Understanding the Electronic Cheque Clearing System in Ghana

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Abstract: The widespread use of bank cheques in daily life makes the development of cheque processing systems of fundamental relevance to banks and other financial institutions. Few studies on nature of Electronic Cheque Clearing System (ECCS) have also shown jurisdictional differences in the application of the technology. Despite its increasing adoption in Africa, no attempt has been made to model the process and highlight the challenges to drive policy changes. This study addresses this research gap by studying the nature of ECCS in Ghana to identify the inherent challenges. To achieve the objective, data was collected through interviews, observations and direct participation. Findings suggest that cheques go through five set of processes before they are cleared electronically; different from the four processes indicated in existing literature. These processes are Pre-Conversion, Conversion, Transaction, Security and Storage. The pre-conversion process depends on the banks objective, whilst some banks centralise the process to reduce cost, other banks decentralise the process to enhance service delivery to customers. The remaining processes are the same across all banks in Ghana. The study also found that security breaches at cheque printing houses, poor bank collaboration and manual cheque reviewing process are the main challenges facing ECCs.

Keywords: ECCS, cheques, payment systems

1. Introduction

Traditional payment systems used in many countries were mainly cash payments prior to the emergence of Information Technology (IT), until cheques surfaced and became the major payment method used by individuals and corporations (Asmah, Ofoeda, and Gyapong, 2016). The increasing usage of cheques in everyday lives is due to its ability to allow users to pay bills without visiting physical location designated by service providers and at the same time reducing the risk of theft and loss associated with cash payment (Pasupathinathan, Pieprzyk, and Wang, 2005). In developing countries cheque continues to be the major payment model although the case may be different for some developed countries with several payments options. In Ghana, cheques are the most patronised non-cash forms of payments with about 96.8 billion cedis worth of it presented in 2014 (GhIPSS, 2015).

Clearing cheques drawn on different banks, until recently was tedious and time consuming as clearing houses required physical cheques from all banks to be sorted manually, perused and accepted by the various banks before values are transferred. This required that the cheques be physically moved from the collecting bank to the paying bank as part of the clearing process. With this practice, cheques were cleared using several days (Norman, Shaw, and Speight, 2011).

In the late 1990s, the Bank of Ghana (BoG) (which is the central bank charged to ensure efficiency, reliability and timeliness in clearing cheques), introduced the Magnetic Ink Character Recognition (MICR) technology and the standardization of paper payment instruments to enable the semi-automation of cheque clearing in the Accra Clearing zone in 1997. The problems associated with the manual clearing systems in Ghana and the determination of the BoG to improve cheques clearing led to the decision to migrate to Cheque Codeline Clearing with Cheque Truncation (CCC) under new rules published by BoG (Asmah, et al., 2016). Ghana moved away from the traditional paper based clearing into the full electronic clearing in 2010. Although the system has attracted lots of attention since its implementation, just like any other system, some inherent challenges exist which limits its continuous acceptance and usage. In addition, there are clear evidences of the introduction of e-banking systems which have failed to achieve the intended benefits especially in Ghana. For instance, E-Zwich (a highly secured payment platform) was introduced prior to ECCS, but statistical evidence (Bank of Ghana, 2015) and literature suggest that the patronage has waned drastically since its introduction in

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2008 (Agyeiwaah, Anane, Appiah, and Opoku-Ware, 2014; Antwi, Hamza, and Bavoh, 2015). Both Agyeiwaah, et al. (2014, pp. 2) and Antwi, et al. (2015, pp 168-169) identified some inherent challenges that hindered the continuous acceptance and usage of the technology in the country. These challenges if identified earlier could have driven policy changes and saved the system from it collapse.

Efforts have been made by researchers in recent years to model the ECCS in various countries (Khiaonarong, 2000; Jresat, 2007; Al Shibly, 2011; Sreedevi, 2013) which have indicated that the model applied in countries vary considerably. For example, Sreedevi (2013, pp. 185) modelled the ECCS in India which is different from the model adopted by banks in Thailand as studied by Khiaonarong (2000). With these different ECCS models, solutions to their inherent challenges must be tailored specifically to the implemented model. In Africa, specifically in Ghana, arguably no attempt has been made in the literature to model the ECCS process making this study necessary. It will therefore be difficult to implement solutions in other jurisdictions and expect them to work in a country with different cultural background and different level of IT adoption and usage rate. The need to tailor solutions to specific models of the system necessitate the need to investigate the nature and model of cheque truncation in Ghana in order to assess the challenges and propose solutions tailored to the model.

2. Literature Review and Theoretical Framework

2.1 Cheque Truncation System / Electronic Cheque Clearing System

Sreedevi (2013, pp. 184) defined CTS as an online image based cheque clearing system where cheque images and Magnetic Ink Recognition (MICR) data are captured at the collecting bank branch and transmitted electronically without the actual cheque movement of physical cheques. Al Shibly (2011, pp. 463) also defined the automatic clearing of a bank cheque as the extraction and recognition of handwritten or user entered information from different data fields on the cheque such as courtesy amount, legal amount, and date. Given the definitions cited above, it can be gathered that ECCS involves the process of capturing bank cheques electronically and transmitting them to other banks without physical movement of the cheques.

Electronic Cheque Clearing System (ECCS) also known as the Cheque Truncation System (CTS) involves the process of inter-bank cheque settlement by using both cheque electronic records and scanned copy of the cheque (AL-Refai and Nawafleh, 2014). Once the teller in the bank of first deposit (BFD) receives the cheque item, the scanned copy is sent to the paying bank through central bank to be technically and financially cleared through high speed secure connection lines, the reply for that action to pay or reject the cheque is generated from the paying bank to the central bank and then sent back to BFD (Jresat, 2007).

