



# Cashless Society, Problems and Prospects, Data Mining Research Potentials

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**Abstract**– No doubt, our modern society is gradually catching the cashless syndrome. E-payments, ATM cards and others are now the order of the day at our work-places. This paper takes a keen look into the feasibility of introducing cashless means of business transactions into our society and the security threats associated with it. The paper explains the potentials of applying data mining techniques to effectively control the security threats and finally presents a model for knowledge extraction in a cashless environment.

**Index Terms**– Cashless Society, Cashlessness, Electronic Money and Data Mining

## I. INTRODUCTION

THE implementation of electronic commerce based on e-cash as the main engine driving global economic activity will determine the future shape of society (John, 1997). Virtual shopping, the digital economy, e-cash, e-commerce - these are just a sample in the range of economically-laden terms that have cropped up in recent years to accompany the plethora of new vocabulary spawned by the development and commercialization of the Internet. While most people either know or can guess at what these terms mean, fewer realize the motivations and implications that lie behind the expressions which are being thrown at us by the western world- and even by us.

For centuries, coins, notes and cheques were the only options to make purchases and to transfer money between people and organizations. The second half of the last century witnessed the introduction of plastic cards, Electronic Fund Transfer, Internet banking, and pre-paid payment cards all aimed at making payment more efficient. With advances in information technology a number of new payment solutions has emerged, including premium SMS payments, M-PESA, Pay Pal, Google Wallet, and Bit Coin, Flatter, and Square-Up. Many of these innovations offer advantages in terms of costs, security, and convenience. They also pose a number of challenges and risks related to, at least, technical standards, data security, legal issues and consumer behaviour.

Overall, these innovations are changing people's perception and experience of money and paying. The innovation process in payments is promoted by different groups of actors (such as financial institutions, star-up software companies, merchants,

and mobile operators) and by international governmental agencies (for example the World Bank). Not only new payment solutions attract a lot of attention in media and press, but they also trigger a debate regarding the cashless society.

Throughout history there has been much speculation about a cashless society. With a cashless society in the near future there are many benefits, as well, as many negative implications. The development towards a cashless society affects our life. It will have an impact on the actors in the payment ecosystem, leading to a number of both anticipated as well as unanticipated consequences on individual, organizational and society level. These consequences are of critical importance and need to be explored.

## II. CASHLESS SOCIETY: CONCEPTS AND CONSEQUENCES

Qfinance.com(<http://www.qfinance.com/dictionary/cashless-society>) defines a cashless society as a *community in which all payments are electronic*; a society in which all bills and debits are paid by electronic money media such as bank and credit cards, direct debits, and online payments. It is a society where no one uses cash, all purchases being made by credit cards, charge cards, cheques or direct transfer from one account to another.

Paper money revolutionised the economy when it was introduced (In Europe during the 17th century, though it was around from the end of the first millennium in China) however now it is getting old. We are increasingly moving towards a cashless society. Money will change hands using cards, the internet and mobile phones.

Gradually, in Africa we are moving into cashless economy. For instance, in Nigeria today we have been embracing e-payments in lieu of cash and cheques for services rendered. Instead of carrying big cash around, traders are now sending their money online ahead of their final market destination, by way of PostCash, AfriCash, FastCash and other electronic banking means. ATM cards are also there for people to withdraw money any time and anywhere in the country.

Money is becoming much more of a concept than a physical entity. In developed countries, people are using credit and debit cards in more and more everyday situations, from meals purchased at fast-food restaurants and fuel purchased at gas stations to movies, groceries, sundries, highway tolls and

clothing. Even New York City taxicabs are rigged with electronic card readers. Increasingly, paychecks are electronically deposited, and the money for the bills they pay – mortgages, utilities, cable and phone--are paid electronically as well. Banks offer incentives to consumers for using these direct-pay options, which allow them to keep better tabs on their customers and their money. Welfare and food stamps are issued on cards, which can be downloaded at the register or through an automatic teller machine. As at 2003, the US Federal Reserve Bank said 2003 was the year electronic payments trumped checks as the method of choice. That year, there were 44.5 billion e-payments, compared with 36.7 billion checks (Cashless Society, 2006).

