Conceptualisation of a national integrated credit bureau (NICB) in a developing country context

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Abstract: The financial crisis of 2008 was triggered by a liquidity shortfall in the banking systems of major global economic players, which resulted in the collapse of large financial institutions and businesses, loss of jobs and lack of confidence in global economy. A number of developing countries (e.g., Nigeria) had long been experiencing liquidity shortfall in the banking system due to a highly disintegrated credit management system that has resulted in a high ratio of non-performing credits. The review of literature indicates that a large number of African countries do not have an integrated national credit bureau system. This has resulted in individuals incurring credits beyond their income capacities through the use of single collateral for multiple loans. The research reported in this paper focuses on the development of a conceptual framework for an integrated national credit bureau databank. The proposed framework recognises the uniqueness of the African traditional credit system, which is still predominant in most African societies.

Keywords: credit bureau; databank; financial institution; integrated; credit information; developing country; credit management system; conceptual framework; business information system.

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1 Introduction

Credit bureau/credit reference agency (CB/CRA) is an organisation that collects, collates and processes customers' credit data from various credit sources in order to provide the details of customer credit information to appropriate organisations. The information provided helps to assess the borrowing and repaying habits and credit rating of such an individual or organisation (Arthur and Sheffrin, 2003). The Central Bank of Nigeria (CBN) Act of 2007 S.57 (CBN Act, 2007), advocates the use of such mechanism in order to enable credit agencies make appropriate decisions on whether to grant customers credit. The credit history helps to deduce customers' credit score, which is based upon a variety of factors such as (Chatterjee et al., 2005):

- a Payment history (35%): A late payment or non-payment of past loans has a negative effect on customer's credit score. Thus, customers with poor credit score (bad credit history) may not be able to further obtain loan in the future.
- b Outstanding debts (30%): The amount of outstanding debts against a customer reduces the credit worthiness of the customer.
- c Length of credit history (15%): Customers that obtain loans regularly and maintain loan account for longer periods and also repay on time receive higher credit scores than customers that are newly opening loan accounts. This factor plays an important role in formulating a customer's credit rating.
- d Recent opening of numerous loan accounts and credit limits (10%): A customer that opens different loan accounts and applies for numerous credit facilities is tagged as suspect or 'loan hungry' and may receive a lower credit rating due to these abnormal activities.
- e Types of credit (10%): Loans from reputable sources such as banks and insurance companies increase a customer's credit's score.

The CB/CRA looks at a customer's credit applications vis-à-vis the credit history and repayment report and thus produces a credit score based on the credit report. The contents of the credit history among others are: the open and closed accounts stating the start dates for those accounts; the credit limits; loan amounts and any outstanding balances. The record of payments and repayment patterns are also shown in the credit history (Association of Consumer Credit Information Suppliers, 2009).

CB/CRA offers a number of advantages to companies that are willing to grant credit facilities. Firstly, the reduction in the financial risks on lending institutions who could verify a client's solvency before granting credit. As a result, the likelihood of non-performing loans is reduced. The second advantage is that CB/CRA helps prevent customers from becoming financially over indebted. Based on the information obtained from CB/CRA about the customer, the lending institution may decide not to grant new credit on the basis that it would put unnecessary stress on either the financial institution or the customer. Also, CB/CRA helps lending institutions to minimise default in the loan repayment and to optimise the decision making process involved in granting credit facilities. In general, the more positive information a lending institution can obtain about a customer, the better the credit assessment of that customer and the lower the chances of loan default (Association of Consumer Credit Information Suppliers, 2009).

The credit history of a customer can show positive and/or negative information, depending on the credit bureau's system and the national laws. The national laws define the legal environment in which the CB/CRA operates. The laws may define what kind of data and the degree of details that can be stored. In addition, data protection issues, banking laws and other regulations have to be respected, depending on the national legal system (Association of Consumer Credit Information Suppliers, 2009). The ability of CB/CRA to carry out its duties effectively and efficiently depends on the availability of national integrated database of customers' credit data and also the accessibility to the database. It is established that a number of developing countries do not have integrated national credit bureau system (Luoto et al., 2007; Mylenko, 2007). In Nigeria, CBN Act of 2007 supported national integrated credit bureau (NICB) databank [CBN Act, 2007; S.57(1)] but this has not been fully implemented. As a result, customers could incur credit facilities beyond their income levels and use the same set of collateral for multiple loans. Aremu et al. (2010) identified non-performing credit as a major threat to the banking industry in Nigeria and emphasised the need for financial institutions to embrace the (FICO) credit scoring system as a means of assessing a client's solvency before loans are granted.

