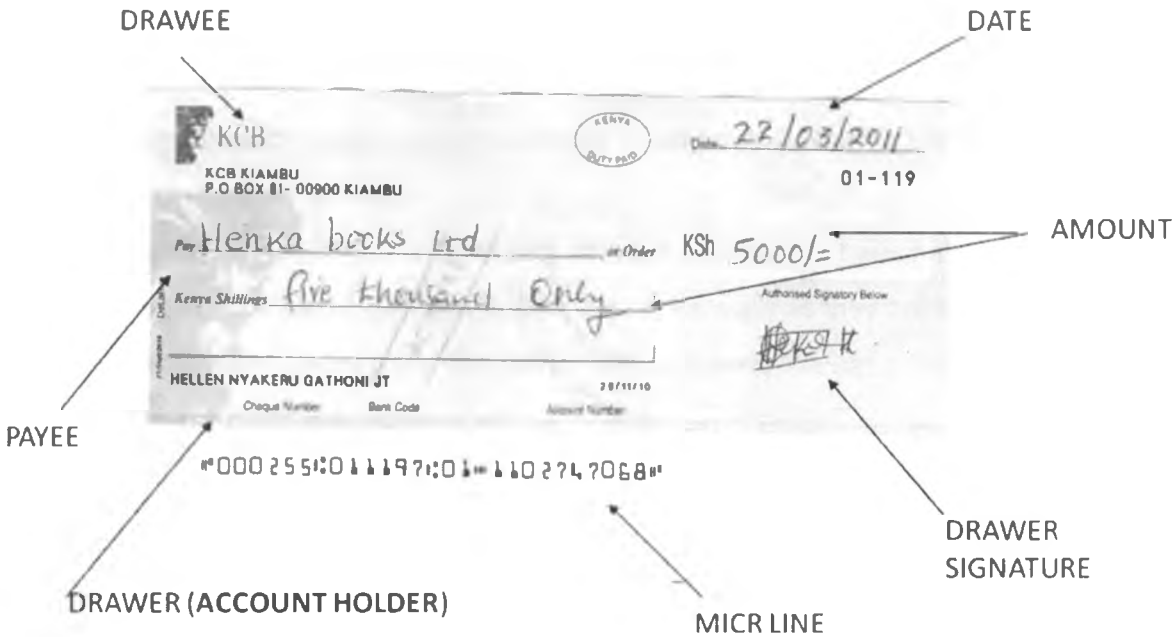


Fig 1. Cheque sample

In 1959 a standard for machine readable characters (MICR) was agreed and patented in the United States for use with cheques. This opened the way for the first automated reader/sorting machines for clearing cheques. The following years saw a dramatic change in the way that cheques were handled and processed as automation increased. Cheque volumes continued to grow, and in the late 20th century cheques became the most popular non-cash method for making payments, with billions of them processed each year. Most countries saw cheque volumes peak in the late 1980s or early 1990s, after which electronic payment methods started to become popular and cheques usage started to decline. Electronic payments such as credit card, Wire transfer (local and

international) have become more competitive in most countries i.e. Such as US, UK but in some countries such as Kenya cheque plays a major role and thus why thus why the study seeks to select Kenya as a study guide on cheque clearing systems.

From the mid 1990s, many countries enacted laws to allow for cheque truncation, in which a physical cheque is converted into electronic form for transmission to the paying bank or clearing house. This eliminates the cumbersome physical presentation and saves time and processing costs.

However, currently in many African countries settlement of cheques is performed by physical presentation of paper-based cheques to the clearing house for transmission to the drawee banks and for payment thereafter. In Kenya 68% of payments is done through cheques, however MICR system was adopted in 1968 as a basis for automation of the clearing process but cheque amount are input manually as they are not encoded. Finally Kenya through central bank and Kenya Banker Association has announced to go the way of cheque truncation by June 2011.

1.02 Problem statement:

Currently cheque clearing model used in many African is ACH (automated clearing house), Kenya being among them. According to a focus group held on 19th march 2011 at KCB leadership Centre in Karen, it was noted that although the clearing process (outward clearing) takes (T+3), T (today) means the date from when a bank clearing centre i.e. for KCB its' CPC receives the cheque. It was also noted that for I.e. banks whose cheque from the branches get to their headquarters the same day upon deposit bby the customer takes at least 3-4 days but for remote branches such as Mandela and Lamu, cheque clearing takes at least 14 working days(Monday to Friday) from the time the customer deposit in the branch.

Cheque truncation is meant to increase efficiency of cheque clearing process. Currently African countries are still lagging behind in cheque clearing process. The research aims

at studying both the ACH (automated clearing house) that is currently in use in Kenya and many African countries and cheque truncation model as well as how RTGS knowledge can be used to reduce the number of clearing days to one. According to a focus group on 19th march 2011 at KCB leadership Centre in Karen, Kenya Bankers Association wish to reduce clearing day from 4 to 2 and 14 to 4 days for remote branches respectively.

Though the process is said to start either in June 2011 (piloting stage), there is need to study both system in order evaluate how turnaround time can be improved and harmonized across the country.

An RTGS (real time gross settlement) is a clearing model that clear amount above value cap (1,000,000) in hours and hence the research aim is to see, using the simulation techniques, how this technology can be incorporated to increase efficiency of cheque clearing models.

1.03 Objective.

- Understudy and document the existing cheque clearing system in order to identify problems in the clearing system.
- Develop conceptual models for:-
    a. Existing cheque clearing systems
    b. Modified version of cheque clearing system
- Develop computer model (simulator) from the conceptual models.
    a. Existing cheque clearing systems
    b. Modified version cheque clearing system (eliminate couriers manual codeline and masked amount correction, no sorting cheque, balanced process- no cheque is sent to clearing house before they balance).
- Run the simulation of the two systems and record outputs

- Analyze the simulation output and compare the results

1.04 Significance of the study.

By implementing cheque truncation the banks will be able to reap the following benefits:

Reduced cost i.e. since in truncation there no movement of physical cheque but rather the image, the banks will no longer require to hire security companies to transport the cheque and hence reduction in transportation cost.

Reduced fraud; - since no movement of physical cheque, then there will no longer be loss of physical cheque while in transit as it was before.

Improved turnaround time:-Customers will be able to get fund cleared within a day unlike in the other system which is (T+3) and 14 for remote branches.

1.05 Limitation.

Cheque clearing system is categorized into four legs namely **outward clearing, inward clearing**, **outward Unpaid** and **inward Unpaid**.

The research projects aims to cover interbank clearing process (outward clearing cheque and outward return cheque). The project also takes Kenya as a model in which to study how clearing house operates. According to a focus group held on 19th march 2011 at KCB leadership Centre in Karen, Kenya Bankers Association (KBA) which is one of the regulatory body that govern banks together with Central Bank of Kenya, the bodies exercise control between interbank's clearing/ settlement. For the 48 bank to clear effects, they are all registered under the body as incase of dispute between banks they normally report to KBA for arbitration.

The key emphasis is on outward clearing because; different banks have different policies of clearing they in-house (inward clearing cheque) i.e. for Standard Chartered in-house

within Nairobi, clearing effect is on the same day, while remote branches is (T+2) days, for KCB branches that cheques are transported to CPC (central processing centre) effect is within at least two days (T+2), while remote branches it's a day.

Though the project covers cheque truncation system, it does not cover the security aspect i.e. encrypting and decrypting among other data exchange security.

There will be no changes in the clearing process for foreign cheques drawn in offshore banks (i.e. out of Kenya) as they are normally forwarded for collection in the country they were drawn.

1.06 Summary.

Cheques are a type of bill of exchange and were developed as a way to make payments without the need to carry around large amounts of gold and silver. Bank of England pioneered the first use of a pre-printed form of a cheque in 1717.Up until around 1770 an informal exchange of cheques took place between London Banks; clerks of each bank visited all of the other banks to exchange cheques, whilst keeping a tally of balances between them until they settled with each other. In 1811 the Commercial Bank of Scotland is thought to have been the first bank to personalize its customer's cheques, by printing the name of the account holder vertically along the left-hand edge. In the late 19th century a number of countries formalized laws around cheques. The UK passing the *Bills of Exchange act* in 1882, India passed the *Negotiable Instruments Act (NI Act)* 1881 which both covered cheques. In 1959 a standard for machine readable characters (MICR) was agreed and patented in the United States for use with cheques which opened way automated cheques clearing system. From the mid 1990s, many countries enacted laws to allow for cheque truncation, in which a physical cheque is converted into electronic form for transmission to the paying bank or clearing house. Cheque clearing system is categorized into four legs: - inward clearing cheques, outward clearing cheques, inward return cheque and outward return cheque.

CHAPTER 2: LITERATURE REVIEW

2.0 CHEQUE SETTELEMENT SYSTEM.

2.01 INTRODUCTION

Although cheques have been around since at least the 9th century, it was during the 20th century that cheques became a highly popular non-cash method for making payments and the usage of cheques peaked. Up until around 1770 an informal exchange of cheques took place between London Banks, clerks of each bank visited all of the other banks to exchange cheques, whilst keeping a tally of balances between them until they settled with each other, the clearing cycle took a long time.

Originally this was done by taking the cheque in person to the drawee bank, however as cheque usage increased this became cumbersome and banks arranged between each other to meet each day at a central location to exchange cheques and settle the money. This became known as central clearing.

Daily cheque clearings began around 1770 when the bank clerks met at the Five Bells, a tavern in Lombard Street in the City of London, to exchange all their cheques in one place and settle the balances in cash. About 30 clerks from the several London bankers take their stations, in alphabetical order, at desks placed round the room while other clerks working for the Inspector would examine the paper trail of documents so that the numerical errors could be found and corrected. See bankers' clearing house for further historical developments.

In countries such as Kenya in the early 90s, cheques were listed on hand operated machines and reconciled manually.

In 1959 a standard for machine readable characters (MICR) was agreed and patented in the United States for use with cheques. This opened the way for the first automated reader/sorting machines for clearing cheques. The following years saw a dramatic change in the way that cheques were handled and processed as automation increased. Cheque volumes continued to grow, and in the late 20th century cheques became the

most popular non-cash method for making payments, with billions of them processed each year. This reduced the clearing cycle

From the mid 1990s, many countries enacted laws to allow for cheque truncation, in which a physical cheque is converted into electronic form for transmission to the paying bank or clearing house. This eliminates the cumbersome physical presentation and saves time and processing costs.

New Zealand was one of the first countries to introduce truncation and imaging of cheques, when in 1995 they amended the cheque act 1960 to provide for the electronic presentment of cheques. A number of other countries followed over the next few years, but progress was mixed due to the decline in the use of cheques in favor of electronic payment systems. Some countries decided that the effort to implement truncation could not be justified for a declining payment method and instead phased out the use of cheques altogether. In 2004, the Check 21 Act was implemented in the United States to authorize conversion of the original paper check into an electronic image for presentment through the clearing process.

Most African countries are still lagging behind in technology in the 21st century i.e. this is well demonstrated in Kenya where the MICR technology was adopted in 1998 as a way of automating cheque clearing process(the process is not fully automated as some banks processing is still done manually) and hence an Automated clearing house. It is in the year 2008 that Kenya through Kenya Bankers association started to invest in 2008, but in its now 2011 that the country is preparing for the pilot stage to start in may and for the Go live date is June 2011. Below is a diagram that will help in demonstrating cheque clearing process.

2.02 MANUAL/SEMI AUTOMATED /MICR CHEQUE CLEARING.

To illustrate the process, the researcher takes two banks namely **A** (Kenya commercial Bank) and **B** (Equity Bank).

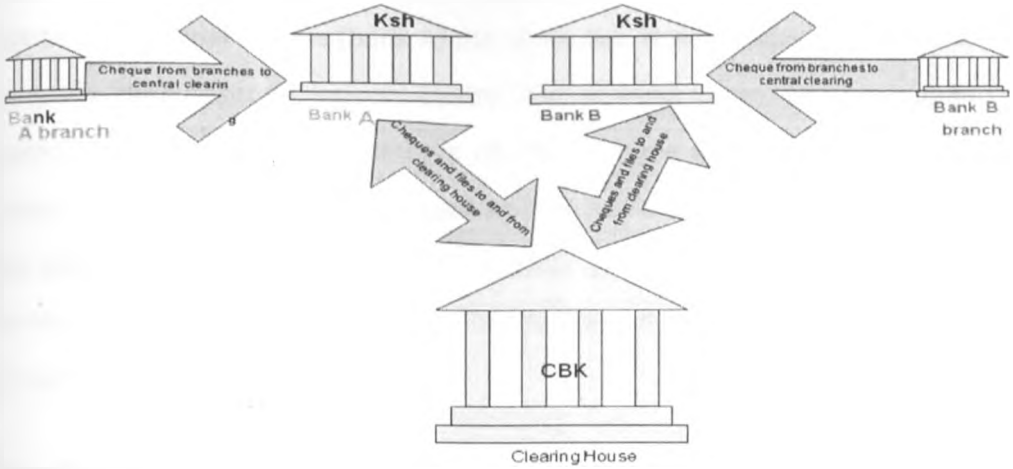


Figure 2. MICR clearing model

Outward cheque clearing process involves the following:-

Step 1:

Deposit of cheque by customer (at the branch level)

The research focuses more on Bank A for clear demonstration on the clearing cycle. The process begins when a customer deposits a cheque at his/her branch (any branch for i.e. bank A). At start of business each branch manager/operation manager in bank A issues its teller with a bag both physically and in the bank core banking system. The teller receives the bag in the system in order to be able to deposit cheques from the customer at the start of business. Toward close of business, the teller(s), prints a report and ticks the cheque against confirming that all the physical cheques have been captured in the system, puts the cheque in the bag, carefully seals it and return the bag to the person who issued it physically and in the system. This cheque with all the other cheques deposited at the branch, are bundled together and couriered to a regional centre (***Bank A***). The branch (s) prepare an electronic journal (a file containing the MICR, date,

amount, payee account) and sends it's electronically to regional centre (***bank A***). In these regional centers that out-clearing is carried out. This marks the day zero which is referred as (T) in cheque clearing models.

Clearing centre:-some branches are in remote area and so the couriered cheque don't get to the regional centers (bank A) the same day. Note clearing days start to count the time the cheque get to regional centre (T). For small banks, process is manual. Most banks which receive large numbers of cheque have invested in technology that will make the process more efficient such as the Canon CR180 scanner (***scans 180 cheques per minutes***). Below is a canon CR180 scanner.

For banks that receive large number of cheque and has invested in technology such as CR180, the following takes place:-

Day T (0)

Electronically reading the sort code account number and cheque number from the bottom of the cheque using Magnetic Ink Recognition (MICR) technology or ICR Technology (UNISYS QUANTUM reader sorter that process 600 document per minute), of the cheque couriered from branch. The process is as follows:-

Comparison of BEJ, with the data collected from EJ (Electronic journal), an EJ is collected from the cannon CR180 scanner, which is connected to administrator's machine who distributes the work from the machine to his officers. The process is repeated for all the branches. This process ensures that both the EJ and BEJ tally; else in case of discrepancy it is reported to the receiving branch as a clearing difference.

Once the officers are done with the process above, the cheque are all run through the machine again, the purpose is to capture cheque image both front and the rear side of the cheque.

The cheques are run again on the scanner; they are electronically sorted into piles corresponding to each clearing bank (using the sort codes read to identify the clearing bank on the MICR line). Thus at the end of the process there should be a pile for the 42

banks i.e. Barclays, Giro, Transnational bank, Equity, KCB, and so on. This pile are bundled and packed to be couriered to clearing house the following day (T+1).