*The Australian* (CeBIT, 2011), an Australian daily Newspaper recently reported that the number of Australians withdrawing cash from ATMs has dropped to its lowest point in over six years, signaling that consumers are reducing their over the counter cash transactions. Debit and credit card analysis firm MWE Consulting, found that debit card ATM withdrawals fell by 6.3 per cent to 2.39 per month in 2009. Monthly transactions peaked in 2006 with an average of 2.62 cash withdrawals each month.

The arrival of the smartphones; and the development of 3G networks which transfer all information quickly, plus the creation of new applications and services by banks and retailers are bringing cashless-ness nearer to us. Orange, one of the Europe's mobile network companies is quickly launching its Quick Tap system, which will let one to buy goods up to £15 at "wave and pay" contactless readers already installed in 50,000 UK stores. But the system will initially only work with one handset – the Samsung Tocco Lite–though more are promised later, and is operated only through Barclaycard. And another network, O2's more advanced offering will let one's phone host several bank and credit cards and permit purchases above £15 while inputting a pin. It will also allow one to text money. So that if one owes someone a penny he will be able to send it from his phone to theirs (UK, *The Guardian*, 2011). Thus, even for low-price purchases, a new generation of mobiles could eventually mean the end for coins and notes.

The above suggests that "Mobile banking has truly come of age as people no longer see the ability to effectively manage their finances by mobile as a novelty or a 'nice to have', but increasingly as the norm".

#### A. Cashless Society Instruments

In this section, we describe briefly some of the electronic instruments facilitating driving the force of electronic society. Card-based alternatives to cash payments are now well established, with credit and debit cards in popular usage. Additionally, new technology has enabled the development of so-called 'smartcards' where additional data can be stored on a microchip (Paul, 2006).

##### 1) Credit and Debit Cards

Credit cards are typically a plastic card (figure 1) with data stored on a magnetic stripe and, increasingly, a microchip. The majority of cards are the same size of 85.60 × 53.98 mm, as set forth by the ISO 7810 international standard. Between



Fig. 1: Credit cards issued by VISA and MasterCard

1971 and 2001, the number of cards per household in the United States grew from 0.8 to 7.6 (Paul, 2006).

Similar in appearance and usage to credit cards, debit cards are a further popular alternative to the use of cash when making purchases. The major difference, as the name suggests, is that in this case funds are withdrawn directly from the purchaser's bank account, rather than accumulating credit which then has to be paid off at a later date, potentially with interest. Debit cards became popular later than credit cards, but are particularly favoured by the banks over alternative more traditional payment methods, such as cheques, which are much more costly for them to process.

##### 2) Smart Cards

A smart card is a plastic card, similar in appearance to a credit card, and containing one or more embedded semiconductor chips. Smart cards typically have a storage area in EEPROM and may also include a microprocessor able to process any data stored. Recent technological progress has seen the development of a "contactless" smart card, in other words one in which the chip communicates with a card reader using radio frequency identification.

Smart cards have significant potential over magnetic-stripe 'swipe' cards, not only can more data be stored, but it can be processed in some way as well. Despite privacy concerns, it seems likely that smart cards are the way forward, with increasing systems merging together. In an article for *Credit Union Magazine*, Schacklett (2000) predicts that "as smart cards gain momentum in the financial services marketplace, it's likely that other forms of plastic like credit, debit, and ATM cards will all meld into one universal, multifunctional smart card". The first major use of smartcards was by French banking association *Cartes Bancaires* who saw advantage of using the technology in reducing fraud. By replacing magnetic striped cards with smart cards fraud rates in France dropped tenfold then (Flohr, 1997).

##### 3) Stored-value Cards

Stored value cards are typically similar in appearance to credit cards and either employs a magnetic stripe or smart card technologies in order to store data. Under this scheme, using an appropriate reader an amount can be electronically added or deducted from a balance on the card. As at the year

2002, such a scheme was seen by some as an “initial step toward a cashless society” (Shelfer and Procaccino, 2002).