According to Chatterjee et al. (2005) over 75% of mortgage lenders and 80% of financial institutions world wide utilise the Fair Isaac Corporation (FICO) credit score. So, it does seem from the findings of Aremu et al. (2010) that the Nigerian financial institutions are late and reluctant adopters of the FICO scoring system. The FICO scoring system could have a number of strengths relating to customer credit assessment. However, the African (especially Nigerian) environment imposes some contextual limitations on the FICO scoring system. The FICO scoring system is not applied to some loans such as high interest pay day loans and other informal/semi-formal loans (Agarwal et al., 2009). These kinds of loans are prevalent in developing countries such as Nigeria, with high communal financial system. Islam et al. (2009) also note that the FICO scores tend to have a high 'bad accepted' rate, and proposed a genetic algorithm alternative to the discriminant analysis and logistic regression-based FICO scores. Using purely statistical methods for decisions with elements of subjective judgements could be faulty. It is argued in Hao et al. (2006) that FICO has a subjective aspect of prediction, which makes it difficult to make consistent estimates.

According to Vlasenko (2009, p.4), existing statistical credit scoring methods 'tend to focus on abstract reports and statistical data to the exclusion of personal contact with the borrower'. The score tends to ignore a key attribute of the borrower (i.e., his/her character). In most African settings, a person's character indicates his ability to fulfil obligations (including financial). A very good financial standing does not guarantee fulfilment of financial obligations. Because of the non-existence of integrated credit management system, it is possible for persons of dubious characters to present just one collateral for multiple loans. Character reference is an essential component of most community informal and semi-formal loans in Africa. A related shortcoming of the purely statistical FICO scoring system is that rigid categorisation of behaviour through credit scoring allows little or no room for discretion and consideration of unusual circumstances (Vlasenko, 2009). In Africa, where a number of people constantly seek small loan amounts, the present FICO credit scoring dimensions would tend to present such persons as having a lower credit rating.

The challenge would be to create an integrated credit management system that takes cognisance of contextual issues relating to the trust-based African lending environment. This study aims at providing an integrated credit evaluation system that takes the following into consideration:

- 1 existing FICO scoring
- 2 informal and semi-formal credit individuals and organisations
- 3 decision support filters (DSF) that take cognisance of character and other non-structured elements associated with informal and semi-formal lending environments.

The framework presented in this study is an integrated and multilevel structure that collates and processes information about individuals at all levels of credit management. The proposed integrated credit bureau framework is meant to capture and track credit information of customers from all financial institutions and also from community groups/organisational credit agencies as well as individuals, and therefore provide a veritable data for loan administration. Apart from the fact that there is no integrated database on customers' credit history, the existing credit agencies do not recognise the peculiarity of the credit environment in Nigeria, which is characterised by the existence of informal and semi-formal loan granting institutions such as contributory scheme associations and other cooperative associations. Access to loan from community groups and individuals is peculiar to African societies.

Nigeria is used as a case study for this modelling. Section 2 describes the credit management system in Nigeria, while Section 3 explores traditional credit scoring models. The design of the proposed system is presented in Section 4, while the implementation structure and organisational schema for the proposed system is presented in Section 5. Some conclusions are drawn in Section 6.

2 Credit management system in Nigeria

The operational capabilities of Nigerian banks and other financial institutions were strengthened by CBN through the implementation of the banking reform which led to merging of some banks in Nigeria (Enyi, 2007). This has helped to increase the capital base of banks and thus increase their lending capabilities to customers. Though lending scope is widened but the credit facilities has to be given to credit worthy customers that has good credit history.

In Nigeria, the credit system is unique compared to what exists in the developed country. In African community, friends and relations can give loan to one another, which is usually based on mutual trust that exists in the family or in those relationships. It is not established that any CB/CRA incorporate this in its system, though such loaning system may be difficult for a CB/CRA to capture. This information is vital and should be part of the credit history of customers in CB/CRA.

Savings and credit cooperatives or credit associations, have always been used in Nigeria and many of the African countries to mobilise local savings and provide credit to members, thereby encouraging thrift and entrepreneurial activity (Bamidele and Spencer, 2007). Members of the credit cooperative societies benefit immensely from the association. The benefits include obtaining loan, which can be two or three times their

savings. Credit cooperatives use relatively unsophisticated administrative practices, so that costs are very small and most interest income from loans may either be distributed to the members as dividends/returns or reinvested in the society in the form of reserves [Nigerian Investment Promotion Commission Act (Decree No. 16 of 1995)].