From the electronically read amount information and the electronic code line information electronic files of cheque payment records are created for each clearing bank. These are called IBDE (Inter Bank Data Exchange) files in UK, in Kenya it's referred as J (journal) or EJ (Electronic Journal). In Kenya the day is stored in diskettes for each bank code.

The cheque images of the cheques that belong to bank A (Kenya Commercial Bank) are distributed to the bank A officers for further process (crediting the right/indicated accounts and technical validation. Note day zero process takes place at night.

DAY (T+1):

Exchange: At around 9:00am, authorized officer of bank A, carry bundles of cheques in very big brief case that combinations (security locks) and diskettes to clearing house. There they meet with officers from all other banks, in Kenya 42 banks are represented (in our example above we take bank B). The banks exchange diskettes containing electronic information corresponding to each bank as well as the physical cheque.

At around 11:00am, the banks are done with step 1 and a tally is done, i.e. In Kenya, the total amount of all cheque drawn from i.e. Barclays is put on the table for each of the 42 banks. Note all banks hold current accounts in clearing house (Central bank) and this account are not allowed to go into debit at any particular point. Therefore the each banks treasury keeps count of the entire process.

At the end of the process, Bank A gives Bank B all the physical cheque and a diskette containing electronic information for all the cheque that were drawn on Bank B, Bank B all hands over the same to Bank B.

Each banks leaves clearing house to its regional centre. The cheques received from Bank B are run again on the scanner which captures the image, the MICR details as well as the amount and the date. Actually DAY 0 processes are repeated. The only difference is that:

Sorting of cheque is done per branch and account number order for potential retrieval in case of queries/returns, Sorting is also done to remove cheque that have been dishonored by the administrators because of errors such as, amount in figure in Bank A EJ differs with EJ from bank B. The scanner also indicates the reason why the cheque was returned. These cheques are bundled to be returned to clearing house the following day. The administrator does this by running the cheque (in the cheque clearing system i.e. SYBRIN system) against the bank core system (i.e. T24 for KCB) in order to debit accounts captured in the MICR line. Synchronization of the two systems takes place over night.

DAY (T+2)

Pay/No Pay

Clearing Bank B now spends a considerable part of day T+2 deciding whether to pay or not the cheques that have been drawn on its customers' accounts. These decisions are a mixture of computer based and human based decisions. They fall into two categories.

Account Related:–the process is conducted by Clearing call back centre.

The operators check if the account has insufficient funds to cover the amount of the cheque the overnight accounting will highlight the account as being in excess. Credit assessment systems then kick in on the account and for many customers will decide whether to honor the cheque or bounce it (in all cases the bank will charge fees but some accounts may be deemed credit worthy by the computer and hence allowed to go overdrawn). For some classes of customer such as large corporate or high net worth individuals where the customer relationship is very important banking officers will make the decision to pay or not. Other account based reasons for returning the cheque might be that the account has been closed or the customer has deceased.

Cheque Related: - technical verification department verifies technical issues related to cheques. There are also a range of Fraud and Technical reasons why the cheque should

be returned. Banks run a number of tests such as testing the cheques are on special bank issued paper or that the signature on the cheque is a good match with their record of the customer's signature to ensure the cheque is bona fide. They also run "profiling" tests which use statistical techniques to highlight unusual payments (e.g. unusually large, unusually frequent, etc.) to seek out potential frauds. Customers can ask to have cheques stopped so the bank runs a comparison of cheques to be processed against lists of stopped cheques with a view to returning such items that match. They also test to ensure words and figures match and that the date on the cheque is okay. If they discover problems with any of this they can return the cheque unpaid.

Unpaid out

Clearing Bank B, towards the end of T+2, having decided that the cheque paid to customer to be returned, has to physically locate it among the thousands of cheques processed. A sorting process takes place creating piles of unpaid cheques, one for each of the other banks. These piles are then couriered to **clearing house** to be returned to the other clearing banks.

Therefore bank A, receives its unpaid cheques and vice versa.

Day (T+3)

Clearing Bank A reads the code line of the returned cheques and uses the sort code, account number and cheque numbers as a key to identify the account that received the credit for the cheque amount. Once identified, the account is debited on the night of T+3 for the amount of the cheque, thus reversing the credit posted a few days earlier.

During day (T+3), if no credit is reversed overnight the customer can withdraw money from his account the following day else bank A dispatches the Cheque based on the mother branch(the branch where the customer opened his account so as the unpaid cheque can be given back to the customer upon proper identification. The diagram below demonstrates the entire process.

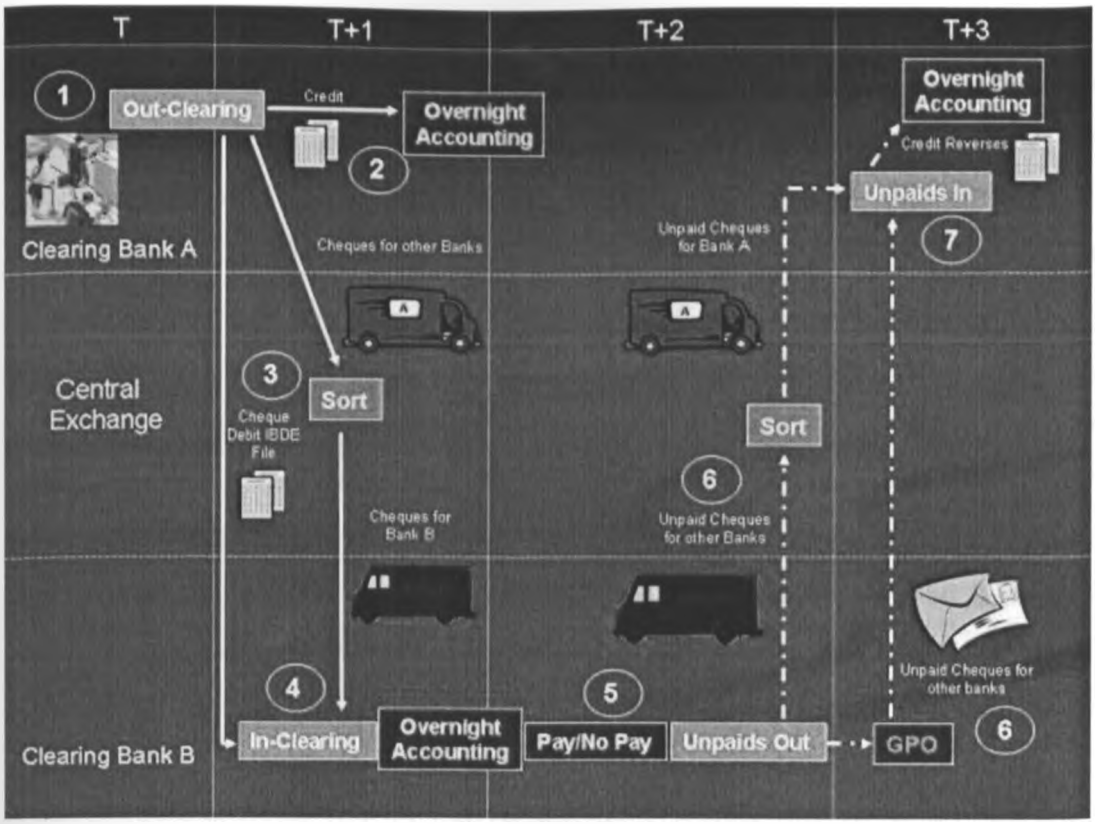


Fig 3. Manual cheque clearing cycle [http://www.howbankswork.com/15.1.html]

For small branches that don't have not invested technologies such as cannon CR180 machines, process that are done in day0 to day3 by scanners is done manually. The difference in the level of technology serves as a clear challenge in the clearing system in that some banks are semi automated while others are still manual and has served as a hindrance to growth in the clearing sector.

2.03 CHEQUE TRUNCATION.

The process in which cheque details are captured by the payee bank (or its clearing agent) and electronically presented in an agreed format to the drawee bank (the bank on which it was drawn) for payment. Settlement in this model is made on the basis of MICR information.

Day (T) 0

Just like in model A, there a start of business and close of business. At start of business, the system is opened and the tellers are now authorized to receive cheque from customers. The process begins when a customer take the cheque for depositing.

The process that was handled by technical department in DAY (T+2), is handled by the teller at the point of receiving the cheque from the customer. The teller or point of deposit has the duty to verify / Perform Technicality checks on the cheques presented by the customers such as date, amount, (words and figures tally), signature is present, watermarks (for Kenya we have Kenya Bankers Association watermark. Water marks and other security features are visible under UV Light), no endorsements, crossings or alterations or cancellation on the face of the cheque, stamping of the cheques on receipt in the designated areas on the REAR, the instrument is not an obvious counterfeit; e.g. the code-line, although visually present, does not exhibit the appropriate magnetic qualities and that the Physical Security features set out as basic minimums in these standards are met by the cheque before acceptance.

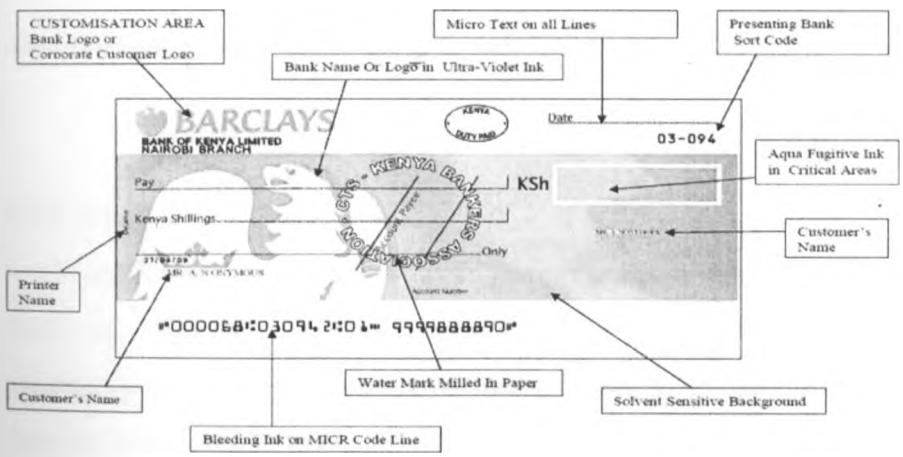


Fig . Security features of a cheque [www.kcbbankgroup.co.ke]

The teller post the cheque in the system and at the click of commit button, the image is sent to the bank database server. Note once the image has been captured cannot be recaptured again. At EOD (end of day), each Teller hands over the days processed

cheques to a Supervisor who confirms physical items against journal prior to archiving, for ease of retrieval in case of need. The physical cheques will be archived at the branch of receipt for a stipulated time before they are moved for central achieve. Note in, Kenya it will reduce clearing cycle to two from four days taken to process cheque issued in major towns and to four days from 10 the number of days for clearing upcountry and remote cheques [Kenya Bankers Association (KBA) chief executive Habil Olaka said in an interview].

At cutoff time, the officer in charge of the image database closes the server and tellers are not able to receive more cheques until the next day. The clearing centre for each bank i.e. Bank A in our model above, have a duty to sort the images corresponding to each bank code and generate a file/journal (the file contain all the information relating to each cheque such as the (account to be debited, paying bank, date and amount). Therefore, banks officers will be expected to late night unlike before where they spent the whole night in the banks. The reason for working late will be to prepare for settlement the following morning, reconcile cheque information captured in the branch i.e. ensure that cheque amount captured by the tellers tally with what is in the image, if not a clearing difference is highlighted and sent back to the branches to collect.

DAY (T+1).

The central clearing centre also has an image database server where all the participating banks are expected to send their images and files corresponding to each bank for clearing. Unlike in the system above (manual system), bank officials will no longer, go to clearing house/centre but will send their file and image to the server which will be opened at a particular time i.e. 9:00am to allow participating banks to send their files.

Central clearing centre does the settlement and prepare settlement figures for each bank, they again send a settlement certificate, debits and credits to each bank accordingly. In return, it again open the system for each bank to receive its file (all cheque images drawn on the paying bank i.e. ***bank B*** in our model above).

Upon receiving the images, the paying bank reconciles the image and the journal (generated file from receiving bank) to ensure the following:-

All the images tally with the number of image information (MICR, date and amount for each image) in the journal. If there is there happens to be a discrepancy in the two, i.e. there is an image with no information and vice versa, then it's dishonored and the image is stored to be returned to clearing centre the following day.

The amount in the image information differs with what is in the image; the cheque is prepared to be returned to paying bank.

The image does not have a signature.

Verification of Digital signatures accompanying each image files to ensure authenticity from the time of delivery from the collecting bank. Where an image fails the digital signature verification, the paying bank should unpay the item and request that the collecting bank produce an image and a digital signature that passes the verification tests.

After doing the above reconciliation, the official runs the cheque clearing system alongside the bank core system, this is to debit all the account highlighted in the journal. However, the process is not instant and synchronization of the two systems happens at night.

Day (T+2).

PAY or NO PAY:

This decision in the manual system was based on technical aspects of the physical cheque or account related information of the account being debited. In cheque truncation, since the technical aspect is done at the point of receiving i.e. by the tellers what is left is now the account related information such as where the customers specimen signature in his/her account differs with what is in the image, in cases where

the payee account number and account name differs with what is in the image and Insufficient fund

In case the image is dishonored it will be prepared to be returned to the receiving bank. All unpaid items images are returned together with their digital signatures and attach a reason for return to the collecting bank.

Image Return Document (IRD) Sample

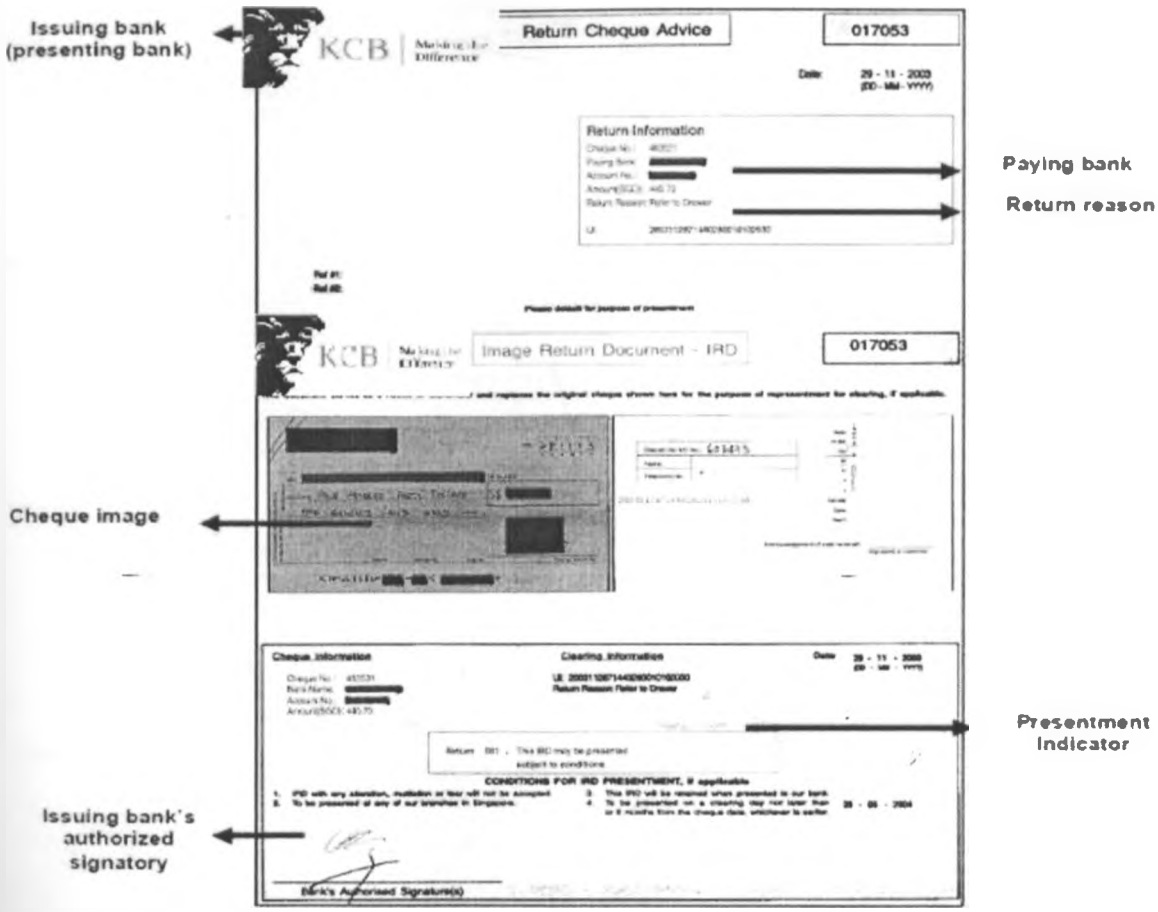


Fig 5. Sample of Image Returned Document [www.kcbbankgroup.co.ke]

On receiving the unpaid cheque the receiving banks send the IRD (image returned document for collection.