#### 4) Electronic Cash

Several companies have taken this idea further and developed cards which can be used in multiple retail outlets, effectively as “electronic cash”. One such system is Mondex, developed by the National Westminster Bank in the UK and later sold to MasterCard International. Mondex was originally developed in 1996 as a “smart card alternative to cash”. Graham Higgins, a banker and co-inventor of Mondex, had been quoted as explaining that the scheme would help alleviate “the burden of counting, storing, as well as the security associated with, physical cash” (Ives and Earl, 1997).

#### 5) Point of Sale Terminals– Automated Cash Register (ACR)

Point of sale (POS) or checkout is the location where a transaction occurs. A “checkout” refers to a POS terminal or more generally to the hardware and software used for checkouts, the equivalent of an electronic cash register.

A POS terminal or machine manages the selling process by a salesperson accessible interface. The same system allows the creation and printing of the receipt. Point of Sale (POS) Terminals are the preferred way of processing credit cards, debit cards, cheques, smart chip cards, electronic benefits transfer (EBT), and other electronically submitted transactions in a traditional retail environment. The terminals are used in “face-to-face” transactions. The merchant will swipe the customer’s card through the terminal or key-in payment information and the terminal does the rest. No doubt, POS terminals are already installed in some of our retail outlets in Nigeria.



Fig. 2: PoS Terminals (Source: Wikipedia – POS)

#### 6) ATM Cards

An Automated Teller Machine (ATM) card (also known as a bank card, client card, key card or cash card) is a card issued by a bank, credit union or building society that can be used at an ATM for deposits, withdrawals, account information, and other types of transactions, often through interbank networks. ATM cards are typically about 86 × 54 mm, i.e. ISO/IEC 7810 ID-1 size (Wiki).

Unlike a debit card, in-store purchases or refunds with an ATM card can generally be made in person only, as they require authentication through a personal identification number or PIN. In other words, ATM cards cannot be used at merchants that only accept credit cards. However, other types

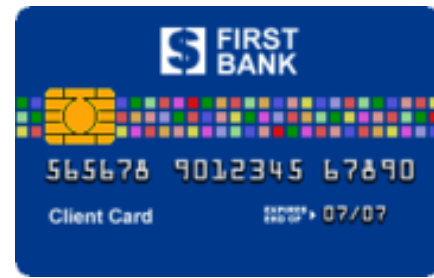


Fig. 3: An ATM Card (Source: Wikipedia– ATM Card)

of transactions through telephone or online banking may be performed with an ATM card without in-person authentication. This includes account balance inquiries, electronic bill payments or in some cases, online purchases.

#### 7) Smart Phones

From the UK Guardian of Saturday May 28, 2011, the following information was written “*Get ready to start paying for sandwiches, magazines and pints down the pub with nothing more than a swipe of your mobile phone as a payment revolution hits Britain's high streets. The idea is that your mobile phone will be embedded with a chip that contains your credit and debit card details. For low-value items, selling for no more than £15, all you will have to do is wave the phone in front of the shop's sales terminal. For higher priced goods, you'll have to punch a pin number into the phone as well. Orange last week unveiled its Quick Tap service, while rival O2 says it is lining up for a major launch in the autumn. Meanwhile, Google this week launched Google Wallet for Android phones which might soon make the traditional wallet stuffed with cards, notes and coins a thing of the past..... Users will be able to check their balance on the mobile phone's screen to see how much they are spending, which you cannot immediately do when touching your debit or credit card on contactless readers*” (UK, The Guardian, May 28, 2011).

#### 8) Implants

Possibly the most frightening aspect of the movement toward a cashless society is the emergence of technology that would allow a microchip to be placed in the human hand that would identify every human being on the planet and allow them to buy and sell without coins, paper or a card (New Dawn Magazine, 1995). A human microchip implant is an integrated circuit device or Radio Frequency Identification (RFID) transponder encased in silicate glass and implanted in the body of a human being. A sub-dermal implant typically contains a unique ID number that can be linked to information contained in an external database, such as personal identification, medical history, medications, allergies, and contact information (Wikipedia).

Theoretically, a Geographical Positioning System (GPS)-enabled chip could one day make it possible for individuals to be physically located by latitude, longitude, altitude, speed, and direction of movement. This GPS-enabled chip would be able to work with the microchip implants. Though, such implantable GPS devices are not commercially available at



Fig. 4: The hand of microchip implant hobbyist Amal Graafstra, just after an operation to insert an RFID tag. The yellow coloration comes from iodine used to disinfect the hand for surgery (Source: Wikipedia - Microchip implant (human))

this time. Convenience or conspiracy, you decide. But like it or not the cashless society is on its way.