Consequently, credit cooperative societies are set up in local communities, where there is access to credit facility at non-exploitative terms and conditions. These enable the poor to avoid permanent indebtedness. Presently it is not established that current CB/CRA system has the tools to capture credit history of members of cooperative societies. Such information cannot be underestimated while computing the credit score of a customer. The existence of functioning cooperative societies leaves a positive mark on the economic and social structure of a country since cooperatives develop on the basis of local initiative and local economic strength.

A number of authors have researched into the Nigerian lending environment, which possesses some unique feature. Some of the research works are briefly described in Table 1.

The ability of banks in the country to grant loans has been eroded by individuals who borrowed money from these banks and have reneged on their promises to repay the loans as at when due. Majority of these debts have been classified as bad debts (loan losses) which run into several billions of naira and thus making the banks resort to belt-tightening measures with regards to loans and credits. The absence of credit data has led to banks granting loans to unworthy persons. Customers utilised same collateral to secure loans from multiple banks.

The need to have financial structure that provides information on borrowers and their history became imperative especially after the consolidation exercise in the banking sector when huge funds were injected into the economy. According to CBN, a licensed credit bureau is mandated to collect information on the background and credit history relating to the commitments of persons, enterprises and other organisations in order to determine their overall debt exposure and repayment behaviour [CBN Act of 2007 S.57(1)]. The absence of an institution to provide credit history on individuals and corporate bodies has restricted access to credit to a few (Ekundayo, 2009). The CBN has licensed three Credit Bureaux in the country in line with the CBN Act of 2007 S.57(1). This was done in order to keep track of customer credit history. The licensed Credit Bureaux are: XDS Credit Bureau Limited, Credit Registry and Credit Reference Company. The credit bureau is part of measures to ensure adequate reporting, repositioning and strengthening of the Nigerian Financial System to avoid total collapse, thus becoming an important aspect of the nation's match towards becoming one of the world's 20 biggest economies and Africa's financial hub by the year 2020, as contained in the Vision 20 2020 (Ighomwenghian, 2010).

The Federal Government of Nigeria has indicated its readiness to pursue the growth and development of the Nigerian economy with significant reduction in risks, through appropriate credit information on individuals and corporate bodies (Eboh, 2009). To this effect, the CBN operational guidelines for credit bureau operations requires financial institutions to register with and use the services of the credit bureaux before granting any loan to customers, the guidelines states that, "*All financial institutions must have data exchange agreement with at least two credit bureaux. All banks must obtain credit report from at least two credit bureaux before granting any facility to their customers*" and this is in accordance with the CBN Act of 2007 S.57(3). The approval of CBN for the establishment of credit bureaux in the country is intended to bring a new lease of life to the financial system and restore confidence in the banking system which was recently rocked with crisis of un-serviced debts, lack of confidence and credit challenges.

 Table 1
 Research works on lending in Nigerian environment

Author	Research description
Bamidele and Spencer (2007)	The authors empirically evaluated the effect of cooperative thrift and credit societies in entrepreneurial growth. It was concluded that these societies provide accessibility to affordable credit by rural dwellers and that Nigerian Government should provide enabling environment for the societies to thrive.
Adolphus (2011)	The author did a study to examine the effects of bank management rates on rural lending and small business finance in Nigeria. It was established that the excess liquidity in banking system between 1992–2007 did not improve the flow of credit to small and medium enterprises (SME) in Nigeria. Young small enterprises have little collateral and short credit histories and thus may find it difficult to secure credit facilities from banks.
Olokoyo (2011)	The determinants of commercial banks' lending behaviour in Nigeria were investigated for the period of 1980 to 2005. The determinants considered are commercial banks loan advance (LOA), volume of depositors (Vd), investment portfolio (Ip), interest (lending) rate (Ir), stipulated cash reserve requirement ratio (Rr) and liquidity ratio (Lr). The author established that commercial banks deposits have the greatest impacts on their lending behaviour and thus suggested that they should concentrate on mobilising more deposits in order to enhance their lending performance. Also, comprehensive and realistic strategic financial plans should be formulated.
Dogarawa (2012)	The canons of lending and credit administration methods in pre-colonial Nigeria were studied taking a case study of Kundila of Kano City, Nigeria. The study identified the similarities in lending principles and credit management styles in both the pre-colonial informal setting and modern financial institutions' practices. It was concluded that modern financial sector can learn from the leasing methods of Kundila in order to accord SMEs the opportunity of acquiring sophisticated machineries and equipment.
Tawose (2012)	The author investigated the effect of bank loans and advances on industrial performances in Nigeria between 1975 and 2009 and concluded that the following variables (i.e., <i>commercial</i> <i>banks loan and advances to industrial sector, aggregate</i> <i>saving, interest rate and inflation rate</i>) are major long run determinants of industrial performance in Nigeria. Thus monetary authority is advised to be sensitive to the behaviour of these variables in order to ensure industrial sector growth and economic development.
Kolapo et al. (2012)	Empirical investigation into the quantitative effect of credit risk on the performance of commercial banks in Nigeria within the period of 2000–2010 was carried out and it was recommended that the capacity of banks in Nigeria in credit analysis and loan administration should be enhanced.