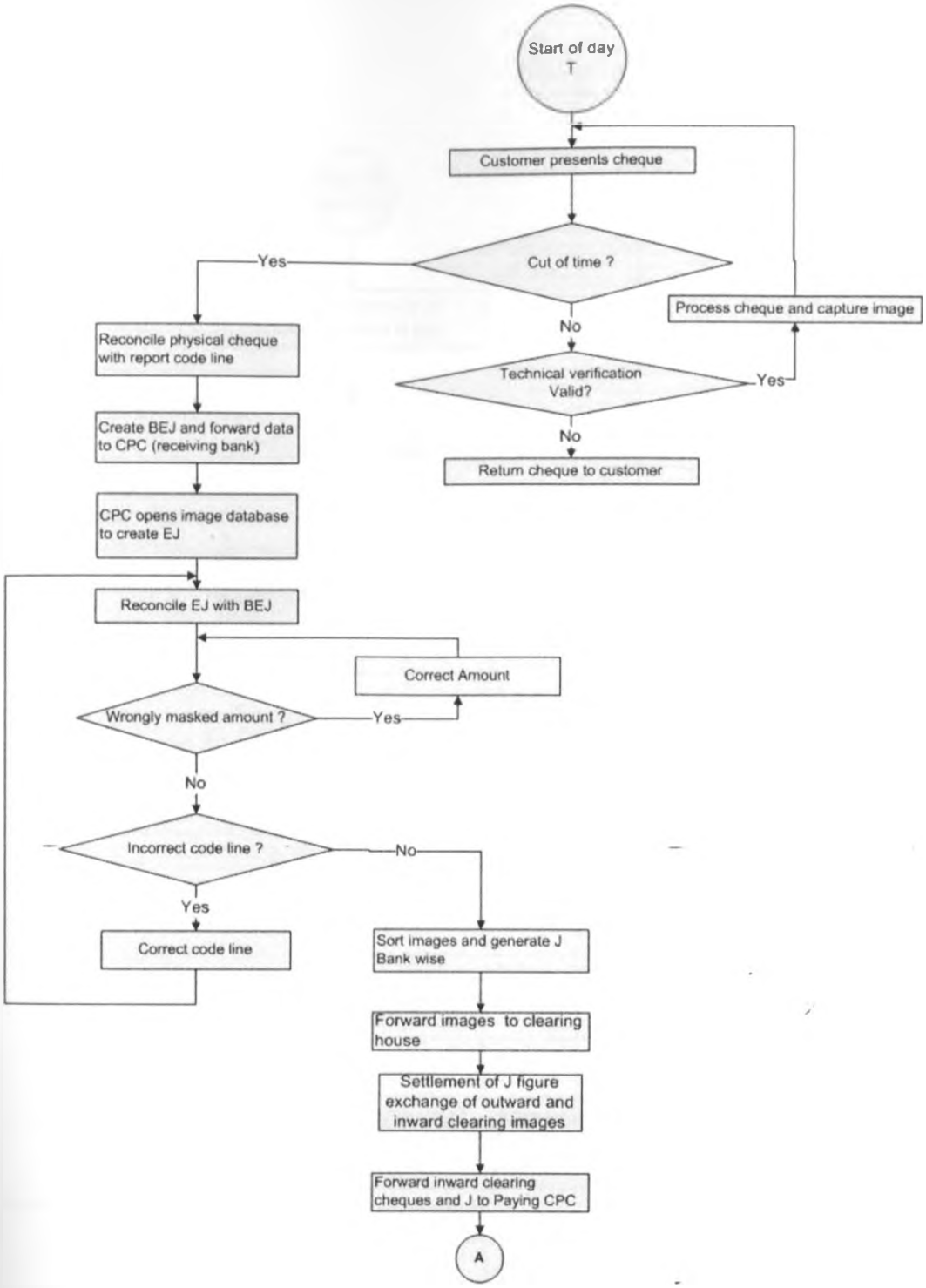


Fig 6 a .CTC logic flow diagram

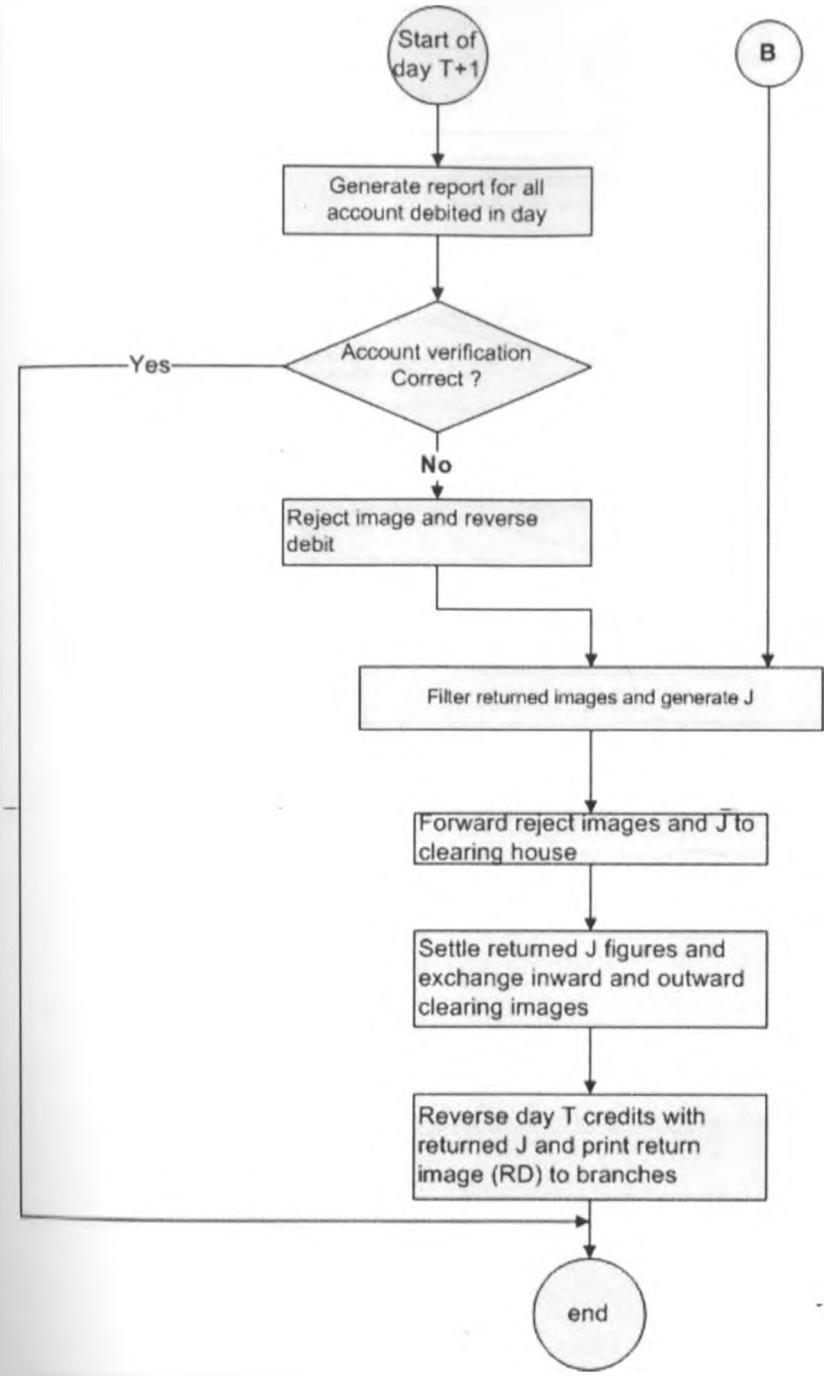


Fig 6 a. manual cheque clearing flow chart

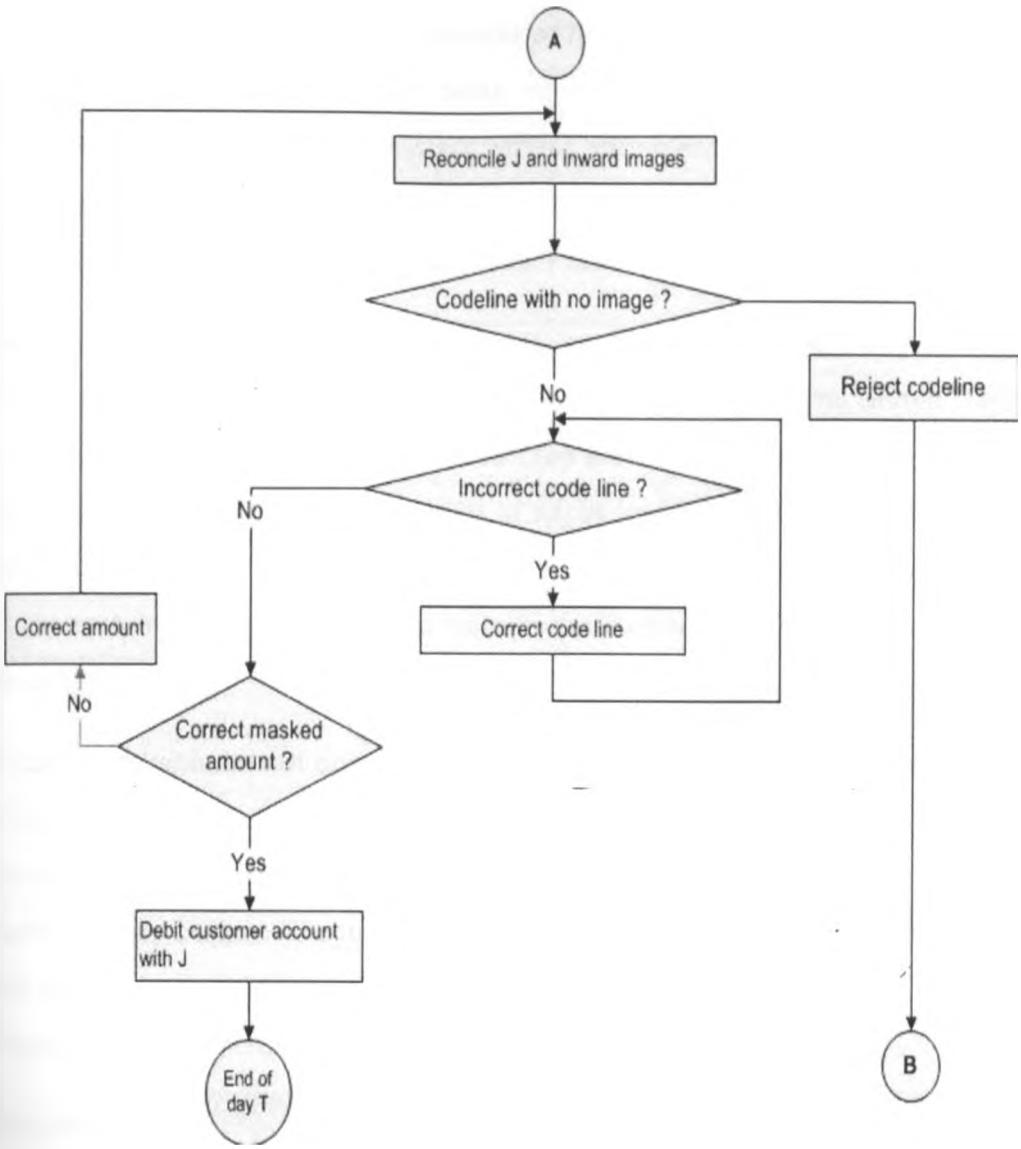


Fig6 c.CTC logic flow diagram

2.04 REAL TIME GROSS PROCESSING RTGS:

Real time gross settlement refer to transfer of funds between banks, every transaction is completed individually rather than being combined with others hence the term gross. Unlike the other cheque clearing system, where settlement is made on a single amount of all the cheque that have been received in the bank (net settlement), RTGS transactions are processed and finished as they are received in the paying bank.

RTGS were introduced for high value low volume transactions; the process is fast and efficient. Different countries use different names for the same i.e. The United States has a real time gross settlement scheme named ***Fed wire*** and Canadian equivalent is, ***LVTS***. RTGS were introduced in the year 2009 in Kenya and were meant for value capping (processing of cheques worth more than a million), as time went by customers realized that the system is more efficient and majority resulted to using the same to transfer as little as KSH. 50,000.

For customers who did not operate account that didn't have cheque books, they could not issue cheque to their customers but rather went to their bank, withdrew money and deposit it in their clients account, for transaction that involved a lot of money then they bought bankers cheque (cheques bought from their banks by debitIng their account) which also go to clearing house. With introduction of RTGS both customers who operate saving accounts and accounts with cheque books they are able to transact.

RTGS process:

The process starts when customers go to their bank and ask for an RTGS form. Unlike in cheque processing when the payee deposits a cheque in his count, the drawer request his bank to remit money to the payee (beneficiary) who hold an account. The drawer/ customer provide his bank with the following:-his account number and the amount to

be remitted, name of the beneficiary customer and his bank and beneficiary's account number and sender to receiver information, if any (payment reason).

For most corporate customers, they send letters containing the above information which is used to remit funds.

Upon receiving customer's instruction, the remitting bank confirms the following before the customer leaves the bank whether the customer has sufficient fund for the transaction in the customer account and that the signature in the customers letter (for corporate customers) or on the RTGS form is similar to the specimen signature in the customer's account.

After confirmation of the above, some customers may choose to wait for the deal slip or collect it later. The teller inserts the swift code for the receiving bank (from a list of bank codes provided by central bank) which is unique for each bank and post the transaction in the system quoting the information that was provided by the drawer/customer.

The teller commits the transaction and forwards it to his supervisor for further verification and transfer of fund. If satisfied, authorize the transaction which goes to the bank head office for remitting to central bank where all banks hold account else he returns the transaction to the teller for re work.

Bank A head office/clearing house confirms they have enough funds for the transaction with central bank. Note, there no exchange of physical cash between banks. The work of central bank is to facilitate transfer of funds between account held between banks and also ensure that this account do not overdraw just like in net settlement of manual and cheque truncation system. Therefore central bank debits the remitting bank (***bank A***) and credits the receiving bank (***bank B***).

Upon receiving the funds, bank B credits the beneficiary customer, if for any reason, the beneficiary's account cannot be credited, the receiving bank have to return the money in 2 hours and the reverse transactions take place. The timings for RTGS

transactions at RBI(reserve bank o India) is from 9.00 am to 3.00 pm on week days and from 9.00 am to 12 noon on Saturdays while for Kenya its between i.e. start of business i.e.8:30 to 9:00am depending on the time the banks open to 2:00pm, RTGS transactions are not handled on Saturdays.