Generally, Cheque truncation is the process in which the physical movement of cheque within a bank, or between banks and clearing house is replaced by electronic records. Implementation of CTS usually brings all the participating banks to a common platform in the cheque processing operations (See Figure 1). Cheque truncation is one of the ways to compress the clearing cycle to provide faster clearance of local and intercity cheques (Sreedevi, 2013). The system enables banks to enjoy greater efficiency and provide better service to their customers.

Cheques are written orders from account holders instructing their banks to pay specified sums of money to named beneficiaries (Hancock and Humphrey, 1998). When customers deposit their cheques to the collecting banks, the scanned copy is sent to the paying bank through the central bank to be technically and financially cleared through high speed secure connection lines. The digital image can also be transferred through a data link, CD-ROM or cartridge (Qatawneh, Aldhmour and Aldhmour, 2016). The collecting banks or the clearing house will capture the transaction electronically and transmit the transaction as part of the transmission of the digital images. The centre of the cheque clearing process is the clearing house, central bank, monetary agency. The role of these institutions is to verify the cheque clearing process and enforce financial procedures, regulations and laws, as well as to monitor and follow up their implementation (Alsoof, et al., 2011).

Truncated cheques will then be presented to the drawee's bank electronically for verification. The reply for that action to pay or reject the cheque is generated from the paying bank to the central bank and then sent to collecting bank for final payment to the customer (Jresat, 2007). The physical cheques are kept at the collecting bank or the clearing house although the drawee bank may still be able to examine it to make payment decisions.

There is no change to the traditional practice pertaining to the writing of cheques by payers, the deposit of cheques by payees, the schedule of making funds made available by banks and returning of unpaid cheques to payees.

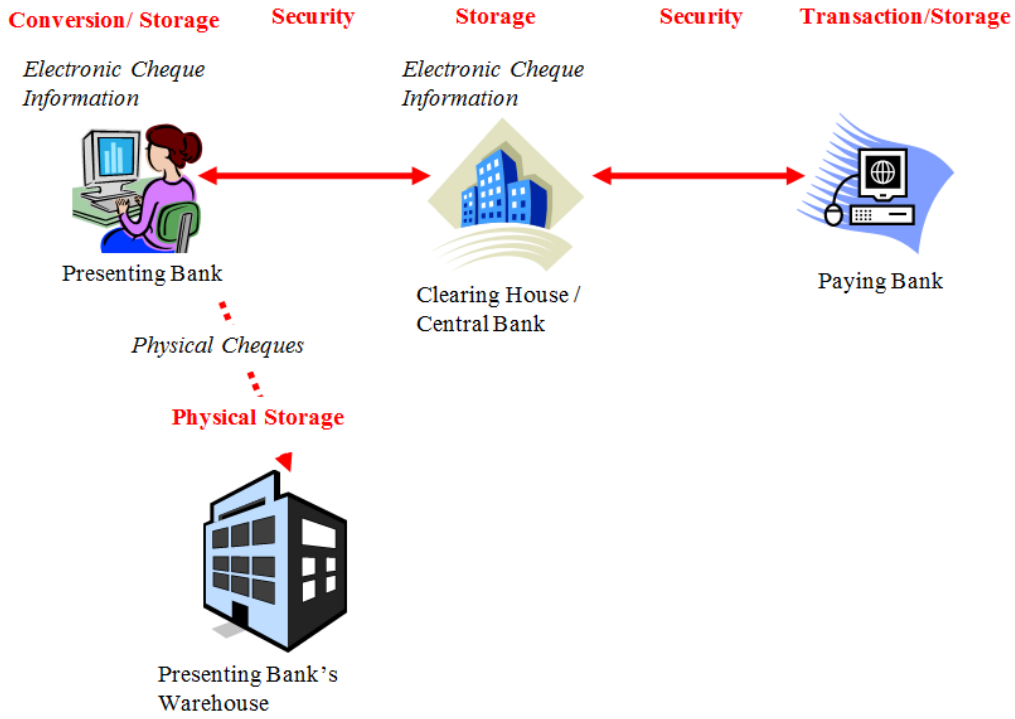


Figure 1: ECCs Process (Source: Authors' Construct)

2.2 Nature of ECCS Models

Literature addressing the nature and benefits has discussed the process of the cheque truncation process in the various jurisdictions. Sreedevi (2013) studied the cheque truncation processes in India (Figure 2), a country which is far advanced in the process, and modelled the process which appears different from what is discussed by Khiaonarong (2000) as the process in Thailand (Figure 3). In Thailand, the process begins with a cheque encoder reader capturing information written on cheques. Second, the information is sent and received through telecommunications links between front-end processor machines located at both commercial banks and the Bank of Thailand. Lastly, cheque information in original physical form is delivered and matched with their electronic versions for verification and settlement in the evening. Sreedevi (2013) and Akshatha (2013) explained that unlike in Thailand, all the cheques are archived in a common warehouse of the presenting bank in India. This is to say that the physical cheques are kept by the receiving bank in India instead of presenting to the central bank for verification as is the case in Thailand. Due to this, the receiving bank in India is responsible for verification of the physical cheque to ensure that it has not been altered in any way.