In Nigeria, the banking reforms accepted a framework on risk-based supervision (RBS) which is focused at improving asset quality and enhancing lending growth (Adolphus, 2011). However the question is how detailed is the credit history of customers such that banks will be enticed to enhance their lending? Is there a system that captures the entire credit history of people to the local cooperative societies and relationship/family lending? None of the literature reviewed in this work provides answers to these questions and this motivates the credit bureau system proposed in this paper.

3 Credit scoring models

Credit scoring is a method that a lending company uses in order to assess the potential risk of a loan applicant. It gives the company an idea of the average percentage chance of an individual paying back a loan. Credit scores are designed to measure the risk of default by taking into account various factors in the financial history of a person (myFICO, 2010; Dayana, 2010). Typically, the more points you score, the better you are in the eyes of the lender. A credit score is a numerical expression based on a statistical analysis of a person's credit profiles, to represent the creditworthiness of that person. A credit score is primarily based on credit report information typically sourced from credit bureaux (myFICO, 2010; Dayana, 2010). Stated below are some credits scoring models:

3.1 FICO credit score model

FICO is a credit score model mostly used in the USA. FICO score is statistically computed using the information obtained from credit files of customers. It helps to give an idea of the risk involved when banks and other lending institutions are making decisions on granting credit facilities to customers. Customers with higher FICO scores may have the privilege of getting good interest rates on loans. The actual formulas to compute credit score are kept secret by the lending institutions; however FICO disclosed the following components for credit score computation (myFICO, 2010; Dayana, 2010).

- 1 35%: Payment history late payments on loans can cause a FICO score to drop. Loans paid on time will improve a FICO score (Edward, 2008).
- 2 30%: Credit utilisation ratio. This is the ratio of current revolving debt to the total available revolving credit or credit limit. FICO scores can be improved when debts are paid off and credit utilisation ratio is lowered (Block, 2008).
- 3 15%: Length of credit history as a credit history ages it can have a positive impact on its FICO score (Hopkins, 2008).
- 10%: Types of credit used (instalment, revolving, consumer finance, and mortgage)
 customers can benefit by having a history of managing different types of credit (Goldwasser, 2008).

5 10%: Recent searches for credit – credit inquiries, which occur when customers are seeking new credit, can hurt scores. However, individuals shopping for a mortgage or auto loan over a short period will likely not experience a decrease in their scores as a result of these types of inquiries (The Dallas Morning News, 2007). While all credit inquiries are recorded and displayed on credit reports for a period of time, credit inquiries that were made by the owner (self-check), by an employer (for employee verification) or by companies initiating pre-screened offers of credit or insurance do not have any impact on a credit score.

The following factors also weigh on the FICO score:

- 1 Any money owed because of a court judgement, tax lien, and the like, carry an additional negative penalty, which is affected by whether such records are recent or not
- 2 Having one or more newly opened consumer finance credit accounts may also be a negative (Teegardin, 2007). FICO-based scores were marketed under the following names:
 - a Experian: FICO or FICO II
 - b Equifax: BEACON
 - c TransUnion: EMPIRICA

3.2 NextGen score

NextGen credit score is a scoring model designed by the FICO Company for evaluating customer credit risk (FICO, 2009). NextGen score was marketed under the following names:

- 1 Experian: FICO advanced risk score
- 2 Equifax: pinnacle
- 3 Trans Union: precision.

Other credit scoring models are:

- 1 vantage score
- 2 CE score.

Each credit scoring model has differing weights and unique scoring. In Nigeria FICO Scoring model is adopted. Credit score formulas are proprietary and often closely guarded secrets (Khalfani-Cox, 2011).