From the above systems it's important to point out that for payments to be done a customer who holds account in different bank from the drawers' bank the key important factors that need to be worked on is drawers signature and sufficiency of fund for settlement to take place. The research aim to improve the system by using knowledge derived from systems such as RTGS to develop an efficient cheque system (reduced cheque clearing cycle) using simulation techniques.

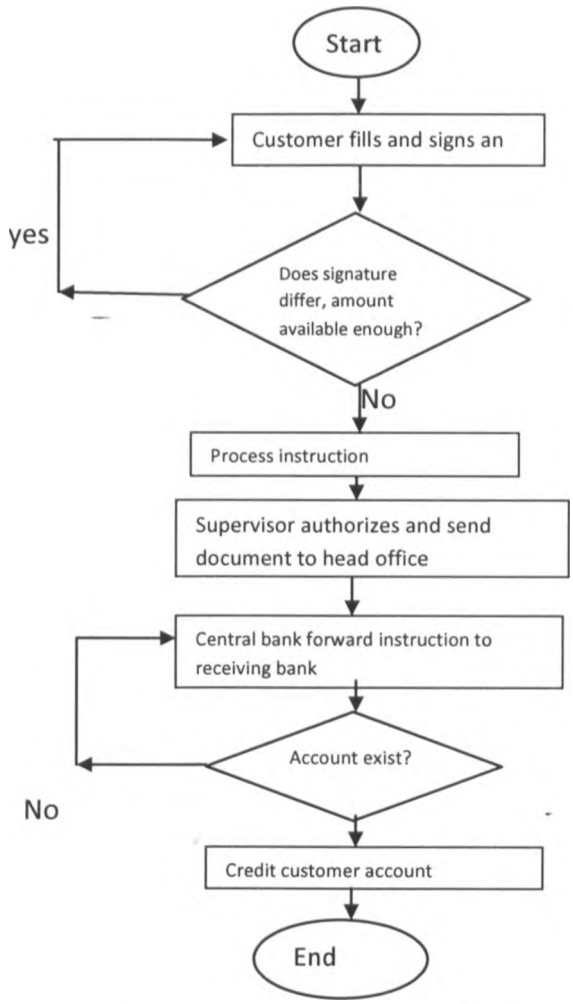


Fig 7. RTGS Logic flow diagram

2.05 SIMULATION:

Simulation is the experimentation with a simplified imitation (on a computer) of an operations system as it progress through time, for the purpose of better understanding and/ or improving that system [Robinson Stewart, 2004]. There are key elements in simulation i.e. modeling the progress of time and modeling variability. The purpose of simulating system it know whether there are viable of not, it also help to make decisions in future and also improve the system. Simulation process enable the researcher to model a system that can be tested and if viable develop a system that meets the stipulated requirements.

Key modeling processes in simulation studies

Most of model frameworks are similar except for some differences in naming process and the number of sub-process into which they are split. Consider the outline of simulation process below [Landry et al, 1983]

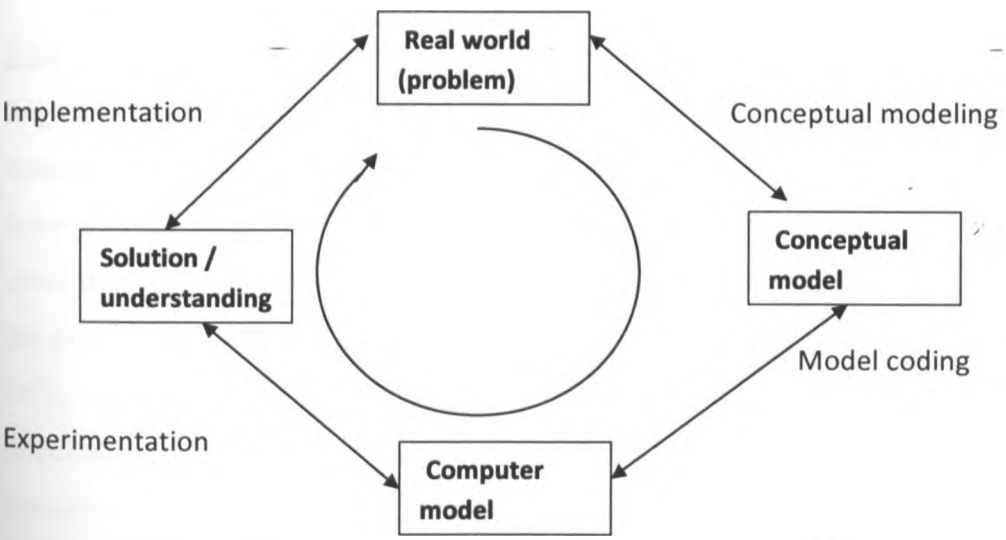


Fig 8: Simulation studies: key stages and processes. (Brooks, R.J and Robinson, S., Simulation 2000, Palgrave Macmillan) [Robinson, pg. 52].

Conceptual model: it's a description of the model that is to be developed.

Computer model: this is a conceptual model (simulation) model implemented on a computer.

Solution and/ or understanding: are lessons that are inferred from the results of experimentation.

Improvement in the real world: are gain that are obtained from implementing the solutions and/ or understanding that is gained.

Today there are several simulation software and there no need to start from scratch. In simulation test data is used to study the performance of the system. Analysis is made based on the result and recommendations made.

The purpose of simulating cheque processing system to gain an understanding on how the different systems operate and also improve cheque clearing system i.e. reduce the clearing cycle from the anticipated two days to one and at least two days for upcountry and remote areas.

2.06 CHAPTER SUMMARY

Originally cheque clearing was done by taking the cheque in person to the drawee bank, however as cheque usage increased this became cumbersome and banks arranged between each other to meet each day at a central location to exchange cheques and settle the money. This became known as central clearing. Introduction of MICR enhanced the process and based on the level of technology some banks automated their process while other remained manual. Cheque truncation is process of image other than the physical document and the process is fast as compared to automated or manual system. Simulation involved developing model to understand a system and knowledge obtained used to improve existing system and also help to make future decision.

Chapter 3 : METHODOLOGY

1.01 COLLECTION AND INSTRUMENTS

Data collection was done using various data gathering techniques listed as follow:

Interview:-The researcher held interview session with the Project manager of cheque truncation system Mr. Fidelis of KBA and also with Mr. Munyei head of CPC Kenya commercial bank. The aim was to understand the steps taken in the banking sector and also understand the type of research the country has made in regard to cheque processing as seen in the appendix

Documentation:-The researcher did a document scan of various journals as attached in the appendices; this was done to facilitate understanding of cheque clearing systems in other countries and also learn what has made the process more effective and fast as compared to Kenya.

Observation:-During the research the researcher was involved mostly in manual cheque processing at Kenya Commercial bank CPC which served as both receiving and paying bank. This activities were mainly capturing of images and sorting of images at branches and also at CPC, generating and reconciling Journal), correcting incorrect code lines and wrongly masked amount, debiting of accounts at, technical verification of cheques, account details reconciliation as well as processing returned cheques and printing return code on the cheques at paying CPC.

3.02 SIMULATION.

The researcher developed conceptual model for the existing and modified model. This was achieved through data gathering techniques such as interviews, documentation and interviews.

The researcher developed conceptual models for the various cheques processing model namely the RTGS, Semi automated cheque processing (MICR cheque processing) and the proposed cheque processing system (Enhanced cheque processing system)

The conceptual model was developed in computer system through model coding. The simulator (computer model) was developed using Matlab simulation software.

The researcher developed computer models for Legacy system and the enhanced cheque processing model. The legacy system will run parallel to the enhanced cheque clearing system, with the aim of comparing performance. Due to minimized redundancy the enhanced cheque clearing system is expected to have increased turnaround time. The researcher obtained test data by scanning processing logs of the legacy system in order to be able to formulated the proposed system

3.03 summary

The researcher understudied the existing model using data gathering techniques. The existing system formed the benchmark for the modified system. Simulator for existing and the modified system will be achieved using Matlab simulation software.

Chapter 4: ANALYSIS AND DESIGN

The researchers used different conceptual diagram in order to understand the cheque clearing system.

COMPONENT LIST:

People: - various categories of people are involved in the cheque clearing system and are mainly **customer** (this includes the drawer who gives payee a cheque in order to pay a sum of money owed to him) who presents cheque for processing, **tellers** (a bank officials at the branch level presented with a cheque to process), **security firms** (this include firms such as G4S who offer courier service to bank and hence courier cheque from source to required destinations), **operators** (this a team of bank official who work on cheques at CPC and determines whether the a cheque clears or note) lastly are **managers** who supervises the work of tellers and operator and thus ensures everything works as required

Cheque:- during the clearing cycle a cheque exists in various states such as a **Presented cheque** (this a cheque given to the teller by the customer for processing), **Outward clearing cheque** (this a cheque received by a teller of a receiving/ beneficiary bank to be forwarded to paying bank to be honored), Inward clearing cheque (this a cheque presented to the drawing bank by the receiving bank for honoring) , **Returned cheque/ Unpaid cheque** (is a cheque that has been dishonored for not meeting the clearing requirements) while a cleared cheque is one that has been honored and funds made available to beneficiary customer.

Banks: - banks were introduced as a media in which cheques cleared. In clearing banks fall in different categories **Paying banks** (cheques are honored or paid in paying banks as this banks holds the drawer account details), **Receiving banks** (this banks holds the payee accounts and thus cannot honor outward clearing cheques). Banks have small

banks that operate under the main bank and operate as terminal services and thus are known as **branches,** both receiving and paying banks have their central processing centre where cheque from branches are collected for processing known as **CPC**.

Clearing house:-this a central place where all the banks meet to exchanges both incoming and outward clearing cheques and also for settlement. Settlement refers to clearing of fund owed to either paying bank or receiving bank and thus all the banks participating are members of the clearing house associations.

INPUTS:-

Cheque clearing system main inputs are instructions which are given by the drawer either in form of a cheque or an RTGS form. Therefore the main input is a Cheque (drawn) or an RTGS in case of RTGS transactions. The instructions serve as resource to the clearing system as they provide the banks with MICR, beneficiary date as well as the amount, currency to be paid and the routing code of beneficiary or paying bank.

PROCESS FLOW CHART

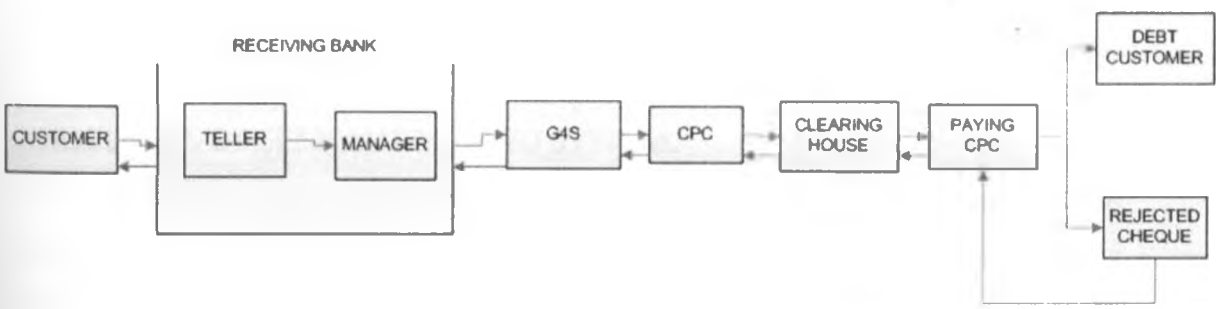


Fig 9: Cheque clearing process flow.

The flow chart applied for both legacy and proposed clearing system

ASSUMPTION:

The researcher made several assumptions in order to be able to model the system such as:-cheques are received within clearing days (holidays and Saturdays are not clearing days), all cheques are below one million (1M), cheques received at the branch tally with teller report (code lines), all banks use the same clearing system (Sybrin and transport model) and are members of the clearing house, cheques processed at CPC are those received from all branches i.e. remote branches that take (10 days) upcountry that take (4 days) and those that are from local branches that get to CPC the same day and customers are treated equally and therefore no customer is given direct credit before the cheques matures.

MICR CHEQUE CLEARING SYSTEM /SEMI AUTOMATED SYSTEM

Cheque clearing system was introduced for large volumes low value cheques. Introduction of MICR technology led to increase in number of cheque being processed as the process is semi automated. Cheque clearing in the current system takes four days. During Day T cheque processing starts at 8.30am in the morning and all cheques received are forwarded to CPC where they are received at around 6.00pm and are processed for forwarding to clearing house which marks the end of day T. this explains why day T is longer than any other day. The process runs from Monday to Friday except on holidays.

CHALLENGES OF SEMI AUTOMATED SYSTEM.

Legacy/ semi-automated system has several challenges as cheque funds are available on the down of the sixth day though customers were made to understand that funds will be available on fourth working days, the number of cheques reported as missing while in transit was alarming and couriering of cheque is expensive.

The following **conceptual diagrams** show movement of cheque from the time customer presents cheque (account is credited with unavailable funds) to the time the funds are

made available and dishonored cheque. Below is a logical flow diagram for semi automated clearing system.