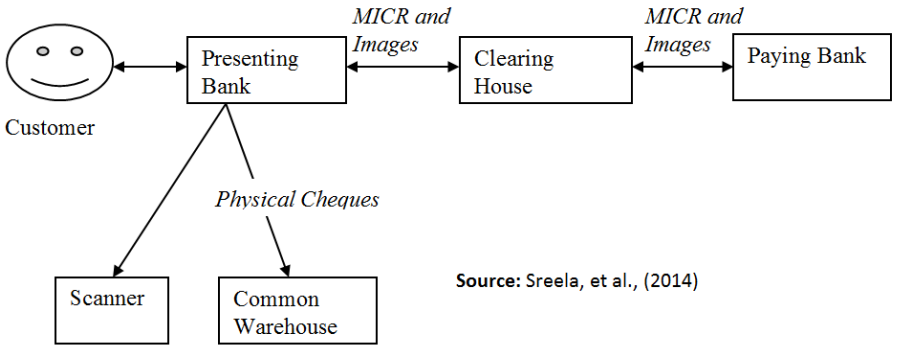


Figure 2: Cheque Truncation Model in India

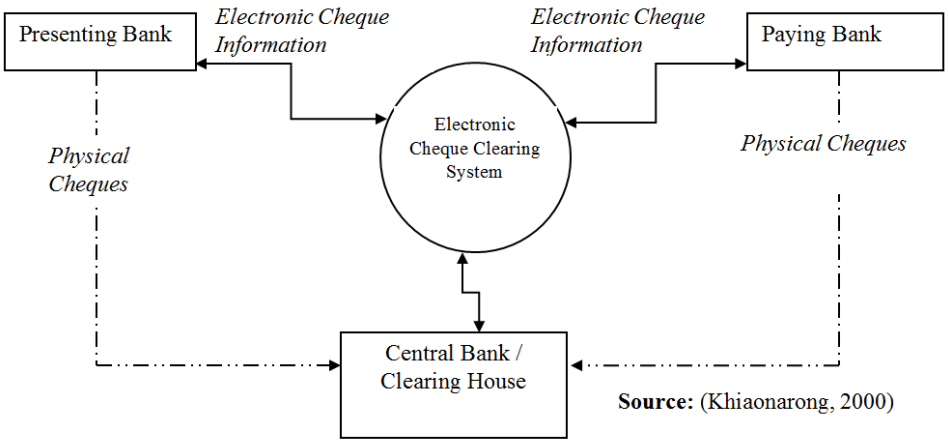


Figure 3: Cheque truncation Model in Thailand

2.3 Automatic Processing of Handwritten Bank Cheque Images

In many countries, the present cheque processing procedure requires a bank employee to read and manually enter the information on a cheque (or its image) and verify the entries such as signature and date (Jayadevan, Kolhe, Patil, and Pal, 2012). Relying on the technology of Pattern recognition, document analysis and biometrics, recent literature (Talele, Nalbalwar, and Rane, 2011; Feng, Ren, Zhang, and Suen, 2014; Mehta, 2010) makes attempt to study the possibility of reviewing bank cheque automatically without manual intervention to streamline the process flow, save cost and time and prevent errors. As many cheques, must be processed every day in a bank, an automatic reading system can save much of the work. Even with the success achieved in character recognition over the last few decades, the recognition of handwritten information and the verification of signatures present on bank cheques remain a challenging problem in document image analysis. Mehta (2010, pp. 761) explained that automatic bank cheque processing systems are also needed to counter the growing cheque fraud menace.

The automatic processing of a bank cheque involves extraction and recognition of handwritten or user entered information from different data fields on the cheque such as courtesy amount, legal amount, date, payee and signature. This is a formidable task and requires efficient image processing and pattern recognition techniques. The only two fields on a cheque that can be processed automatically with near perfect accuracy by character recognition systems are the account number and the bank code as they are printed in magnetic ink. The other fields may be handwritten, typed, or printed; they contain the name of the recipient, the date, the amount to be paid (textual format), the courtesy amount (numerical format) and the signature of the person who wrote the cheque. The multiplicity of handwriting styles although easily recognized by the human brain, is too difficult for electronic systems (Coelho, Batista, Teixeira, and Cardoso, 2008).

2.4 Electronic Interbank Payments Models

According to Chiu and Lai, (2007, pp. 16), there are three main types of interbank payments systems: net settlement systems, real time gross settlement systems, and correspondent banking.

Net settlement is a payment settlement system between banks, in which a vast number of transactions are collated and offset against each other, with only the net difference being transferred and paid by banks. In other words, the participating banks exchange huge sums during the business day and make settlement of net balances at the end of day (Angelini, Maresca, and Russo, 1996).

A clearinghouse acts as an intermediary and collects good funds from due-to banks and releases good funds to due-from banks. Final settlement occurs when the clearinghouse has successfully completed this process. The primary reason that net settlement systems exist is to reduce the cost to settle a given value of payments. If banks had to settle payments individually, they would on average need to hold more reserves (Chakravorti, 2000).

The clearing institution normally completes its daily summarization process and transmits net transfer information to the settlement institution after the cut-off time of the settlement institution. This means that the transfer of funds to the account of the beneficiary bank will be delayed by one business day.

On the economic aspect, the accumulation of huge number of unsettled payments can generate considerable credit exposures among members of the payment system. Moreover, the largest risk in a netting settlement system is the risk that the failure by one participant to fulfil its obligations will lead to a system crash, which is known as the systemic risk (Angelini, et al., 1996; Chakravorti, 2000). The increase of systemic risk in Daily Net Settlement (DNS) systems due to the increasing value of interbank transfers has been a constant concern for monetary authorities. The Bank for International Settlements (BIS) has therefore recommended the adoption of real-time gross settlement (RTGS) systems for large-value transfers (Penaloza, 2009).