### *B) Problems and Prospects*

The main issue of having a cashless society is whether the benefits would outweigh disadvantages. It is important that, if society moves toward a cash free economy, the benefits must outweigh the negative aspects in the end. There are major social and economic benefits to a cashless society such as reduction in cash related crimes and monetary benefits. There are major negative implications with a cashless society such as privacy issues and losing the liberty of cash. A cashless society could only be implemented by the government since the government is the organization that prints and controls the supply of cash in society. With the implementation of a cash free society the major government agency, CBN may be in total control. What this means is that the government would be able to monitor purchases, spending habits and businesses patronized. "The real danger is too heavy a hand watching over your life. It's nobody's business where you spend your money so long as you earn it legally. No government entity should know where you spend money for groceries," (New Dawn, 1995).

The main disadvantages of a cashless society consist of privacy issues and computer hackers. One of the main issues regarding the implementation of a smart card/chip that would record and control all financial transactions electronically is the assault on privacy. With all private monetary data exposed to government officials many citizens may believe that the government has substantial power over society by having access to these types of confidential information. People value their ability to make some of their purchases using cash, with absolutely no record, electronic log, or audit trail of those transactions, as a way to safeguard their privacy (Brown, 1997).

Another major disadvantage with a cashless society is the risk of computer hackers. "Computer experts", so-called "Yahoo-Yahoo Boys", who trick unsuspecting individuals, groups and organisations online to part with their money, might alter records, create fictitious millionaires, set up dummy companies, and so on. In short, they could create an

electronic underground society as well as contribute to the issue of identity theft.

Security is clearly of crucial importance in considering any alternative to physical cash. At the root of this lies the problem of authentication, i.e. the process of verifying the identity of a person. This is typically performed by examining some identifying information such as a password or digital signature.

One of the obvious and most commonly used form of authentication is a password; in the context of payment systems more commonly implemented as a personal identification number (PIN). Such a system has long been in place for authenticating users of cashpoints prior to withdrawing money. However, technological advances meant that criminals have been increasingly successful in making copies of the data stored on the magnetic stripe, and forging signatures in order to commit fraud. Over £402 million was lost in UK through "plastic card fraud" in 2003, which has led to the advancement of a new system, marketed in the UK under the name 'Chip and PIN'5 (BRC Yearbook, 2005; Paul, 2006).

Cashlessness requires that all of society's stakeholders—organizations, financial institutions, governments and individuals—agree on and trust in digital currency. With the global meltdown and continuing fallout in the financial services industry, people are more comforted by the physical and less likely to put all of their confidence in banks and other financial institutions.

Payment processes are the first frontier of a cashless society and will also provide the spark for innovation. Because currently the infrastructure and technology required to support new payment technologies remains largely disconnected. As the world increasingly relies on digital currency, all banks—big and small—will have to evaluate and in some cases enhance their existing technology to reduce errors, increase efficiencies and add transparency. In many cases, the greatest push will be for systems that can deliver end-to-end visibility of the transaction process since accountability will be a major factor in any wide-spread cashless initiatives.

Statistics has shown that electronic payment transactions are quickly replacing cheques. The electronic means mentioned previously is rapidly squeezing the cheque out of the banking scene. The Australian Bankers' Association states that the value of cheque transactions fell by 50% between the years 1998 and 2002 (Shawn, <http://csusap.csu.edu.au/~darbea01/>).

There are numerous perceived advantages often associated with the notion of a cashless society. Firstly, cash is bulky and heavy to carry by the customer. A cashless solution, even a smart card, may well be smaller and lighter. Even a credit or debit card, popular in society today, is significantly lighter than a £1 coin. Electronic solutions also make it a possibility to carry much larger quantities of money around – effectively this could mean carrying one's entire personal wealth. There are also huge costs associated with the overhead of processing physical cash. Primarily, there are costs associated with the production of a large number of coins and banknotes – a cost borne ultimately by the taxpayer. There are also costs associated with the secure transportation of money to and

from banks and retail outlets, as well as staff time to count money (Paul, 2006).