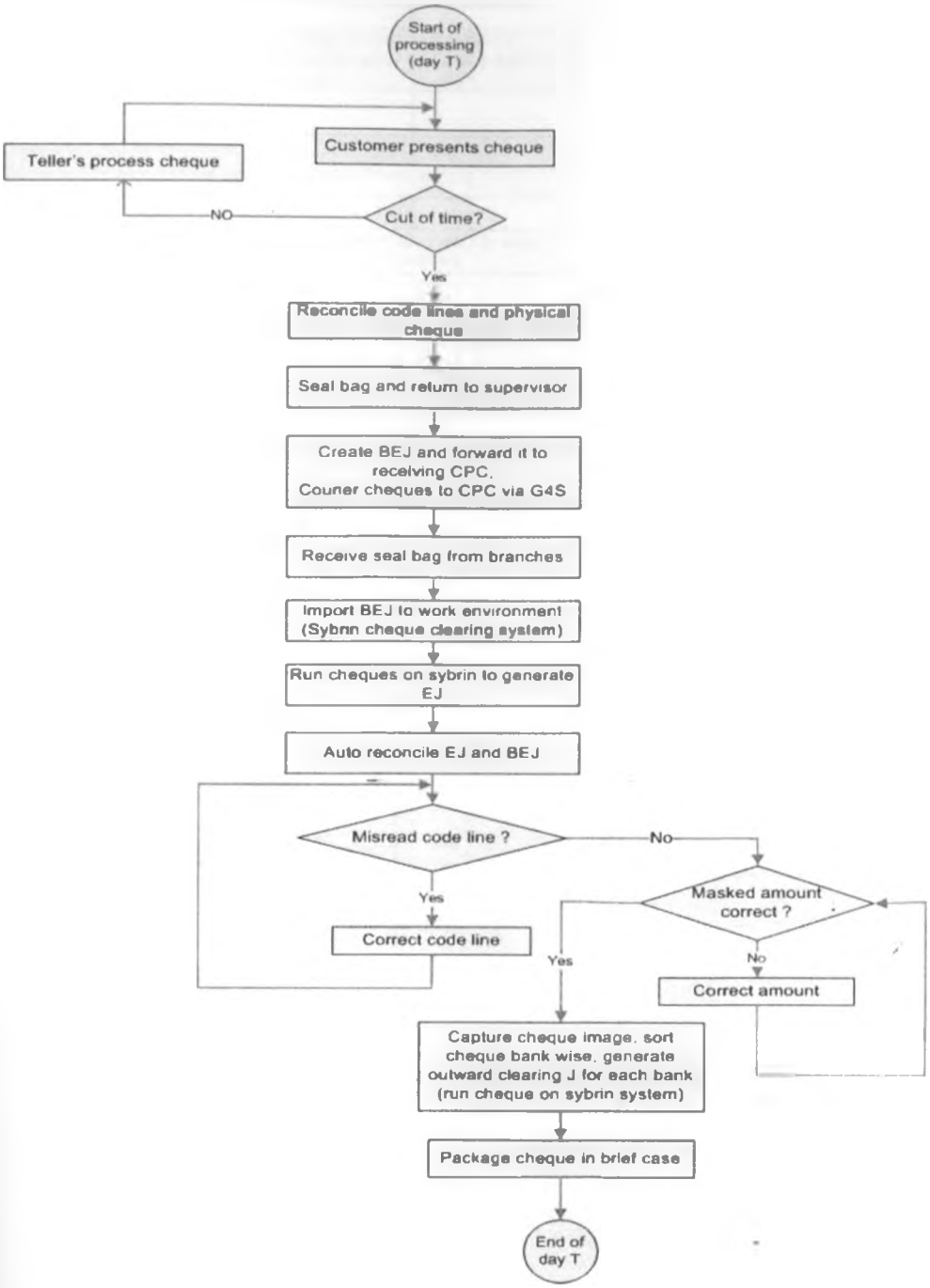


Fig 10a. Day T (Semi-automated)logic flow chart

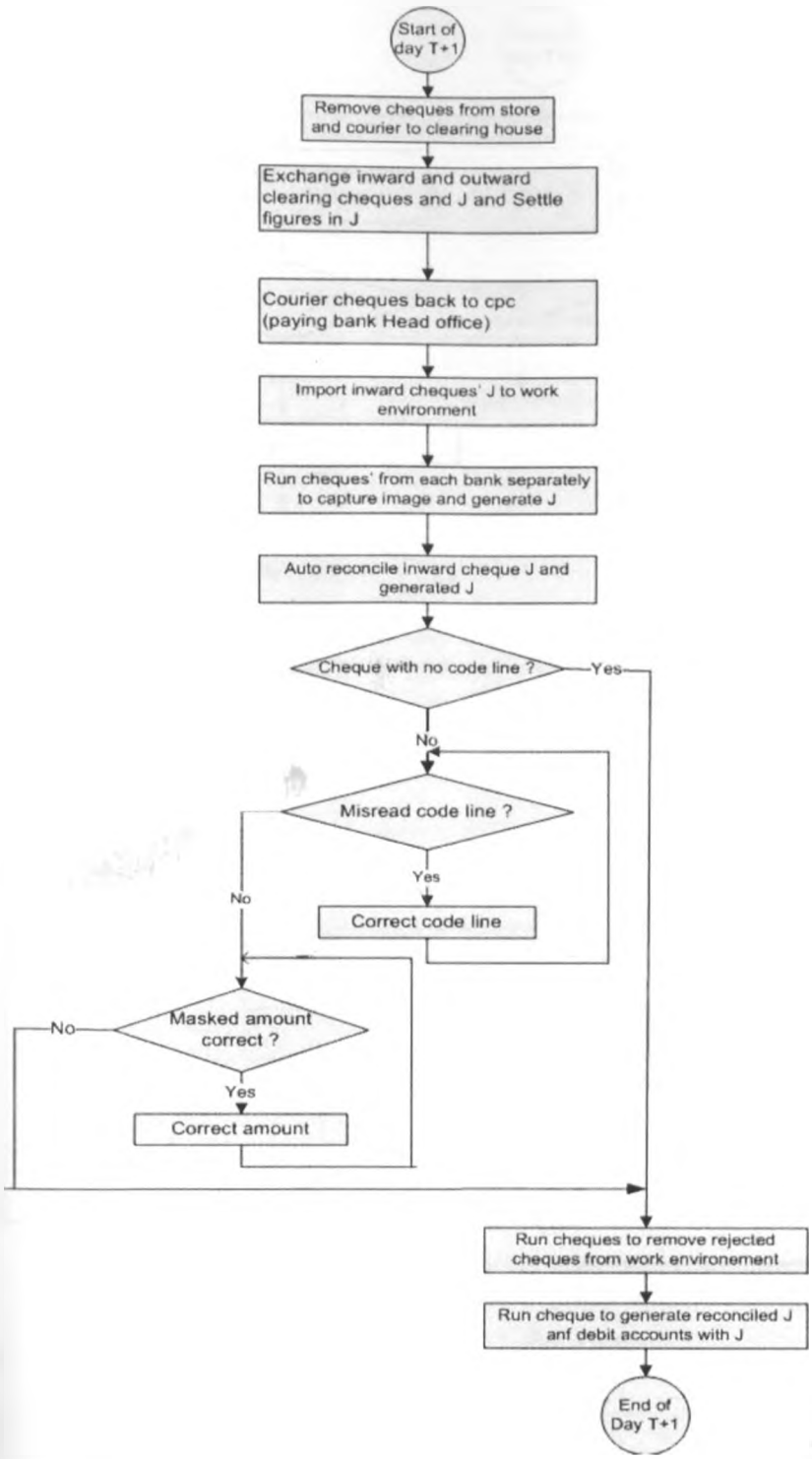


Fig 10b. Day T+1 (Semi-automated) logic flow chart

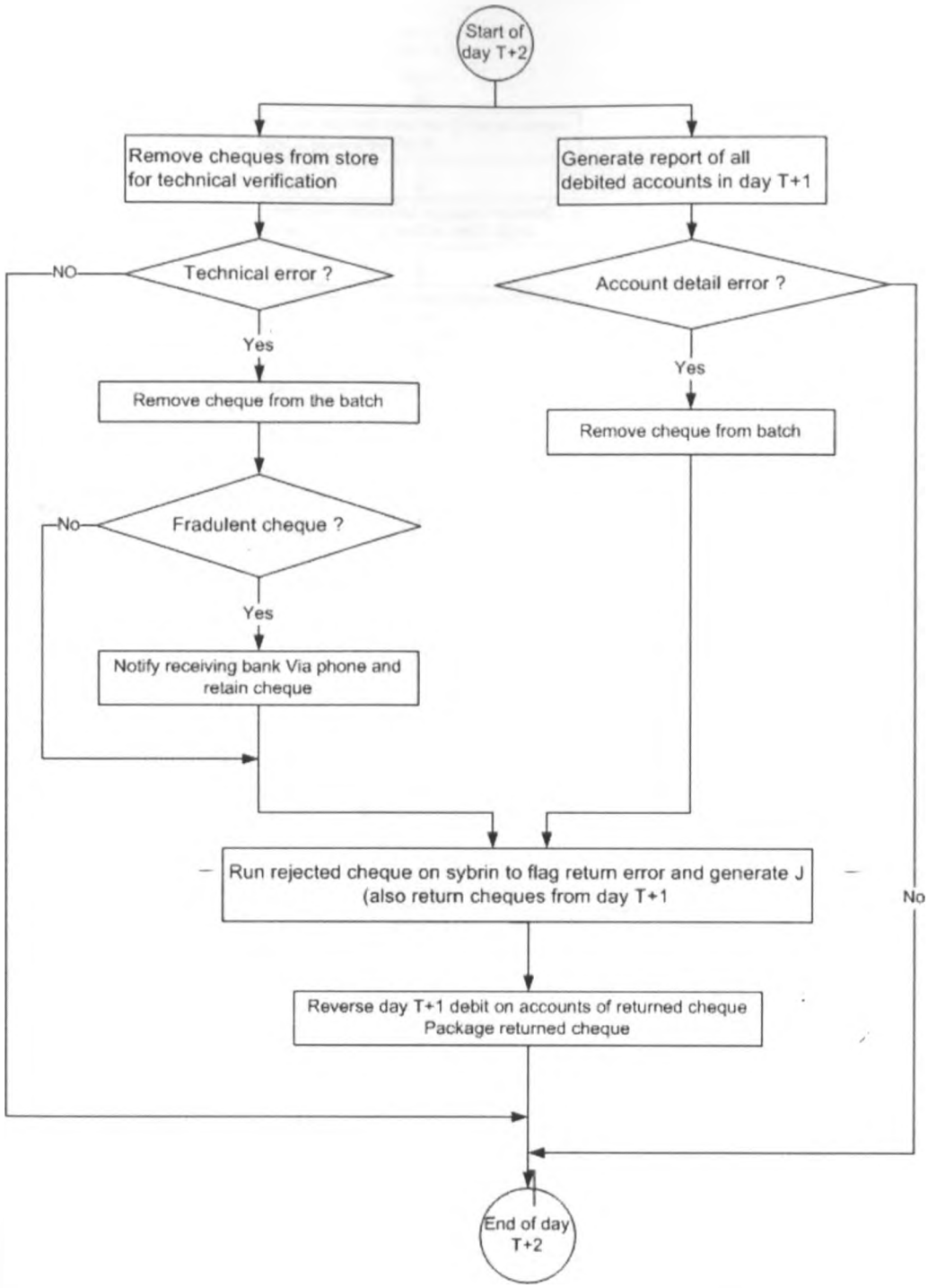


Fig 10c. Day T+2 (Semi-automated)logic flow chart.

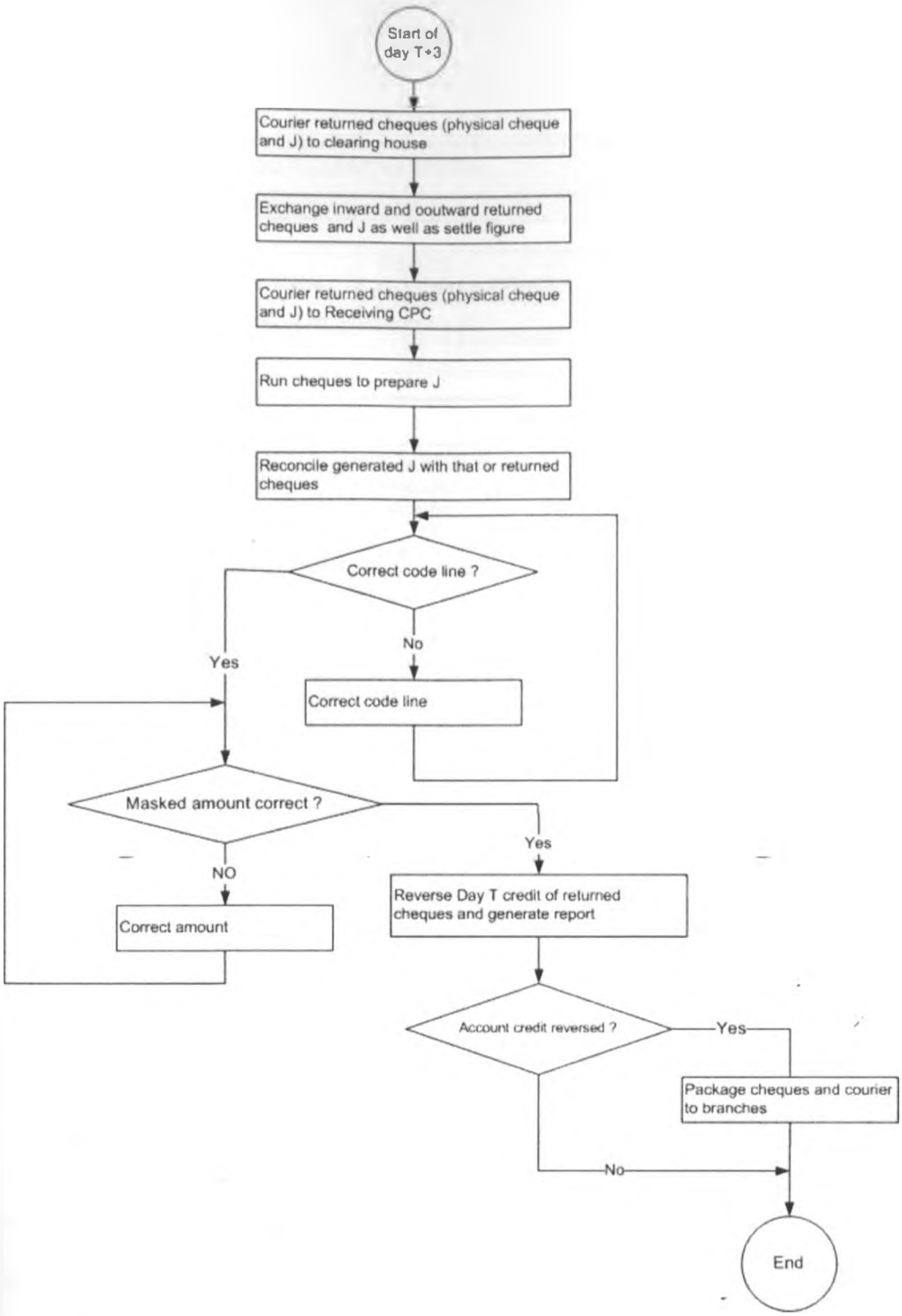


Fig 10d. Day T+3 (Semi-automated)logic flow chart

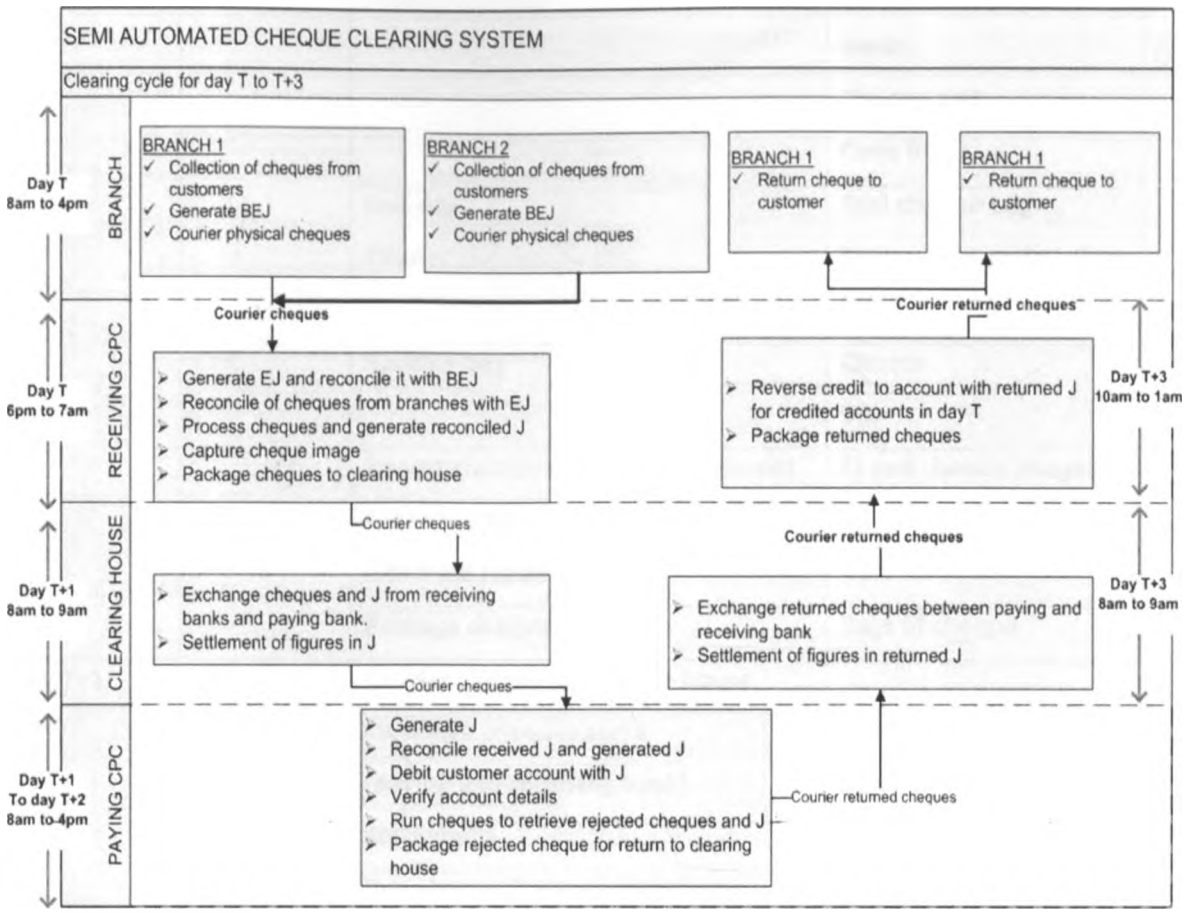


Fig 11. Activity diagram (semi automated clearing system)