Real Time Gross Settlement (RTGS) payment systems have replaced the netting systems around the world in the recent decades. A real-time gross settlement system is a payment system in which all payments take the form of transfers of central bank funds from the account of the paying bank to the account of the receiving bank. In contrast, under net settlement system, payment messages are exchanged continuously, and participants' net positions vis-a-vis all other participants are settled on a periodic basis, usually at the close of business. RTGS uses very advanced hardware, software and communications technology and is based on the processing and settlement of a payment transaction on a real time continuous basis (Khiaonarong, 2000). As banks could make payment orders at any time during a business day, comparing with the net settlement payments system, the RTGS payment system takes the advantage, for which transfers are settled individually, and the system effects final settlement continuously but not periodically. Hence, it prevents the sizeable credit exposures between banks, and the credit risk to receiving banks is at least reduced or even eliminated (Chakravorti, 2000). This, however, comes at a higher demand for liquidity. To prevent the credit and liquidity risk, in almost all RTGS systems, central banks provide intraday credit to participating banks. The terms for such credit vary from system to system, though in most cases, credit is only available in limited amounts or at some cost. In some systems, interest is charged for intraday credit, usually at an administered rate rather than at a market rate. Collateral of various types is often required before credit can be granted.

A *correspondent bank* is a bank that regularly performs services for another financial institution which is usually located in another country. Typical services include handling out of area cheques, trusts and technical services. Overall, a correspondent bank is one that backs up the limitations of a smaller bank, a foreign bank, a merchant bank, or any other financial institutions that would need to "farm out" certain procedures, or services not available at the respondent bank. Many Community banks clear out-of-town cheques through reserve accounts at larger banks. Correspondent banking allows foreign banks to conduct business in the home country and provide services for their customers in areas where the bank does not maintain a physical presence. In a nutshell, foreign banks open correspondent accounts with local banks to avoid the expenses of operating a local bank.

3. Research Methodology

The research objective can better be achieved using a qualitative approach because of the provision of in-depth understanding of this methodology. Following this approach, the case study was deemed appropriate. According to Yin (1994, p.13) the case study method is *"an empirical enquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between phenomenon and context are not clearly evident"*.

3.1 Selecting the case firms

The research population comprises Banks, Savings and Loans and other Financial Service providers operating in Ghana. Within the selected institution, clearing officers and IT officers were used as respondents for the study.. For this study, only three Banks and one Savings and Loans Company in Ghana were contacted. United Bank for Africa, Guaranty trust Bank and Standard Chartered bank were the banks used for the case study. In Ghana, savings and loans are not given the license to participate directly at the clearing house. As such they clear their cheques through other banks with the full license. Opportunity International Savings and Loan was selected to study how they clear their cheques through the licensed banks.

3.2 Development of Interview Questions

Interviews were used as the data collection method. Both open-ended and close-ended questions were written down as a guide prior to the interview. This was done to avoid deviating from the subject matter during the interview. In developing the interview guide the following issues were considered:

Time - 30 minutes of conversation is a limit for bankers due to their busy schedules.
Types of questions- the questions were formulated to satisfy the objective of this study. Clarity of the questions was ensured so that they could easily be understood.

3.3 Data Collection Procedure

Data was collected using interviews. The interviews took place in the convenience of the interviewees' offices. The authors conducted the various interviews with an interview guide prepared on the subject matter. There was however some fluidity in the questioning to allow more insight to be gained on the subject matter and to allow follow up questions. Permission was sought from interview respondents so that a voice recording device could be used to capture all responses whilst putting down notes.

Secondary materials were reviewed, this included the Codeline Clearing rules by Ghana Interbank Payment and Settlement Systems (GhIPSS) and other internal documents from the case Banks that were made available to the authors.

To get first-hand knowledge of the clearing process, the corresponding author used his personal cheque through the clearing process and observed the various activities that transpired to clear. Being an internal audit staff of Private Bank A, the author had full access to all documents, and the right to ask officers any question. The author used the privilege position to conduct an in-depth study on the nature of ECCS in Ghana. Participant observation enabled the authors to learn about the activities of the people under study in the natural setting through observing and participating in those activities (Kawulich, 2005).

3.4 Analysis Techniques

To categorize the qualitative data, the authors used thematic analysis. Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes the data set in (rich) detail. However, it also often goes further, and interprets various aspects of the research topic (Braun and Clarke, 2006). It is a qualitative research technique where the researcher makes notes and sort the data into various categorizes per identified themes (Hinson, et al., 2009). Qualitative approaches are incredibly diverse, complex and nuanced and thematic analysis should be a foundational method for qualitative analysis (Braun and Clarke, 2006). According to Braun and Clarke (2006), "*Thematic analysis can be an essentialist or realist method, which reports experiences, meanings and the reality of participants, or it can be a constructionist method, which examines the ways in which events, realities, meanings, experiences and so on are the effects of a range of discourses operating within society. It can also be a "contextualist" method, sitting between the two poles of essentialism and constructionism, and characterised by theories such as critical realism.*"

In the conduct of this study, the recorded interviews were transcribed, sorted, and classified per the major themes gathered through the literature review as the process of cheque truncation in a systematic and interactive manner. Clarifications were sought on nagging issues after the transcription. The data was further categorized per major themes that answer the research question.

4. Case Findings

The main objectives of this study were to explain how cheques are cleared in Ghana and assess the challenges in order to offer solutions tailored to the ECCS model in use. The study used thematic analysis (Braun and Clarke, 2006) to understand how cheques are cleared in Ghana. An iterative review process of the coding and themes was then undertaken to ensure accuracy and consistency of the analysis. Illustrative quotations as well as system images were gathered to support the analysis and results were also identified during this process.

Finally, the findings of the case study were linked to existing models of cheque truncation systems.

4.1 Pre-Conversion

The pre-conversion process is the first process in ECCS. The process begins after a customer has presented a cheque drawn on another bank for deposit into his or her account. The conversion process differs from Bank and other financial institution. Within Banks individual processes differ. To capture the entire process, the three dominant conversion processes are discussed under the cases below:

Case of Private Bank A

Private Bank A is a commercial bank with a license to operate at the clearing house. The Bank has 25 branches across four different regions in Ghana, namely Greater Accra, Western, Ashanti and Volta Regions.