Credit scoring models combine a set of ratios that pertain to default into a credit score. A credit scoring model has the form:

Credit Score = $(w_1 * \text{Ratio}_1) + (w_2 * \text{Ratio}_2) + (w_3 * \text{Ratio}_3) + \dots + (w_n * \text{Ratio}_n)$

The model sums ratios that are weighted by weights (w). A variety of statistical techniques can be used to determine the weights but two common ones are multiple discriminant analysis and logit analysis.

Multiple discriminant analysis: this is a Z-score analysis, first developed by Altman (1968). Although the model has been refined over time, the original model focused on predicting firm bankruptcy. The z-score bankruptcy model is given as:

$$Z_Score = 1.2 \left\{ \frac{Working \ Capital}{Total \ Assets} \right\} + 1.4 \left\{ \frac{Retained \ Earnings}{Total \ Assets} \right\} \\ + 3.3 \left\{ \frac{Earning \ before \ interest \ and \ taxes}{Total \ Assets} \right\} \\ + 0.6 \left\{ \frac{Market \ Value \ of \ Equity}{Book \ Value \ of \ Liabilities} \right\} + 1.0 \left\{ \frac{Sales}{Total \ Assets} \right\}$$

Altman established a guideline Z-score which can be used to classify firm as either financially sound (a score above 2.675) or headed towards bankruptcy (a score below 2.675). The Z-Score model is based on firms going bankrupt, but models also can be estimated with default on debt or other conditions of financial distress as the defining event. The model can be adapted to situations having more than two outcomes. For example, a model of bond ratings (which involves several classes of bonds) also can be built.

The multiple discriminant analysis is based on regression analysis. The financial analyses of companies for the past years are applied (a period of five years). The study of (Altman, 1968) identified variable ratios that were efficient in predicting bankruptcy namely working capital, retained earnings, earnings before interest and taxes, market value of equity and sales.

Logit analysis: logit analysis is based on different statistical assumptions from discriminant analysis and delivers a score between zero and one that indicates the probability of default. Ohlson (1980) developed an application of the logit analysis to bankruptcy prediction which produced the following model:

$$Y = -1.3 - 0.407(size) + 6.03 \left\{ \frac{Total \ Liabilities}{Total \ Assets} \right\} - 1.43 \left\{ \frac{Working \ Capital}{Total \ Assets} \right\}$$
$$+ 0.0757 \left\{ \frac{Current \ Liabilities}{Current \ Assets} \right\} - 2.37 \left\{ \frac{Net \ Income}{Total \ Assets} \right\}$$
$$- 1.83 \left\{ \frac{Working \ capital \ flow \ from \ operations}{Total \ Assets} \right\}$$
$$+ 0.285 \int_{0}^{1} \left\{ \frac{if \ net \ income \ was \ negative \ for \ the \ last \ two \ years}{if \ net \ income \ was \ not \ negative \ for \ the \ last \ two \ years}} \right\}$$
$$- 1.72 \int_{0}^{1} \left\{ \frac{if \ total \ liabilities \ exceed \ total \ assets}{if \ total \ liabilities \ do \ not \ exceed \ total \ assets}} \right\}$$
$$- 0.521 \left\{ \frac{Change \ in \ Net \ Income}{Sum \ of \ absolute \ values \ of \ current \ and \ prior \ years \ net \ income}{income} \right\}$$

Size is measured here as the natural logarithm of total assets divided by the GNP implicit price deflator (with a base of 100% in 1978). Working capital flow from operations plus changes in working capital flow and cash flow is then transformed into a probability:

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Probability of Bankruptcy =
$$\frac{1}{1+e^{-Y}}$$

where e is approximately 2.718282 and Y is the score estimated from the ratios above.

The models discussed above serve to indicate the form of credit scoring for corporate organisations, which are carried over to individual credit scoring.

4 System design

The existing credit model developed by Epstein and Crane (2005) was modified in order to obtain a model that takes cognisance of the characteristics of the African credit management system, which presents some level of uniqueness to the entire credit scoring process.





Africa has a traditional credit system that spices the western credit culture, which also exists in Africa. This system involves simple (or small) credits that attract little or no interest to the borrower depending on the setting. If it is a close relationship loan such as from family members and friends, it usually attracts zero interest, but if it is a cooperative system, there is usually a marginal amount of interest attached to the loan. For instance in

a cooperative system, a member can obtain loan worth two or three times more than his/her current savings at an interest of just 1%. The model developed by Epstein and Crane (2005) was modified to incorporate some unique features of the African interpersonal and cooperative approach to borrowing and lending money. The modified model proposed in this research is presented in Figure 1.