The table below shows the **model details** of the MICR clearing system and has four columns as follows: **day** to indicate the duration the process takes from start to end i.e. T, T+1, T+2 and T+3., **location** which shows where cheque processing takes place in different location i.e. from the of receipt to clearing day, **events** that refers to a series of event that a cheque has to go through from presentation day to clearing day and **output** column that indicates the end products of various events.

days	location	activity	output
T (T+0)	branch	Start day	Empty bag
		Process cheque	Uncleared account credit Cheque and Code line
		End day Courier cheques to CPC	Seal cheque bag Encrypted code lines (BEJ)
	CPC	Receive bag	Cheque BEJ
		Import cheque to work environment	EJ and cheque images
		Reconcile BEJ and EJ Generate reconciled J	J
		Package cheques	Bags of cheque
Day T+1	CPC	Courier cheque to clearing house	
	Clearing house	Exchange cheques and J (paying and receiving bank) Settlement	Cheques, J Settlement Certificate
	Paying CPC	Run cheque from receiving bank Import J from receiving bank to work environment	Cheque images and J Receiving bank J
		Reconcile received J and generated J	Flagged cheque for return
		Correct misread code line and illegible Masked amount	
		Run reconciled J	Reconciled report
		Debit account	
Day T+2	Paying CPC	Generate report of debited account	
		Technical verification Account details validation	Flag cheques for return

		Run cheques on clearing system	Remove flagged cheque for return and insert return code
		Generate j for returned cheque Reverse debit	Reversed debit charges
		Package cheque for return to clearing house bank wise	Bags of cheques
Day T+3	Paying CPC	Courier cheques to clearing house	
	Clearing house	Exchange of returned cheque and J Between paying and receiving bank	Settlement certificate Returned cheques and J
	Receiving CPC	Run cheque to generate J for returned cheques	J
		Reconcile received J with generated J for Returned cheques and sort cheques branch wise	Batches of returned cheque
		Reverse credit of returned cheque	Debit
		Packaging return cheque for return to Receiving branch.	Cheque bags
			End of clearing cycle
		Courier cheque to branches to be sent to customer,	

RTGS (REAL TIME GROSS PROCESSING SYSTEM)

The system was introduced to clear cheque whose value was above threshold (above Ksh. 1,000,000). The system has proved to be so efficient such that customer get values of their monies same day and also non chequeing customers use the facility.

The process runs from 8.30am to 2.30pm from Monday to Friday except on holidays.

ASSUMPTIONS

RTGS transaction starts at 9:00am in the morning and takes a maximum of at least two and a half hours to clear. The transaction is a straight through process as the paying bank inputs the right details.

NOTE:-though an RGTS was meant for high value transaction customer still use it to transact values as low as KSh. 10000.

CHALLENGES OF RTGS

RTGS clearing process is quite expensive because during the clearing period banks make profits by holding customers fund while awaiting account verification to be done and funds made available to their account on the eve of the sixth day by lending funds to customers, thus in order to cater for the shortfall the charges for RTGS are high.

A small error on the processing means the document has to be returned to the branch at a cost of Ksh. 2000/= hence funds not available the same day on beneficiary account thus inconveniencing customers.

The logic flow diagram below illustrates RTGS cheque clearing system

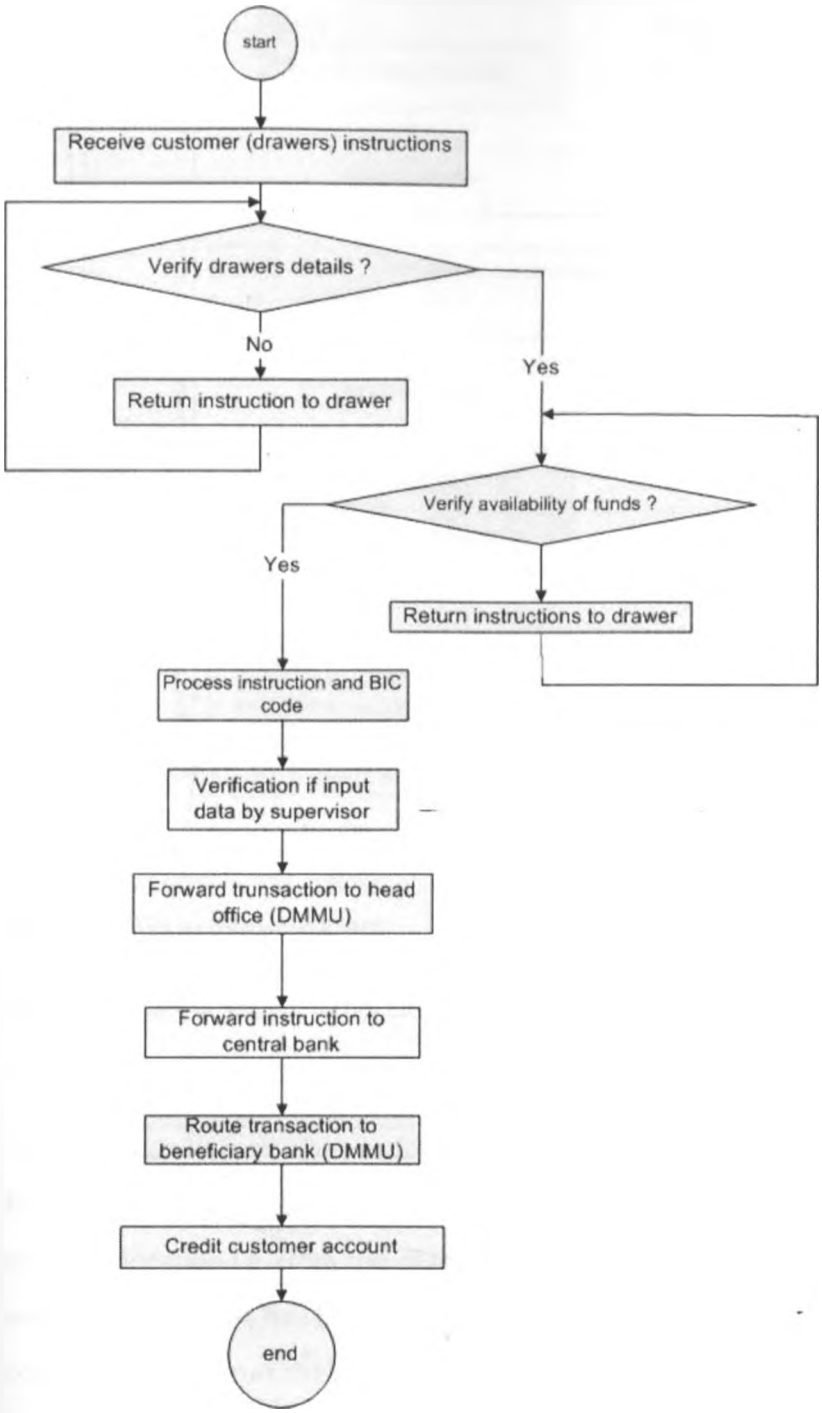
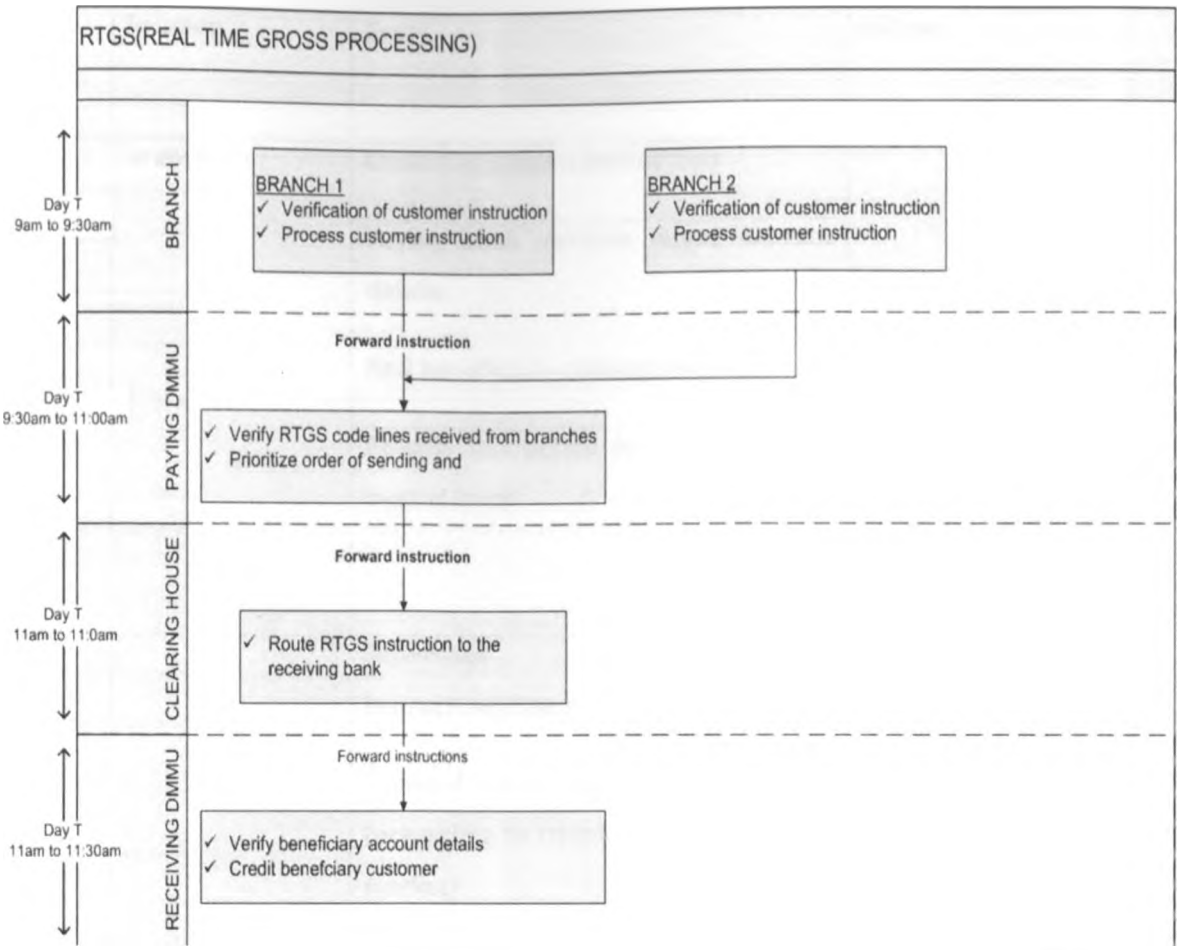


Fig.12: RTGS logic flow



Clearing takes at most 21/2 hours

Fig. 13: RTGS activity diagram

The table below shows RTGS clearing cycle from time customer submit request to the time the beneficiary receives money in their account.

The table has four columns as follows: - **time** to indicate the duration the process takes from start to end**, location** which shows where cheque processing takes place in different location i.e. from the of receipt to clearing day, **events** that refers to a series of event that a cheque has to go through from presentation day to clearing day and **output** column that indicates the end products of various events

Time (hrs)	location	Event	output
9.00	branch	Customer present instructions	
		Paying bank validate payee account details And beneficiary customer details	
9.20		Process instruction for forwarding to central bank	Code lines Receiving bank BIC code
9.30		Supervisor verifies input instruction(code line and BIC CODE) Forward transaction for onward forwarding to DMMU(domestic money market)	
9.30	DMMU (head office of paying bank)	DMMU forwards instruction (code line and BIC code) to central bank	
11.00	Central bank	Verify BIC code and route transaction to paying bank	
11.20	Receiving bank (DMMU)	Verify beneficiary account details	
11.30		Credit customer	Transfer

ENHANCED CHEQUE TRUNCATION SYSTEM)

The system shows that the number of days taken to process the transaction reduces from four to two days and the process is cheaper.

This was achieved through:-Truncating cheques at the branches in order to reduces cost of movement of cheques from branch to CPC and also to and from CPC to clearing house hence saving on time and cost, providing branches with Magnifying glasses and Ultra violet light so as they can carry technical validation of the cheque at the branch before even receiving the cheques and return cheques to customer before collecting the cheque for processing, reducing cut off time from 4.00pm to 3.00pm as this ensures cheque go for clearing the same day and hence debiting of account the same day by the paying bank, when debiting of account is done same day the following day bank are able to do account verification and validation and hence un pay the cheques images that need to be unpaid while also making funds available to the other accounts and reduction in the number of cheques reported lost while in transits by truncating cheques at the branch level.

CHALLENGES:

Since images are truncated at the branch level banks need to educate their staff of the required cheque features.

ASSUMPTIONS:

In order to make the project a success, the researcher made several assumptions such as:- all banks have their branches well configured in order to be able to forward received images and BEJ to CPC and hence to clearing house, bank operates on secure networks to avoid breach of customer confidentiality. Central bank of Kenya and KBA impose a law like other countries i.e. giving out cheques where accounts have insufficient funds or bouncing cheques is an offence as this reduces the number of Images (Cheques) returned.