The Bank runs a cluster cheque data conversion system. Under this system, cheques are converted to images at a central location but segmented based on the geographical location. Cheques presented within the branches in Greater Accra are dispatched to the Head Office Clearing Units who are tasked to do all the conversion. This is the same for the other regions. One branch is designated the head branch within the region and is used as the clearing unit. All images and captured data from the various clusters are transmitted to the Accra Head Office for onward submission to the clearing house.

When asked why the bank adopts the cluster system the Head of Clearing, explained;

> "The system helps the bank to achieve the objective to be a lean bank. With this system, the bank employs as few people as possible for clearing. There is no need to employ clearing officers for each branch and there is also no need to procure hardware and software requirement for each branch."

She however lamented about the inherent risk with the system explaining that;

> "The process of dispatching cheques using motor bikes poses some challenges, for instance on one occasion a dispatch rider was involved in an accident and in the process lost some of the cheques. It also causes delay, as the clearing unit must wait for all the branches to submit their cheques before the scanning process can begin. All cheques must be scanned in a batch before transmission to the GhIPSS. The bank has however put in adequate measures to prevent the reoccurrence of such dispatching issues."

Case of Public Bank B

Bank B is a licensed commercial bank with 52 branches across 8 regions in Ghana which are Greater Accra, Ashanti, Brong Ahafo, Northern, Western, Eastern, Volta and Central Regions.

In clearing, the bank runs a decentralized system where the various branches have been provided with the necessary hardware, software and staff requirement for the clearing process. When a cheque is submitted by a customer, the clearing officer at the branch does the scanning and onward submission to the clearing house.

Case of Financial Services A

Financial Services A is a private microfinance company based mainly in Accra. The company is not licensed to operate at the clearing house, as such participate in the clearing process through Private Bank A. Private Bank A deals with the Financial Services A as one of its branches with one sort code and present all its instruments to the central clearing unit of the Bank for clearing.

4.2 Conversion

The actual conversion begins with scanning the image through the scanner and the capture of data associated with the images such as date, amount, cheque number, sort codes, drawer and payee. Before scanning, the clearing officer is required to ensure that the cheque meets basic banking rules and is not a forged or cloned cheque. Clearing Officer for Public Bank B explained

> "It is against the clearing rules to present a defective cheque for clearing. The onus lies on the presenting bank to peruse the cheque properly before scanning and presentment. It is also important that the right amount on the cheque is captured else the wrong amount will be paid."

All banks and their branches have *sort codes.* These codes have been published by the clearing house and have also been printed on the cheques. The scanner automatically picks the account number, sort code, cheque number from the scanned cheque. The clearing officer is responsible for keying the amount on the cheque which cannot be picked by the scanner. However, in some occasions due to wrong scanning the scanner is unable to pick the sort code and other cheque details. In that instance, the clearing officer is responsible for keying the cheque details manually. It is important that the clearing officer keys in the right sort code.

The Head of Clearing for Private Bank A explained;

"Keying the wrong sort code will result in cheques drawn on a particular bank being sent to another bank. For instance, on an occasion, an error by one of our clearing officers resulted in a GT Bank cheque being sent to Ecobank. Ecobank returned the cheque and the customer threatened legal action against the bank."

An IT officer at Public Bank B explained that;

> "Scanned images must conform to certain laid down procedure enshrined in the Clearing Rule and banks are required to employ vendors who have the requisite technology to conform."

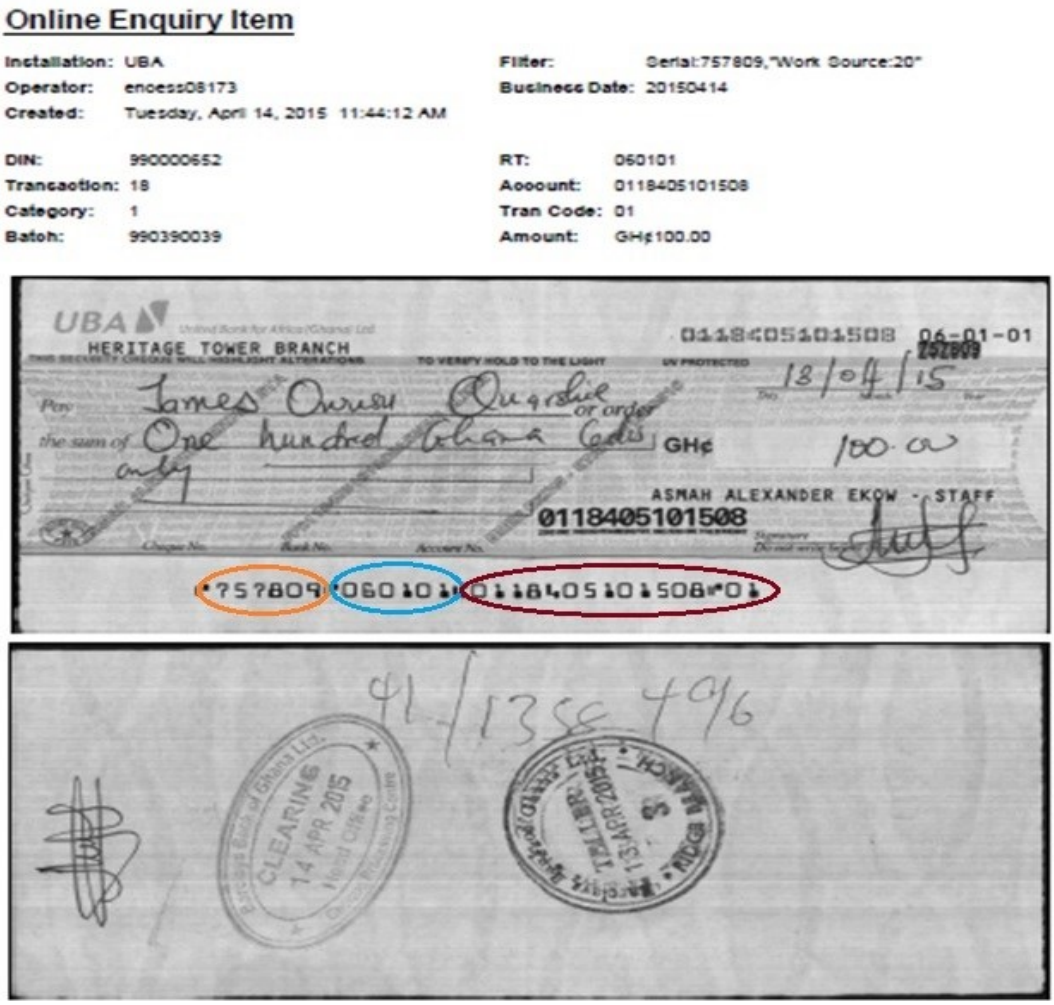
As mentioned in section 2.6 of the Cheque truncation guidelines and procedures published by GhIPSS, Banks shall ensure that the scanning of physical instruments conforms to the prescribed standards as indicated in Table 1 below. Image quality assurance is required at the scanning stage so that the images meet the processing quality standards.