Our model takes cognisance of the following:

- 1 The FICO scores: This is the primary basis of credit evaluation. The FICO scores have been widely used and evaluated in many contexts, and prove to be a viable means of credit evaluation. The value from the FICO scoring system is given a weight of α , which is determined by the central credit bureau. At this conceptual stage, we do not recommend any specific value for α , but recognise that the weighting of the three input components would vary.
- 2 The social component of the credit system accounts for litigation debts and retail store credit obligations: The component is given a weight of $\beta = \alpha \delta$, where δ is a small differential value. This underscores the level of importance attached to the social debt component.
- 3 The African credit characteristics (relation borrowing, cooperative credit system and character-based credit evaluation): note that the African credit system is very subjective, and character-based evaluation is the most subjective component. Such subjective elements are passed through a decision support filter (DSF) that has a mechanism for converting unstructured information into structured components. The proposed DSF utilises a combination of fuzzy logic and the analytic hierarchy process (AHP) in the aggregation and structuring of subjective values into structured crisp values. AHP (Saaty, 1980) can combine objective and subjective judgemental information in a decision model that carries out a stepwise refinement of decision parameters to attain some level of optimality. Fuzzy logic (Zadeh, 1965) on the other hand, has the ability to manage vagueness and uncertainty in a decision process. Character-based credit evaluation and relation borrowing could introduce a high level of vagueness and subjectivity into the decision model. The African credit characteristics is given a weight of $\Upsilon = \alpha - n\delta$, where α is the FICO score weight, n is the weight differential factor between the FICO score and the African characteristics component; δ is a small differential value.

The final credit scoring model is of the form:

 $CS = \lambda \alpha + \mu \beta + \theta \Upsilon$

where λ , μ , and θ are individual scores obtained from the FICO, social credit and African credit component respectively.

Note that the corporate clients are not affected by the African credit, the FICO scoring and the social credit components. Therefore, corporate credit evaluations are based on multiple discriminant and logit analysis. All other definitions of the model components are as indicated in Epstein and Crane (2005).

4.1 System architecture

The proposed NICB is a distributed software system, which allows applications to access data from central and local database servers. It consists of multiple autonomous computers that communicate through a server. The server component provides functions or services to one or many clients, which initiate requests for such services. The conceptual diagram of the proposed architecture for NICB is presented in Figure 2. The architecture is divided into three layers:

- 1 the data sources (credit agencies located around the country, banks and other financial institution)
- 2 the data bank (that is the main data repository which is expected to reside at the CBN)
- 3 the financial institution users who use the web application through a web browser.



Figure 2 Architecture of the proposed system (see online version for colours)

The proposed architecture is a three-tier client-server architecture. The three tiers are:

- 1 The client tier or presentation tier. This is the topmost level of the application. It communicates with other tiers in the network.
- 2 The middle tier or business logic controls the application's functionalities by performing detailed processing.
- 3 The data storage tier. This tier consists of database servers in which data and information are stored and retrieved. This tier keeps data neutral and independent from application servers or business logic. Giving data its own tier also improves scalability and performance. In client-server applications, the server provides some services, such as processing database queries. The client uses the service provided by the server, displaying database query results to the user. The communication that

occurs between the client and the server must be reliable. That is, no data can be dropped and it must arrive on the client side in the same order in which the server sent it.

The NICB is proposed to be a web application. The proposed architecture has a databank and server, a firewall for security, the credit agencies and its organisational users, the commercial banks and its staff as users, other financial institutions (such as microfinance banks, insurance houses, stockbrokers, etc.) and their system users. The Databank repository of the proposed credit bureau system will be hosted at the office of the CBN. This is to foster data uniformity, easy and quick access to data/information, concurrency operations and reduction of data redundancy. The firewall in the architecture acts as security for the centralised credit bureau databank, in order to avoid unauthorised user access. The sources of data for the databank are the credit agencies, commercial banks, and other financial institutions (which include microfinance banks, stockbrokers, insurance houses, cooperative organisations and other informal/semi-formal lending agencies). The employees of each of the sources of data connect to the application using secured protocol through a web browser. We propose that the credit agencies should be located in each local government within the country. They will all report to the national credit bureau office. This approach is similar for the Commercial banks and the other financial institutions including credit societies located throughout the country. This ensures a hierarchical aggregation of information.