Convenience is a major player in the lives of most people in today's society. Now clients can easily complete the same transactions from the comfort of their own home and at their own convenience. The only real prerequisites to this are that the user must have an up-to-date computer and have an internet connection. The user can do this in the middle of the night if they wish, right after they get off their evening shift. The bank branches are closed, but this is no longer a concern.

Electronic cash in itself is not evil, nor is money itself. It would not be doing the topic justice if a very real hurdle was not addressed as an obstacle to be overcome in the future. This obstacle pertains to religious connotations that are interpreted by many religious people as end time prophecy being fulfilled as outlined in the Holy Bible.

A view held by a lot of Christians is that electronic cash is the vehicle that will introduce the cashless society, and in time, the implanted microchip on all human beings that wish to buy and sell. This view is deeply founded in their belief in the Holy Bible, in particular the passages that refer to the end of time.

*"And he [the Antichrist] causeth all, both small and great, rich and poor, free and bond, to receive a mark in their right hand, or in their foreheads: and that no man might buy or sell, save he that had the mark, or the name of the beast, or the number of his name. Here is wisdom. Let him that hath understanding count the number of the beast: for it is the number of a man; and his number is Six hundred threescore and six." Revelation 13:16-17, (The Bible).*

The implications of a world in which money can only be accessed through personal identification 'marks' in relation to this prophecy are evident to any fundamentalist Christian. Because of Christian's strong beliefs in this area, it will be very difficult to implement a system that will please everyone, and corporations that expect to introduce this type of system can expect a high degree of resistance. The subtleness of implementing this over a long period of time may have some effectiveness, but when it comes down to the actual implanting of foreign devices in their body, there will be an alarm ringing in their head warning them of implications of doing this. The majority of society, both Christian and non-Christian, will probably not accept this as the norm unless there is some overwhelming series of events that happen that could be sold as 'preventable' by having an implant on every human on the planet (Shawn, <http://csusap.csu.edu.au/~darbea01/>)

### III. DATA MINING RESEARCH POTENTIALS

Data mining is defined as the identification of interesting structure in data, where structure designates patterns, statistical or predictive models of the data, and relationships among parts of the data (Fayyad & Uthurusamy, 2002). Data mining in the context of crime and intelligence analysis for national security is still a young field.

There are many data mining techniques available. Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at

large. This approach frequently employs decision tree or neural network-based classification algorithms. The data classification process involves learning and classification. In Learning the training data are analyzed by classification algorithm. In classification test data are used to estimate the accuracy of the classification rules. If the accuracy is acceptable the rules can be applied to the new data tuples.

*Entity extraction* has been used to automatically identify person, address, vehicle, narcotic drug, and personal properties from police narrative reports (Chau et al., 2002). *Clustering techniques* such as "concept space" have been used to automatically associate different objects (such as persons, organizations, vehicles) in crime records (Hauck et al., 2002). *Deviation detection* has been applied in fraud detection, network intrusion detection, and other crime analyses that involve tracing abnormal activities. *Classification* has been used to detect email spamming and find authors who send out unsolicited emails (de Vel et al., 2001). *String comparator* has been used to detect deceptive information in criminal records (Wang et al., 2002). *Social network analysis* has been used to analyze criminals' roles and associations among entities in a criminal network.

There are many research potentials in a cashless society. For instance, according to Edwin Knorr (1997), given the phenomenal amount of transactional data that is likely to be generated, it makes sense to seriously consider the opportunities for mining this transactional data. For example, we may wish to identify suspicious transactions, abuses or fraud in government benefits programs; we may wish to determine what kinds of web information are most in demand; or we may wish to identify patterns in transactions to see where people are spending their money, even if those transactions involve very small amounts. Suppose for example, that people are spending x naira to view certain types of stock market information and that a very large number of such transactions occur per day. It would be interesting to see the type of information most often requested and the type of information likely to be requested next (given that a certain type of request took place). This would not only identify existing trends, but would provide a marketing edge by introducing new services or competition to a particular market niche. After all, if a demand for information exists, it makes economic and strategic sense to exploit it.