Table 1: Image Standards

SI	**Image Type**	**Minimum DPI**	**Format**	**Compression**
1	Front Grey Scale	200 DPI	JFIF	JPEG
2	Reverse Grey Scale	200 DPI	TIFF	CCITT G4

Figure 4 is an image of a scanner used in the clearing process and Figure 5 shows the scanned image of the personal cheque of the corresponding author which was sent through the clearing process.

Figure 4: Scanner used in the Conversion process



Online Enquiry Item

Installation: UBA
Operator: enoess08173
Created: Tuesday, April 14, 2015 11:44:12 AM

Filter: Serial:757809,"Work Source:20"
Business Date: 20150414

DIN: 990000652
Transaction: 18
Category: 1
Batch: 990390039

RT: 060101
Account: 0118405101508
Tran Code: 01
Amount: GH¢100.00

UBA
HERITAGE TOWER BRANCH
0118405101508 06-01-01
18/04/15
Pay James Owusu Quarshie or order
the sum of One hundred Ghana Cedis only
GH¢ 100.00
ASMAH ALEXANDER EKOW - STAFF
0118405101508
⑆757809⑆060101⑆0118405101508⑈01
CLEARING 14 APR 2015
41/1356 496

Cheque No:
Bank Sort Code:
Customer Account Number:

Figure 5: Electronic information and image presented through clearing

All scanned images need to be presented for clearing at a time, known as the clearing session. Section 1.4 of the Cheque truncation guidelines and procedures indicates the sessions as below:

Table 2: Session Timings

Clearing Session	**Weekday Timings**	
	Opening	**Closing**
Presentment Clearing Session – I (Cheques) **(Normal Clearing Session)**	6.00pm **(Previous day)**	9.00am
Return Clearing Session – III (Cheques) **(Normal Return Clearing Session)**	2.00pm	4.00pm
Presentment Express Clearing Session – IX (Cheques)	11.00am	12.00pm
Return Express Clearing Session – XI (Cheques)	1.00pm	2.00pm

Clearing officer for Public Bank B emphasised that;

> "The presentment session is the time which the presenting banks can submit their cheques for clearing. The Return session is the time which the paying banks can return any of the cheque presented during the presentment session." These timelines must be followed as nothing can be done outside the session unless informal among the banks."

A platform has been created different from the main clearing application which shows whether a session has been closed. In some cases, GhIPSS can extend the timeline depending on some circumstances. The two main sessions are the Normal Clearing Session and the Express clearing session.

The capture system transmits the MICR codeline data and images of the cheques to its Clearing House Gateway (CHG) electronically.

The corresponding author presented his cheque at Public Bank B for deposit into another account drawn on Private Bank A. The image was scanned and sent to the clearing house. Nine (9am) the following morning an image as well as the cheque information as shown in Figure 5 was sent to Private Bank A for payment. After due diligence was conducted on the image the author's account was debited and kept in a designated office account pending settlement.

4.3 Security

The images along with the cash data are then sent to the clearing house in a secured manner. The clearing house rules require that systems shall be configured to apply digital signatures to individual images and MICR codeline data in the Clearing House Gateway (CHG) using Public Key Infrastructure (PKI). In addition, files shall be encrypted for transmission to the Clearing House (CH). All images and data files shall be transmitted over dedicated networks connecting all the CHGs with the CH.

It is the responsibility of the collecting banks to affix digital signatures on the cheque images and the MICR Codeline data in the CHG before transmission to the CH. Banks shall use Public Key Infrastructure (PKI) for this purpose to ensure data authenticity, integrity and non-repudiation. Banks and GhIPSS shall ensure that images and the MICR codeline data are duly digitally signed and encrypted.

Per Section 4.9 of the clearing rules;

Files and data digitally signed shall conform to the following:

1. Hash/digest algorithm Secure Hash Algorithm (SHA-1)
2. Padding algorithm Public Key Cryptology Standard (PKCS)#1
3. RSA asymmetric encryption with 1024-bit key length.

File encryption shall also conform to Triple Data and Encryption Standard (Triple DES) (3DES, TDES) symmetric encryption with 168-bit key length. The cryptographic keys shall be generated and stored in Hardware Security Modules (HSM).