The constraints enforced on the architecture of NICB are as follows:

- a the system users will be assigned privileges
- b the system does not register a client twice
- c the system stores log information of any operation performed by a user
- d the system will have a control panel that can be accessed by privileged administrators.

4.2 File structure of the databank

Relational database model is adopted to represent the database object considered for the proposed NICB. A relation is referred to as a table with columns and rows (Date, 1977; Connolly and Begg, 2002). The databank is a network of objects that are semantically related and they are represented using relations. The general form of a relation is as follows (Kroenke, 1992; myFICO, 2011):

 $R[A_1, A_2, \dots, A_k, A_{k+1}, \dots, A_{n-1}, A_n].$

The name of the relation is represented by R, the set $\{A_i\}$, i = 1, 2, ..., n, represents the attributes of the relation R.

The following relations are considered in the proposed database model:

- a USERS[users-id,username,password,last-login] Users table
- b ACCOUNTTYPE[account-id,accttype,description] Account type table
- c AUDITORINFO[organisation-id,accountid,auditreportpath,auditfirmname,auditfirmadress] – Auditor information table

- d BANK[bank-id,bankname,description] *Bank Table*
- e CLIENTBANKINFO[client-national-id,client-acctno,bankname,bankbranch,accttype] – *Client bank information table*.
- f CLIENTINFO[client-national-id,title,surname,fname,othername, residential-addr,office-addr,emailaddr,mobilephoneno, sex,int-passp-no,date-of-birth,driver-lic-no,marital-status,employmenttype,employment-class,employment-status,place-of-employment,monthly-grossincome,monthly-net-income,annual-gross-income,annual-net-income] – *Client information table*
- g CLIENTLOANDETAIL[client-national-id,client-acct-no,name-of-lender, loan-tenure,loan-requested,amount-granted,start-date,end-date,loan-type] – *Client(individual) loan detail table*
- h CLIENTQUALIFICATION[client-national-id,client-qualification] *Client* qualification
- i CLIENTSPOUSEINFO[client-national-id,spouse-title,spouse-surname, spouse-fname,spouse-othername,spouse-employment-place,home-addr,spousephone-no,spouse-sex] – *Client spouse information table*
- j COLLATERAL-LANDED-PROPERTY[client-national-id,registrationno,certificate-of-ownership,survey-reg-no,location,size-squaremetre,monetary-value] - Collateral (industry/land) table
- k GUARANTORINFORMATION[client-national-id,guarantor-national-id,guarantortitle,guarantor-surname,guarantor-othername,guarantor-addr,guarantor-phoneno,guarantor-email-addr] – *Guarantor information table*
- 1 NEXTOFKIN[client-national-id,next-kin-national-id,next-kin-title,next-kinsurname,next-kin-othername,relationship-type,addr-next-kin,email-addr-nextkin,next-kin-phone-no] – Next of kin table
- m ORGANISATIONINFO[org-id,org-reg-no,cert-of-inc-no,name-of-org,officeaddr,cash-flow-statement,financial-projection,industrial-sector-of-operation,auditorsreport,years-in-business,principal-product,avg-monthly-turnover,avg-annualturnover,regularity-of-cash-flow] – Organizational information table
- n ORGANISATIONBANKINFO[org-id,org-acct-no,acct-name,bank-name,bankbranch,acct-type] – *Organisation bank information table*
- o COLLATERAL-VEHICLE[client-national-id,engine-no,chassisno,colour,make,model,monetary-value] – *Collateral (vehicle/machine) table*
- p COLLATERAL-SHARE[client-national-id,share-cert-no,share-unit,monetary-value] *Collateral (share) table*
- q ORGANISATIONLOANDETAIL[org-id,acct-no,name-of-lender,loan-tenure,loan-requested,amount-granted,start-date,end-date,loan-type] *Client(organisation) loan detail table*

r ORGANISATIONRELATIONSHIPMANGER[relationship-officer-id,org-id,relofficer-sname,rel-officer-othername,rel-officer-position,phone-no,office-addr] – Organisation relationship manager table.

5 Implementation structure and organisational schema of the proposed NICB

The implementation of the proposed NICB is a structured one that is viewed in a top down manner and access is gained to it by supplying a valid user name and password, which are verified by the authorisation module/unit. Figure 3 presents the implementation structure. The system is composed of three main modules:

- 1 customer registration module
- 2 customer credit requisition unit
- 3 credit reporting module.