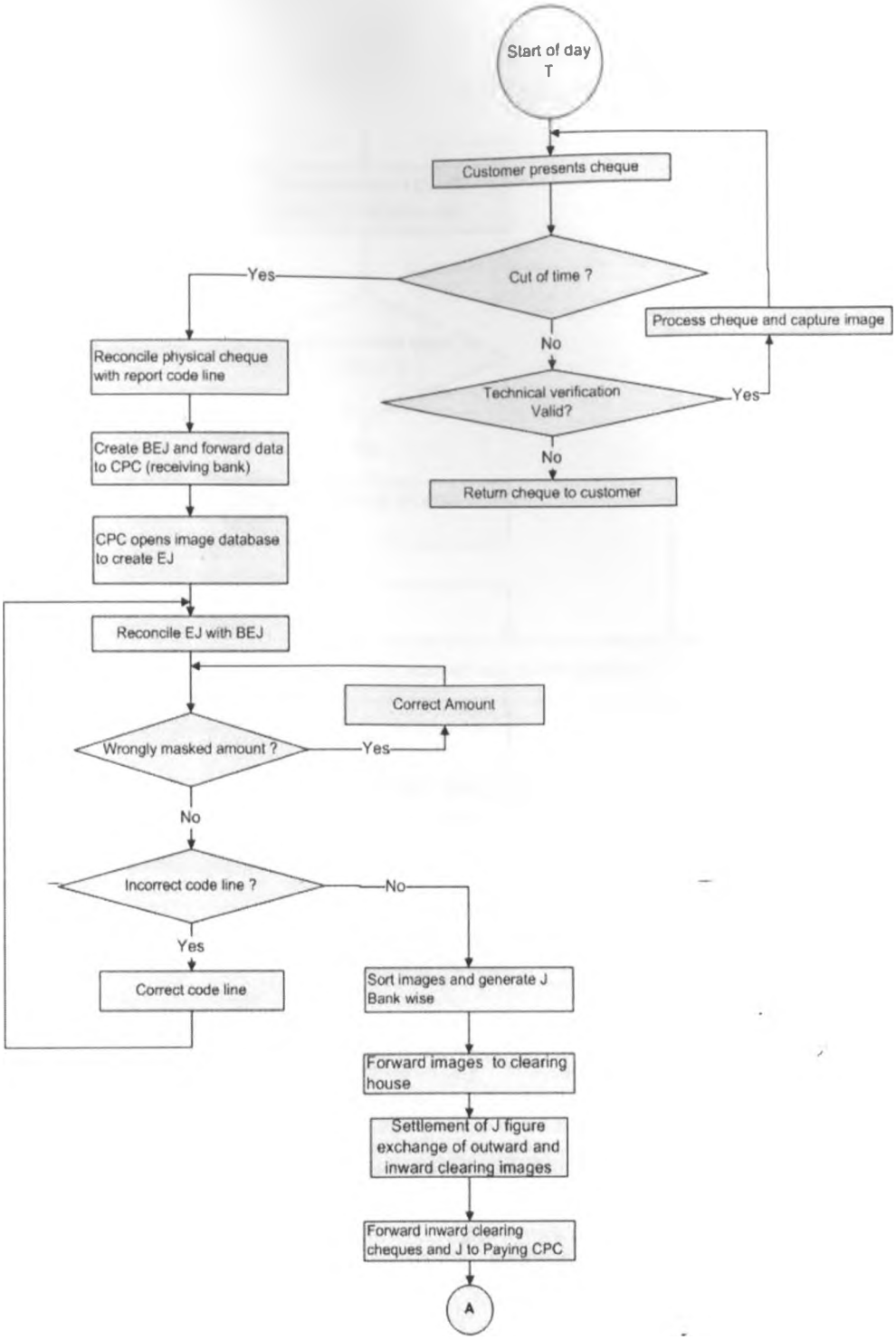


Fig.14a: ECTS system logic flow

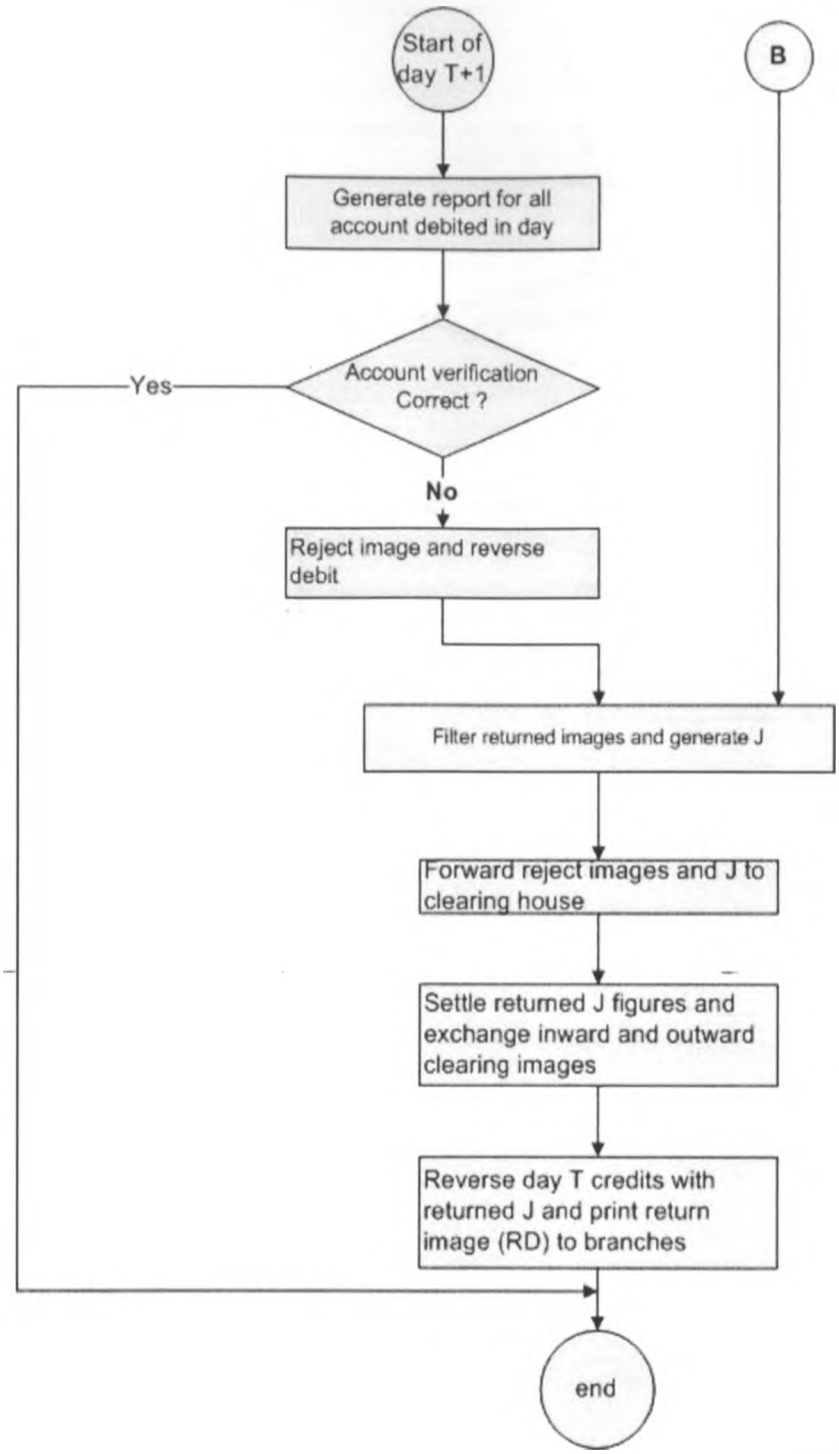


Fig.14b: ECTS logic flow

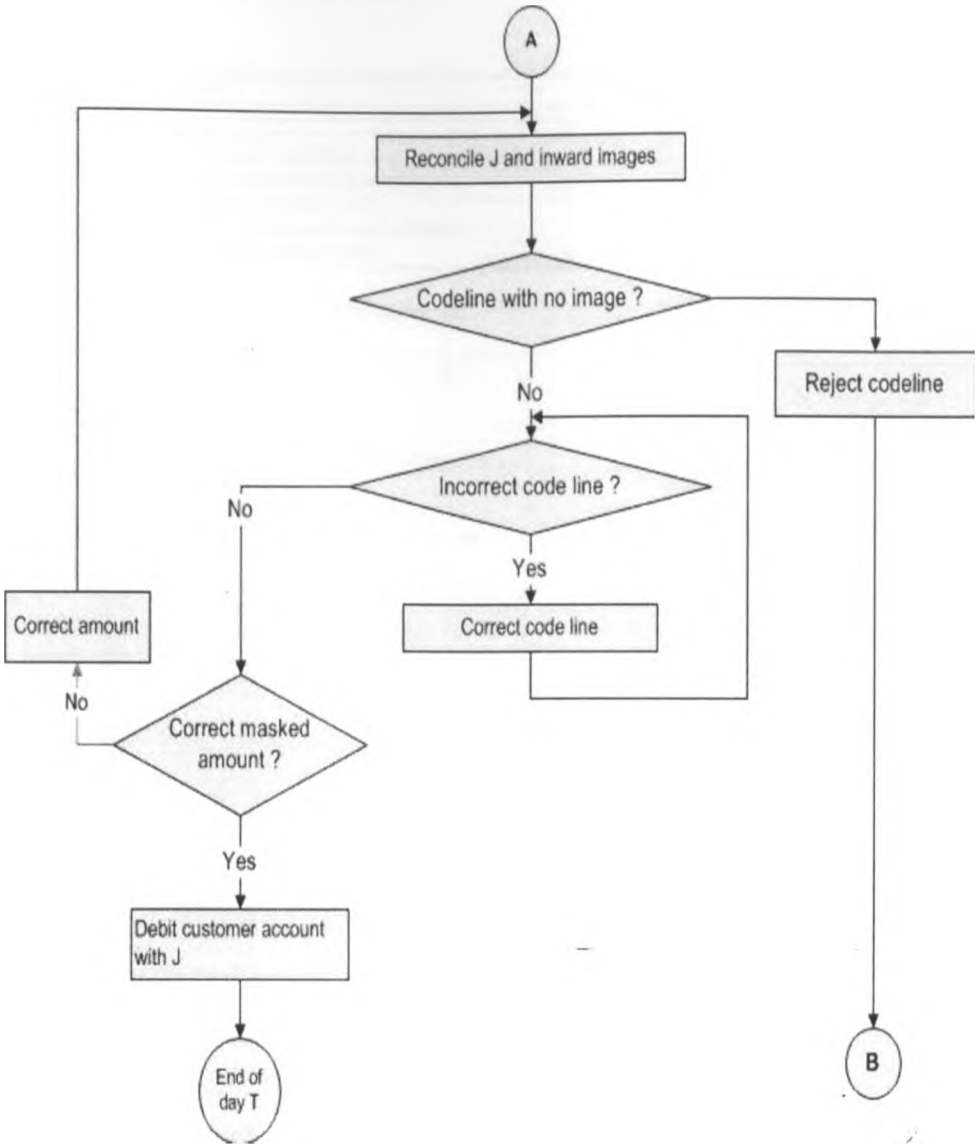


Fig.14c: ECTS logic flow

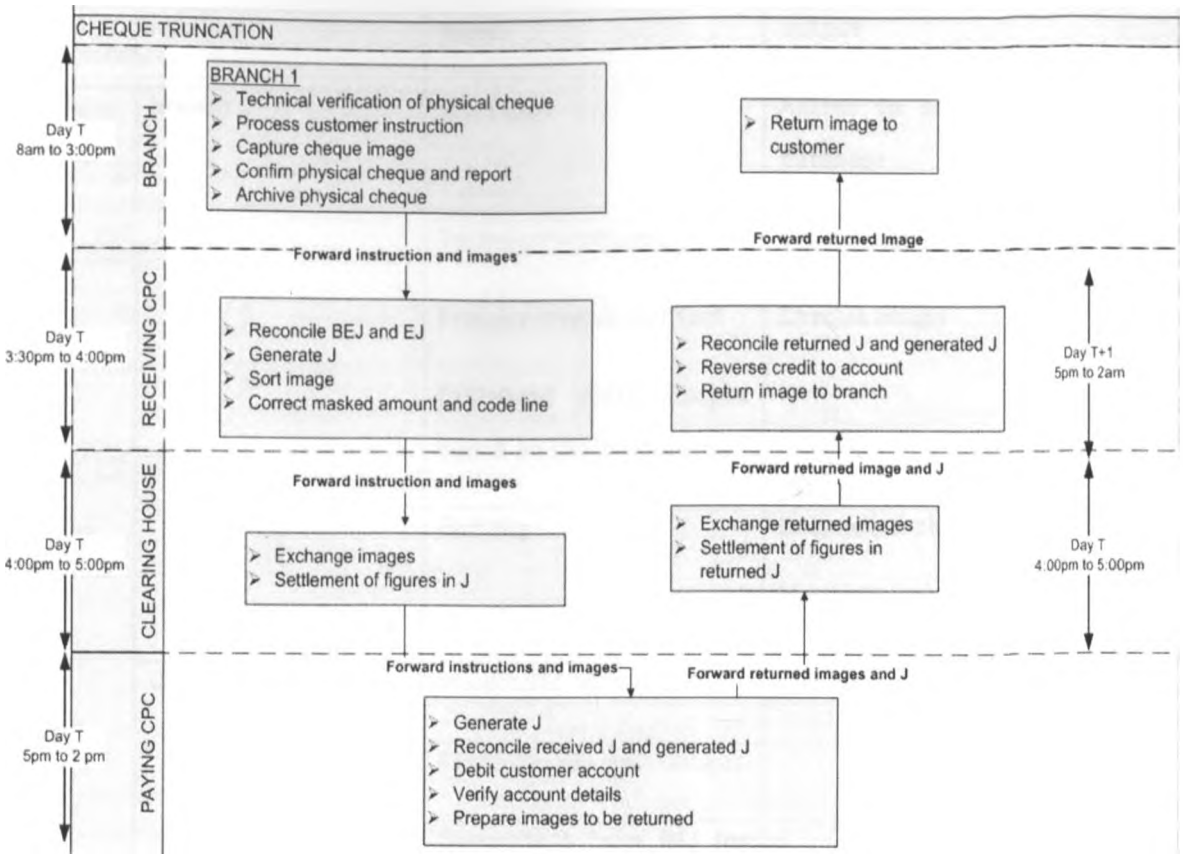


Fig 15: ECTS activity diagram

The table below shows cheque clearing cycle from the time customer presents cheque at the branch to the time it matures.

The table has four columns as follows: **Day** to indicate the duration the process takes from start to end i.e. T and T+1., **location** which shows where cheque processing takes place in different location i.e. from the of receipt to clearing day, **events** that refers to a series of event that a cheque has to go through from presentation day to clearing day and **output** column that indicates the end products of various events.

	location	Event	output
Day T	branch	Start day	Access to send images to database
		Technical verification	Valid cheque
		Process cheque and sort (database store images based on key(bank code)	Cheque image
		End day	Reconciled physical cheque. BEJ
	CPC (receiving)	Import BEJ from branch	Code line and images
		Reconcile BEJ with images	
		Generate J from BEJ for each branch	J
		Forward J and images to clearing house server	
	Clearing house	Exchange images (between paying and receiving bank)	Settlement certificate
	CPC (paying)	Import images to from Clearing server	Images from receiving bank and J
		Reconcile received J and images	Image for return (misrepresented)

		Debit account	
Day T+1	Paying CPC	Generate report for all account debited on day T	report
	Paying CPC	Account verification Image validation	Returned cheque
		Reverse day T debit	Debit charges
		Generate journal for all returned images	Return images J
		Forward returned images to clearing house	
	Clearing house	Exchange returned images and J (paying and receiving banks)	Settlement certificate
	Receiving CPC	Generate J from images returned	
		Reconcile J and received images	Reconciled journal
		Reverse Credit	Debit charges
		Return images to receiving branches	

CHAPTER 5: RESULTS

Conceptual model:

Data gathering techniques enabled researcher to understand the existing system. The researcher used various conceptual models to describe cheque clearing systems such as: - component diagrams (show entity), activity diagram (gives all the activities in the clearing system), process flow diagram and a table that illustrate expected outputs at various milestones as well as the location.

This allowed the researcher to develop a simplified model that will increase efficiency

Computer model

The researcher implemented the conceptual model by developing computer models of the legacy system and Enhanced cheque truncation system. The researcher learnt Matlab in order to be able to develop the simulator. Matlab as simulation software that has a wide range of application, however the researcher dealt more on simulink, and simevents in order to be able to develop the system.

Below is a computer model of the legacy/Semi automated system.