When asked, the IT officer in charge of the clearing application in Private Bank A explained "*Currently images and data are not sent over a dedicated network as recommended by the rules, but with the digital signatures and the PKI system being implemented the system is secured enough. Cost of setting up a dedicated network is huge and would require large investment."*

4.4 Transaction

Images and Codeline data transmitted to the CH are immediately sorted using the sort codes keyed by the collecting banks. These sorted data are made available to the paying banks by CH to download. After downloading the paying bank verifies the cheque data and image to confirm the validity. The signature, amount, cheque number and payee are confirmed before payment. The transaction is confirmed if the paying bank does return the cheque through the issuance of a debit note during the return session as stated above.

The head of Clearing for Private Bank A lamented that "*The default principle where the paying bank pays if no debit ticket is sent in some occasion cost the banks. For instance, recently the bank could not send the debit ticket within the stipulated return session because the internet system for our head office was down. However, the debit ticket was sent during the regular presentment session the next day. The presenting bank did not adhere to the debit ticket which was sent on the next day and credited the customer's account with the full amount of the cheque which was GHS121,250.00. This customer had only GHS4.00 in the account on which the cheque was drawn on. By the next day the customer withdrawn the money from the account making it difficult to retrieve. I recommend that a platform preferably using social media be set-up to aid communication on such occasions.*"

The settlement is done on Net basis. The Bank of Ghana account of each bank is Debited and Credited with the net amount arising out of the clearing sessions.

4.5 Storage

Storage of files and documents in the clearing process occurs in two-fold, i.e. storage of physical cheques and storage of electronic document. The practice is for the presenting bank to store the physical instruments. The paying bank can only request for the physical instrument when there is an issue that needs to be resolved with the physical instrument. Mostly all cheques are kept with the presenting banks and not moved along with payment. Electronically, the presenting bank, CH, and the paying bank all store the images and the cash data associated with the clearing transactions. The minimum statutory period for the storage of the file is Six (6) years.

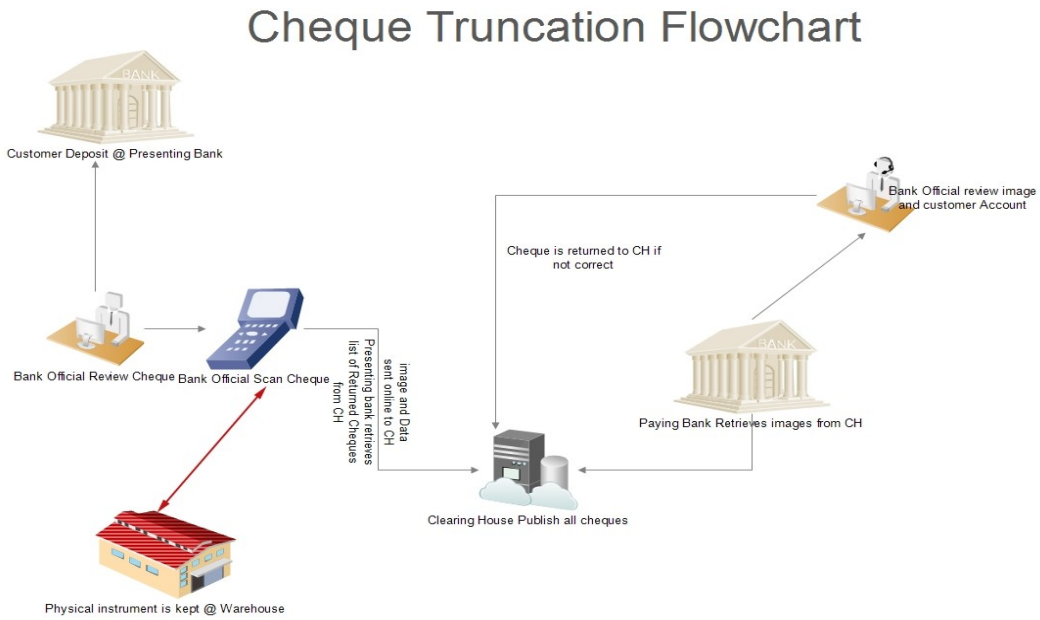


Figure 6: ECCS Flowchart (Source: Authors' Construct)

5. Discussion Of Findings

Figure 6 above depict the ECCS process in Ghana. Studies discussing the pre-conversion process among banks in the Cheque truncation process were non-existent. To this end, this study expands current knowledge of ECCS to some extent.

The conversion process is consistent with the process depicted by both Khiaonarong (2000) and Sreedevi (2013) as the processes in Thailand and India respectively. The quality of the images in the clearing process presented is consistent with the quality indicated by Balakrishnan (2010) as the required quality in India. However, Balakrishnan (2010) stated that in India, although the standards required can be Black and White, greyscale or coloured it was decided that the image quality to be the greyscale technology. This is because the Black and white images do not reveal all the subtle features of cheques and coloured images increase storage and network bandwidth requirements.

Table 1: Image Quality Standards

Image	Type	Minimum DPI	Format	Compression
Front	Greyscale	100DPI	JFIF	JPEG
Front	Black and White	200DPI	TFIF	CCGITT-G4
Reverse	Black and White	200DPI	TFIF	CCGITT-G4

Source: (Balakrishnan, 2010)

5.1 Security

The security system in the cheque truncation process is consistent with the systems described by Balakrishnan (2010) and Sreela, et al. (2014). The use of Public Key infrastructure such as digital signature and encryption for protecting cheque images and data need a lot of computation and usage of keys and thus, to reduce the computation and usage of keys, cheque image can be protected using secret image sharing (Sreela, et al., 2014). With secret image sharing technique, a secret image is distributed to some of the participants through splitting the image into different pieces called shares and recover the secret image by collecting the sufficient number of shares from authorized participants.