There are opportunities for temporal data mining, that is, seeing how patterns develop over time and detecting patterns involving a time dimension. The type of data mining has already sparked interest in the financial community. There is also the possibility of performing spatial data mining, which may be able to address the following types of questions: Which network/host sites receive the most activity and why? Where are most of the financial transactions of a given type taking place? Where are the most security violations taking place and why? Are there flaws in biometric systems that allow too many false negatives or false positives? Do these trends occur along geographic, demographic, or income lines?

Data mining tools are likely to be used extensively in high-volume transaction systems such as those in a cashless society, even if those transactions are not associated with any names (i.e., anonymous transactions). There will be an enormous number of transactions per day, many of them

being for lesser, unnoticeable amounts. Until now, it may not have made sense to record these transactions, but if financial processing is entirely electronic, then these small transactions (which account for the majority of transactions in today's society) will be particularly interesting in terms of knowledge discovery. This means that there are numerous opportunities for research in data mining field especially in this up-coming cashless age about to be introduced to us in Nigeria.

#### IV. A DATA MINING MODEL FOR EXTRACTING KNOWLEDGE IN A CASHLESS ENVIRONMENT

The model presented in Fig. 5 depicts a situation in which the daily transaction data are extracted from server logs of co-operating financial institutions, aggregated and finally subjected to data mining activities. The transaction data has to be extracted via the Internet with a secure network protocol.

From the data aggregation phase, useful data for data mining will be selected, preprocessed and transformed into a suitable data mining structure. Thereafter a data mining task such as classification or prediction is performed using an appropriate algorithm, such as Artificial Neural Network (ANN). Finally, hidden knowledge, such as patterns of spending by people,

from the transaction data will surface. The knowledge so-discovered can be used by decision-makers (the government machineries) and even the financial houses for effective management and administration.

#### V. CONCLUSION

Electronic cash is a system which allows individuals to purchase goods or services in today's society without the exchange of anything tangible. The term money still exists, but it is more in an electronic form than previously. This is the ultimate goal of cashless society paradigm.

This paper has identified some of the important issues which have been, or will be encountered in cashless society brought on in part by electronic cash. By and large, the paper has exposed researchers to a new frontier of research potential— Data Mining.

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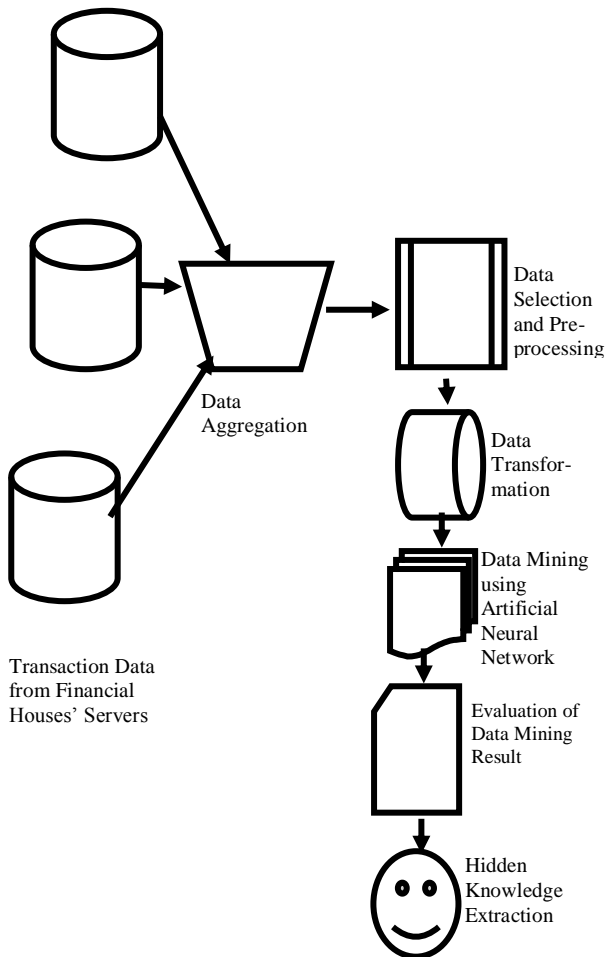


Fig. 5: A model for extracting knowledge from transaction data

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