The customer registration module provides the platform to register details of customers (individual or corporate organisation) that apply for credit facilities. Each customer has unique identification. Customer credit requisition module provides the interface to input records of registered loans or credit facilities that are:

- 1 applied for
- 2 facilities approved and granted
- 3 facilities not approved.

On the credit requisition interface there are links to different loan categories. Customer unique identity is always verified by the module for verification of customer identity. This is done before customer loan request is processed further.

The credit report module provides the platform to present various tabular reports needed by the credit bureau agencies, financial institutions and CBN. There are categories of reports to be generated. Some of the reports envisaged are: generate list of registered customers periodically; periodic report on credit requisition at any given financial institution; compute the credit score of any given customer; periodic report on the total loan awarded by any given financial institution; periodically generate list of customers granted credit facility by any given financial institution; generate report on loan repayment history of any given customer periodically; generate report on loan repayment in any given financial institution periodically; generate list of offset loans at any given financial institution periodically; generate list of servicing loans at any given financial institution periodically; generate list of servicing loans at any given financial institution periodically; generate list of servicing loans by any given customer periodically; generate list of loans overdue for full repayment periodically.



Figure 3 Implementation structure of NICB modules/units and their hierarchical relationship (see online version for colours)

Figure 4 presents the proposed organisational schema to operate the prototyped NICB in real life in Nigeria. Nigeria is composed of three-tiers of government: *Local Government, State Government and Federal Government*. Though both State and Local Governments get revenue from the federal government monthly but they also have the economic power to generate revenue internally. They can also seek credit facilities from both national and international financial institutions in order to finance capital projects or provide loans to the citizens. Loans provided to the citizenry can be for domestic or business financing. In view of this we proposed a schema that will be able to capture credit history of individuals and organisations at the local government level, which is the grass root of the three-tiers of government. The schema is as follows:

- a Location of CB/CRAs in local government areas (LGAs) with client systems. The CB/CRA agencies and financial institutions located at various LGAs capture the customers' bio-data and credit data at various remote locations in the LGAs. This is done through remote terminals located in various towns and villages. These terminals would be connected to the LGA tier server via mobile Internet access provided by phone companies or through satellite access. Data from the LGAs are transferred to the central server for permanent storage and credit analysis.
- b Location of financial institutions client systems at the various financial institutions for capturing regular credit transactions and transmitting such to the CBN office for storage and processing.
- c Location of national database server at HUB for CB/CRA located at the National head office of CBN. The database server at LGA HUBs connects to the National database server. Banks, non-formal lenders and other lending institutions could access the central credit bureau after appropriate authorisation from the client.

Information retrieved by various institutions could be filtered based on the institutional need and privacy requirements for various credit report components. For example, a bank would have access to the full credit record of an individual, whereas an individual or corporative society could be provided with a qualitative statement regarding the credit situation of the individual on a linguistic scale of 'excellent credit', 'very good credit', 'good credit', 'poor credit' and 'bad credit'.



Figure 4 Organisational schema for NICB real life operation

6 Conclusions

As lending agencies (banks, insurance companies, microfinance institutions, credit societies, etc.) spread, competition increases, and bad borrowers who default on one loan might simply take their next loan from another lending institution that is unaware of the bad credit history. Rising competition without information sharing among lenders typically leads to a poor repayment performance of customers. In view of this, the proposed NICB becomes inevitable. This provides lenders with the ability to identify good clients that could benefit from loans at reasonable interest rates, and significantly reduce the incidence of loan default and collateral security pranks.

The other significant contribution of this work is the inclusion of traditional credit system that is peculiar to Nigeria (and many of the African countries) in the proposed framework. This produces an input to the credit evaluation system through the use of the decision support filter, which has the ability to handle vague and unstructured values such as character references. We recommend that credit agencies should be located in the LGAs and accessed through town and village workstations. This is because towns and villages form the locational framework for the African credit system. The credit agencies primary duty will be to capture the simple loan information from informal and semi-formal lenders. Other forms of loans are captured by the financial institutions and transmitted directly to the national credit database.

We recognise that while this paper provides a high level conceptual framework, there is need for further work on the processing and implementation details. The fuzzy-AHP component of the DSF needs to be fully developed and the data objects and processing sequences also need to be elaborated. The system proposed in this paper needs some level of acceptance by government and financial institutions within a corporate framework in order to be operational. An awareness and acceptance study would be necessary in order to define a detailed implementation framework for the model.

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