Kota and Pal (2014) explained that although the transfer of cheques images from the presenting bank to the clearing house and from the clearing house to the paying bank is secured using asymmetric key encryption, the end to end (from the point of scanning the cheque at the presenting bank to the point where decision about payment is made at the payee bank) encryption cannot be adopted because the content of the image has to be accessed at the presenting bank, at the clearing house and at the paying bank for various purposes. Therefore, an unencrypted image of the cheque is available at these processing nodes, leaving the images vulnerable to malicious tampering. They therefore recommended the use of watermarking which will help detect tampering the images.

5.2 Transaction

The net settlement system practice in the cheque truncation process is in line with the system indicated by literature (Angelini , Maresca, and Russo, 1996; Chakravorti, 2000). Clearinghouse acts as an intermediary and collects funds from due-to banks and releases funds to due-from banks. Final settlement occurs when the clearinghouse has successfully completed the clearing session. The primary reason that net settlement systems exist is to reduce the cost to settle a given value of payments. If banks had to settle payments individually, they would on average need to hold more reserves (Chakravorti, 2000).

5.3 Storage

Existing literature has conflicting views on the storage of the physical cheques. Khiaonarong (2000) highlighted that the physical cheques are delivered to the clearing house and matched with their electronic versions for verification and settlement in the evening. However, the process is consistent with the process depicted by Sreedevi (2013) and Akshatha (2013) which places the verification on the presenting bank, thus there is no need for physical movement of the cheques to the clearing house for verifications.

The storage of the image and other electronic information was however consistent in both jurisdictions.

5.4 Nature of Electronic Cheque Clearing in Ghana (Cross Case Analysis)

From the findings and the discussions presented in the earlier sections, it can be noted that in Ghana, cheques undergo five different set of processes before they are finally cleared for customers to have their needed funds. The first stage being the Pre-conversion stage is the process which involves the activities directed at collating all the physical cheques to be scanned. Private Bank A uses the centralised method where all physical instruments are dispatched to the clearing department for scanning. The bank explained that the approach was to reduce cost of hiring clearing officers at the various branches. Private Bank B however recognises the need to employ clearing officers at the various branches to decentralise the process. The Bank explained that the focus is rather on effective service delivery and turnaround time rather than the cost of operations. Financial institutions which do not have license to operate in the clearing house have to adopt the system implemented by the bank clearing their cheques. In effect the differences between the cases are the need to reduce cost (as is the case of Bank A) and the need to enhance service delivery (as is the case of Bank B). Both

cases arrive at the same end were all cheques received from customers are scanned into an electronic format and transmitted to the CH.

The remaining processes (i.e. Conversion, Transaction, Security and Storage) have similar activities across the various banks. With the Conversion, images are scanned using the specially developed scanning instrument. The scanner automatically captures the details such as MICR code, cheque number and sort codes. The amount stated on the cheque requires manual entry as the scanner is not configured to capture handwritten information on the instrument.

The images along with the cash data are then sent to the clearing house in a secured manner applying digital signatures to individual images and MICR codeline data and using PKI.

The paying bank, upon download the image along with the codeline data, peruse the drawers account to verify the signature and the adequacy of funds in the account. A debit note is sent in the return session if the verification identifies any inconsistencies or inadequate funds.

Physical image is stored by the depository bank, whiles the CH, depository and paying banks all store the digital images and the cash data.

5.5 Challenges of ECCS in GHANA

Quality of Scanner: From the interview, respondents lamented about the continuous sophistication of fraudsters who can clone cheques to perfection, to the extents that the scanners are unable to detect some of the forged instruments. This they highlighted lead to huge losses to the banks and the officers involved in the clearing process.

Poor Collaboration Among Banks: In case of fraudulent transactions, the presenting banks usually do not fully co-operate with the paying bank in tracing and retrieving the stolen funds. There is no legislation compelling the banks to co-operate. This practices per the respondents is a huge challenge in fraud recovery.

Security Breach at Cheque Printing Houses: One assurance for the clearing system is the distinctive features of the cheques used in the process. The expectation is that cheques are printed under secure conditions, however in recent times security breaches at the cheque printing companies means that some of the cheques presented through the system, although cloned match all the security features as such go through the process. *Automatic Processing of Hand-Written Cheque instrument:* The existing process of manually perusing cheques by the paying banks is a huge task that need automation. Respondents indicated that thousands of cheques pass through the system on daily basis, and manual review of these instruments presents an enormous task to be completed within the session timelines.

6. Conclusion

Clearing cheques in Ghana follows five sets of processes captured as the Pre-Conversion, Conversion, Security, Transaction and Storage. The pre-conversion process differs from bank to bank. Some banks prefer to centralise the conversion process, as such all cheques received from the various branches are dispatched to a centralised location (usually the Clearing Department). Some other banks prefer to decentralise the conversion process, so each branch is responsible for the conversion of the physical cheques into images. The choice of a pre-conversion process depends on the bank's focus and objective. The pre-conversion process is followed by the conversions process, where the cheque is passed through a scanner to capture the cheque information and generate an image. The cheque information along with the image is transmitted to the CH for onward transmission to the paying bank. The paying bank, on receiving the image, peruse the customer's account to ensure sufficiency of funds. The transmission of the images is done applying digital signatures to the images and MICR codeline data using PKI. The depository bank keeps the physical cheque, however the digital image is kept by all parties (CH, paying and depository bank).

The cheque truncation process in Ghana, is not without problems. With an increasing interest in the usage of cheques, the manual process of reviewing the hand-written instruments makes the process tedious to manage and require automation based on the pattern recognition approach recommended by Talele, Nalbalwar, and Rane (2011). Again, poor security at the cheque printing house is increasing the levels of cloned cheques. The

central bank should liaise with the relevant law enforcement agencies to enforce adequate security in the printing houses to reduce this menace.

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