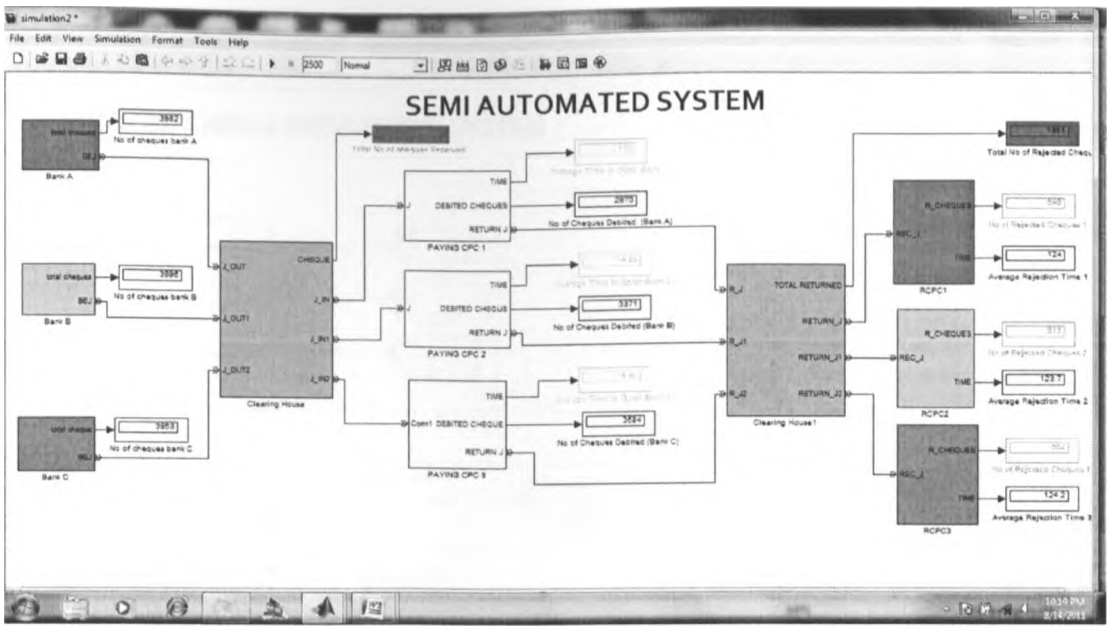


Fig 16 computer model: semi automated cheque system

In the legacy system the researcher modeled inter arrival of cheques from various locations in the country as arrival of cheques varies i.e. one, five and ten days respectively.

Below is a computer model for enhanced cheque truncation system.

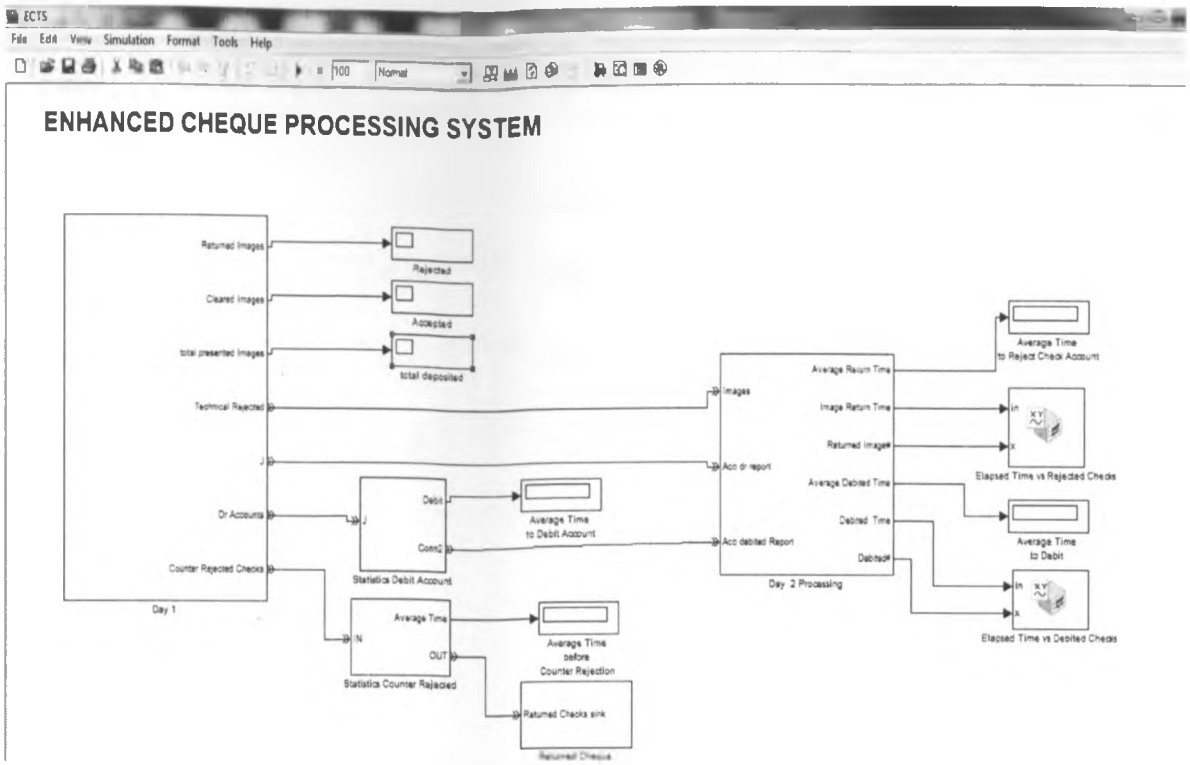


Fig 17: computer model: enhances cheque processing model

The computer model allowed the researcher to test the system for goodness of fitness. The researcher was able to test for efficiency my modeling the error rate and also reduced time by modeling couriering movements of cheques in both system and also use of Optical Character Reader (OCR). The research also prove that simulation can be used to test for efficiency of cheque clearing system as it was possible to test the system by using various numbers of cheques. The table below shows the time and the number of cheques returned in enhanced cheque clearing system.

Below is a table that analyses the performance of semi automated system

Initial cheques	Cleared Cheques	Clearing time	Rejected Cheques	Returned cheques

10488	8798	4.333	690	6.45
5916	4963	4.333	963	6.45
5327	4452	4.333	875	6.45
1893	1597	4.75	296	6.25
2752	2294	4.75	458	6.25
3614	3028	4.75	586	6.25

Total rejected cheque =3868

Total initial cheque=29990

Error rate= total rejected cheque/total initial cheque

=3868/29990

=12.89%

Initial cheques	Cleared Cheques	Clearing time	Rejected Cheques	Returned cheques
10488	8798	2	400	2
5916	4963	2	290	2
5327	4452	2	210	2
1893	1597	2	90	2
2752	2294	2	130	2
3614	3028	2	200	2

Total rejected cheque =1320

Total initial cheque=29990

Error rate= total rejected cheque/total initial cheque

=1320/29990

=4.40%

CHAPTER 6: CONCLUSION AND FUTURE WORK

6.01 CONCLUSION

Improving cheque clearing system means improved economy as customers have available money for their business. This called for need to improve the clearing system thus modeling of a modified model for cheque processing in such of efficiency. The project entailed understudying existing cheque processing system that served as a bench mark for the efficient cheque clearing model.

The researcher used simulation techniques which is a computer science concept to develop the simulator for the modified model. Thus the researcher was able to achieve the project objectives which were developing conceptual model for existing model and the modified models, implementing the models into a computer models using simulation software MATLAB, running the model and thus analyzing the model result which are measure of efficiency as they indicate the error rate.

The modified model was seen to reduce the error rate from 12.89% to 4.04% which was mark of efficiency for the modified model. This was achieved by truncating images at the branch level and introduction of optical character reader at bank clearing headquarters which was done manually thus eliminating redundancy in cheque clearing and hence an efficient system.

6.02 LIMITATION:-

To make the project a success several limitations were put in place and there's need to address them in order to reduce clearing cycle to (T+0) in future. The assumptions were as follows;-

Cheque clearing was meant for low value high volume cheque, but also the low value cheques are further classified to large cheque amount that range from Ksh. 30000 that goes to callback centre's for confirmation, the projects capitalized on cheques below

Ksh.30000. confirmation of such cheques involves calling customers or confirmating with the mother branch. Thus there will be need to educate customers who issues such cheques to be confirming or presenting cheque clearance schedules to their bank to facilitate for an efficient clearing system.

Cheque features: - there need to improve on the cheque features to ensure there are not tampered with. Apart from use of aqua fugitive ink on cheques there need to improve on the cheque features as in the past cheque have been tampered with by having common features that are not easy to interfere with.

Secure network: - infrastructure has been a major hindrance to implementing cheque truncation in the past due to poor infrastructure. Currently though there has been improvement in communication sector there are still lapses that need to be addressed and that are still challenge in countries such as India. In Singapore, fraud in at zero and this has led to efficient clearing system; though in Kenya digital signature will be used a lot need to be done to avoid customer information being tampered with.

Signature verification: - there's need to address signature verification. Signature verification is currently the major cause of slow cheque processing as it will be handled manually. This calls for the need to investigate ways of a system that will be able to confirm specimen signature stored in the bank with that on the presented cheque for clearing and one that provides a margin of error as in reality 50% of all signatures differs with signatures on the cheques. This will ensure that only cheques whose signature margin of error is large are returned.

6.03 Future work:

The modified model reduces and harmonizes cheque clearing to (T+1) this can be further reduced by ensuring that the above limitation are addressed and mostly the issues of signature verifications and also secure network. The Kenyan government also has a duty of enforcing the law against issuing of cheques against accounts with

insufficient funds, closed, or where one has instructed the bank or other institution at which the account is held not to honor the cheque as stated under Section 316A (1)(a) of the Penal Code that came in effect in 2004.

7.0 Reference

Keith Pond (1989), A Legal and Practical Perspective. The Service Industries Journal. Volume 9, www.informaworld.com, last visited, June 2011

Nairobi writer on Banking, Finance, Technology, and Investments(2011), Cheque Truncation Part II, http://bankelele.blogspot.com/2011/06/cheque-truncation-part-ii.html, last visited in June 2011

Mohit Mehta, Rupesh Sanchati and Ajay Marchya(2010), Automatic Cheque Processing System, International Journal of Computer and Electrical Engineering, Vol. 2, No. 4, August, 2010 1793-8163, www.ijcee.org/papers/224-E627.pdf, last visited, July 2011

Singh Sumanjeet (2009), emergence of payment systems in the age of electronic commerce: the state of art, http://www.globip.com/pdf_pages/globalinternational-vol2-article2.pdf, last visited, July 2011

Faizal Okhai (2011), Electronic Cheque Clearing House, http://www.iobmalawi.com/news4.htm,last visited, July 2011

Robert Tripp (2007), Current UK Cheque Clearing Process, http://www.howbankswork.com/15.1.html, last visited July 2011

Stewart Robinson (2004) Simulation: The Practice of Model Development and Use.

KCB (2011), cheque truncation, www.kcbbankgroup.com, last visited, July 2011

APCA Publication 3.3.1(2008), Magnetic Ink Character Recognition(MICR) Technical Specifications.http://www.apca.com.au/Public/apca01_live.nsf/ResourceLookup/Publication_33.pdf/$File/Publication_33.pdf, last visited, July 2011

George Daniel Rice (2011), Basic Steps and Decisions for Simulation, http://www.uh.edu/~lcr3600/simulation/steps.html, last visited, May 2011

Short tutorial on matlab: Simulink Basic www.chem.mtu.edu/~tbco/cm416/MatlabTutorialPart3.pdf, last visited, July, 2011

Appendix

INTERVIEW

Interview was conducted at KENYA BANKERS ASSOCIATION office and at KENYA COMMERCIAL BANK branches in Kiambu, Ruiru, Sarit Centre as well as the Head office CENTRAL PROCESSING CENTRE (CPC) office as follows:

(A) Interview at KENYA BANKERS ASSOCIATION on 14th april, 2011 and 24th June 2011 :

(Fidelis is the contact person and also in charge of the cheque process project both at Central Bank of Kenya and KBA).

Hellen: Why do you think Kenya has delayed to implement Cheque truncation process that was implemented in other countries since mid 90's?

Fidelis: Bank law to allow cheque processing was amended in the year 2007, but since the infrastructure was so poor and so the process was rendered impossible. Most of the branches in remote areas were not connected to their head office and thus communication between the branches was in its self impossible.

Hellen: What changes do you think Cheque truncation will affect in the clearing cycle?

Fidelis: Since truncation will be done at the branch level, then couriering of cheque from branches will come to an end as well as to and from CPC from clearing house and hence reduced cost.

Hellen: The issue of cheque truncation has been postponed since the year 2010 and also twice this year, why?

Fidelis: Central bank is not ready to implement the system due to infrastructure and again the small banks last year were still weighing whether to use big banks

as their agents as investing in the technology is expensive, again the banks have appointed one printer to print the cheques and his overwhelmed to print cheque for the forty two banks.

Hellen: Why the *introduction of value caps and RTGS?*

Fidelis: Value cap just refers to a threshold; - in this case it refers to Ksh. 1,000,000/=. An RTGS was meant for High value low volumes transactions while Cheque clearing cycle was meant for low value (below value cap) high volume transaction.

Hellen: RTGS today is used to transfer money as low as Ksh. 5000/=, would you advice central bank to reduce the cost of RTGS?

Fidelis: Why not? I would go for it. The risk of sending an RTGS is minimal as the paying and receiving party are in agreement and it's the paying party who initiates the transaction.

Hellen: For the country to invest in such a technology, what type of research have you done, would you go for simulation?

Fidelis: KBA did a research in India and Singapore? Simulation no as we believe we can do it like other countries.

Hellen: What do you think will be a hindrance to the project at hand?

Fidelis: Discipline, Kenyans are used to giving bouncing cheques, this is a crime in Singapore and that's why cheques can clear same day, again there's a lot of fraud in the country unlike in countries like Singapore thus we need to advance on security features of the cheques

(B) Interview at KENYA COMMERCIAL BANK on 15th May, 2011 :

(David Munyei is the senior manager at CPC)

Hellen: *what measure has the bank has put in place for the new project and what effect does it have on the bank.*

David: *Well in big banks like KCB, Barclays, Cooperative bank, National Bank of Kenya, CFC stanbic truncation starts on DAY T and DAY T+1 upon receiving of cheques. At CPC of this banks once cheque images are captured and physical cheques handed to technical department the rest is done through Images, therefore the only effect is that we will have to do away with machines such as SYBRIN TRANSPORT MODEL, that is used ny the banks I have mentioned that costed the banks KSH. 10,000,000/.*

Hellen: *CPC operators and managers work day and night do you think this will come to an end?*

David: *They might work day and night as this will make the process simpler and again cut off time might be increased or reduced.*

Hellen: *Initially it was suggested that banks will have one look of cheques (gray) with a small marketing logo, what happened?*

David: *Banks refuted the idea, but they all agreed to have cheques of same size and* **Use of aqua fugitive ink** in key areas of the design (will react by dissolving, smudging or changing colour when alterations is attempted by the use of a wide variety of solvents, providing a visual alert).

Hellen: how long does clearing takes, as at the branches customers are told Four days?

David: for remote branches we receive their cheques on the tenth day, Upcountry fourth day and I

local branches the same day of receipt at the branch. *Clearing of cheque start when CPC receives cheques from branches, this is called day T to the last day (T+3) else before then clearing of cheques has not started.*

Hellen: *how do you determine a cheque has cleared?*

David: *customers are grouped into class and there some who get value of their money the same days such as class A companies (corporate) else in actual sense when a cheque is not unpaid the system automatically makes the fund available on the EVE of day SIX.*

Hellen: *an RTGS takes at most two hours at times it depends with the bank, as one has to a good dealer as one has to know how much to led by giving transactions priorities in order to make more money. Trading of money is like a budget and thus some transactions are delayed.*

Terms:

MICR - magnetic Ink Character Reader.

This refers to a set of digits that appears at the bottom of the cheque and represents the following (cheque number, branch number, bank number and account number).

Code line-refers to a set of digits representing the following information (MICR, amount payable, date and time cheque was banked, account to be credited).

BEJ- Branch Electronic Journal (refers to an encrypted file containing code lines for all the cheques received from that branch.

EJ-Electronic Journal (a file prepared by CPC for comparison with BEJ received from each branch)

J- Journal / file. This a file that contain code lines for all the cheque relating to a given bank for all the physical cheques relating to that bank

CPC-cheques processing centre:- this refers to a department at the Bank Head office where cheque from all its branches a couriered to for processing.

DMMU- a department in banks head office that deals with Domestic Money Matter.

Technical error: - refers to errors such as lack of designated security feature, date.

Account error: - signature differ, amount in figures and in words differ, insufficient funds.

T-is a clearing term used to refer to Today.