

Full Length Research Paper

A prototype mobile money implementation in Nigeria

Ayo C. K¹, Ukpere W. I.^{2*}, Oni A.¹, Omote U¹ and Akinsiku D.¹

¹Department of Computer and Information Sciences, Covenant University, Ota, Nigeria.

²Department of Industrial Psychology and People Management, Faculty of Management, University of Johannesburg, South Africa.

Accepted 24 October, 2011

Researchers have shown that majority of the populace in the developing nations are rural dwellers that do not have access to basic financial services and are poor. This class of people are peasant farmers and petty traders who rely mostly on remittances from their wards and relations in major cities and abroad to meet their financial obligations at home. The methods of remittances are encumbered with challenges. Mobile money is a tool that allows individuals to make financial transactions using mobile cell phones. Nigeria is one of the fastest growing telecoms nations of the world and the adoption of mobile money will help a great deal to solve the problems associated with remittances. In this paper, we present a short messages services (SMS) and unstructured supplementary service data (USSD) implementation of mobile money implementation in Nigeria modelled using Django and Python as the programming language, MySQL as the data store and Apache hypertext transfer protocol (HTTP) as the Web server. The system made comparative analysis with M-PESA implementation in Kenya: the first mobile money implantation in Africa. Furthermore, the system was tested among a selected few of the populace to evaluate the usability of the design. Findings revealed that the prototype implementation is user-friendly and can be used by all without many problems except for the illiterate populace; hence, the need to have a combined bank and agent-based implementation. This approach will help with time to reduce the number of unbanked populace, which is currently at 80%.

Key words: Mobile money, bank, Nigeria.

INTRODUCTION

Mobile money refers to a suite of financial services between partners that are offered through mobile phones and other handheld mobile devices. These services include person-to-person transfer of funds, such as domestic and international remittances, person-to-business payments for the purchase of a range of goods and services, and mobile banking, through which customers can access their bank accounts, pay bills, or deposit and withdraw funds (Jerkins, 2008). The concept of mobile money transfer is not entirely new. It is a veritable tool that is capable of transforming traditional banking for those at the bottom of the pyramid to the present level. Mobile money merges the regulatory environments of both telecommunications and banking

into a new paradigm that ultimately demands a collaborative dialogue among providers to balance intervention for risk mitigation with market innovation (GSMA, 2007). The widespread diffusion of ICT, particularly mobile phones is known to have the potential of bridging the digital divide as well as alleviate poverty through the direct and indirect jobs creation (Drake et al., 2008). Narrowing the digital divide is directly linked to economic development, hence reduction of poverty. Accordingly to the World/UN Foundation and SanBoeuf (2006), about 70% of the population in developing countries, particularly in Africa, majority of the populace live in rural areas and have no access to financial services. Mobile payments (m-payments) are financial transactions undertaken using mobile wireless devices such as mobile phones, PDAs, IPADs and notebooks (Etisalat, 2011). Mobile banking (m-banking) includes m-payments but involves access by mobile device to the broader range of

*Corresponding author. E-mail: wilfredukpere@gmail.com.

banking services, such as account-based savings or transactions products offered by banks (Jerkins, 2008). M-payments and m-banking are themselves subsets of the broader domains of e-payments and e-banking, respectively (Ayo, 2009).

Over the last few years, the mobile and wireless devices market has been one of the fastest growing markets in the world. Mobile devices are the most promising way to reach the masses and to create stickiness among customers, due to their ability to provide services anytime, anywhere, with high rate of penetration and potential to grow (Buse, 2002). Going by the Nigerian statistic, only 30% of Nigerians have bank accounts and over 70% who possess mobile phones (NCC, 2011; Okoegwale, 2011).

As of 2009, 68% of the world's population had mobile cellular subscriptions (ITU, 2009). The growth in mobile telecommunications services is expanding the reach of financial services across wireless networks in the less developed countries, creating the potential for significant growth in mobile commerce and financial inclusion. The mobile money for the unbanked (MMU) is contributing greatly to expand financial inclusion in emerging markets through mobile-enabled financial services and their supporting technologies. The growth of ubiquitous computing has the potential to extend more financial services to unbanked people throughout the world, with the projection of about 364 million people by 2012 (GSMA, 2009).

As more citizens of the developed countries become unbanked as a result of widespread economic crisis, financial service providers have begun to explore the potential of mobile money as a means of enhancing financial inclusion as well as solving the challenges of remittances. Mobile money transfer (MMT) has the potential to catalyze the entire financial service market including mobile payment, banking and transfer because it stabilizes the infrastructure for remote mobile transactions and the concept of mobile wallet (GSMA, 2008).

The motivation for this paper stems from the increased penetration of mobile phones in rural areas, which offers a good platform to reach the unbanked and enable them enjoy financial support from their relatives in towns through remittances. Thus, mobile phones have the potential to empower people in the developing world by providing civic and commercial resources where traditional infrastructures are lacking. Generally, mobile money implementation has a prominent role to play in attaining that Millennium Development Goals (MDGs), particularly in the developing nations of the world. The objectives of this paper are to develop a prototype mobile money implementation in Nigeria through SMS and USSD implementation; to leverage on the experience of M-PESA implementation in Kenya; test the usability of the system; and to propose a framework that will serve as a springboard for mobile money implementation in other developing nations of the world.

LITERATURE REVIEW

M-PESA ("M" for mobile and "PESA" for money in Swahili) is an electronic payment and store of value system that is accessible through mobile phones. It was developed by mobile phone operator Vodafone and launched commercially by its Kenyan affiliate Safaricom in March 2007 (Ignacio et al., 2010). To access the service, customers are expected to register at an authorized M-PESA retail outlet. M-PESA allows customers to exchange digital amounts for cash at any of the 25,000 M-PESA agents or at banks' premises in Kenya as well as uses their phones to transfer funds to other M-PESA users and even to non-registered users, pay bills, and purchase mobile airtime credit etc. All transactions are authorized and recorded in real time using secure SMS. M-PESA is useful as a retail payment platform because it has extensive reach into large segments of the population.

The M-PESA operational overview entails (Jack and Suri, 2010; Jekins, 2008):

1. Consumers register by providing an official form of identification such as a national ID card or a passport.
 2. Safaricom accepts cash deposits from customers who have registered as M-PESA users.
 3. Safaricom issues electronic credit measured in the same units as money in exchange for cash deposits and records the amount to the consumer's account. This e-float is then available for transfer from one registered user to another using SMS texting, or alternatively cashed out at a later time.
 4. The consumer may have received a transfer as a gift or a salary payment, for example, and chooses to withdraw some or all of those funds in the form of cash currency through the MNO agent.
 5. In a reverse sequence to the transaction described earlier, the agent or airtime reseller purchases airtime from a consumer after verifying the consumer's identification and credentials for authenticity and then debits the mobile account, with a corresponding credit to the agent's account with the MNO.
 6. When the sender provides the PIN, the service provider executes the transfer by notifying the receiver of the payment.
 7. The recipient now has the option of cashing out the received funds, saving the funds in the mobile account for future use, potentially using them to pay for goods and services at a retailer; or sending the funds to another mobile account holder. Companies such as PayPal, Obopay, and Cash edge Pop are generally referred to as mobile payment service providers, or MPSPs.
- Although, the current implementation of mobile money in Kenya (M-PESA) and Philipine (Smart Padala and GCash) revealed that banks and post offices are not involved but informal carriers because of accessibility, speed and low-cost associated with the option (Porter,

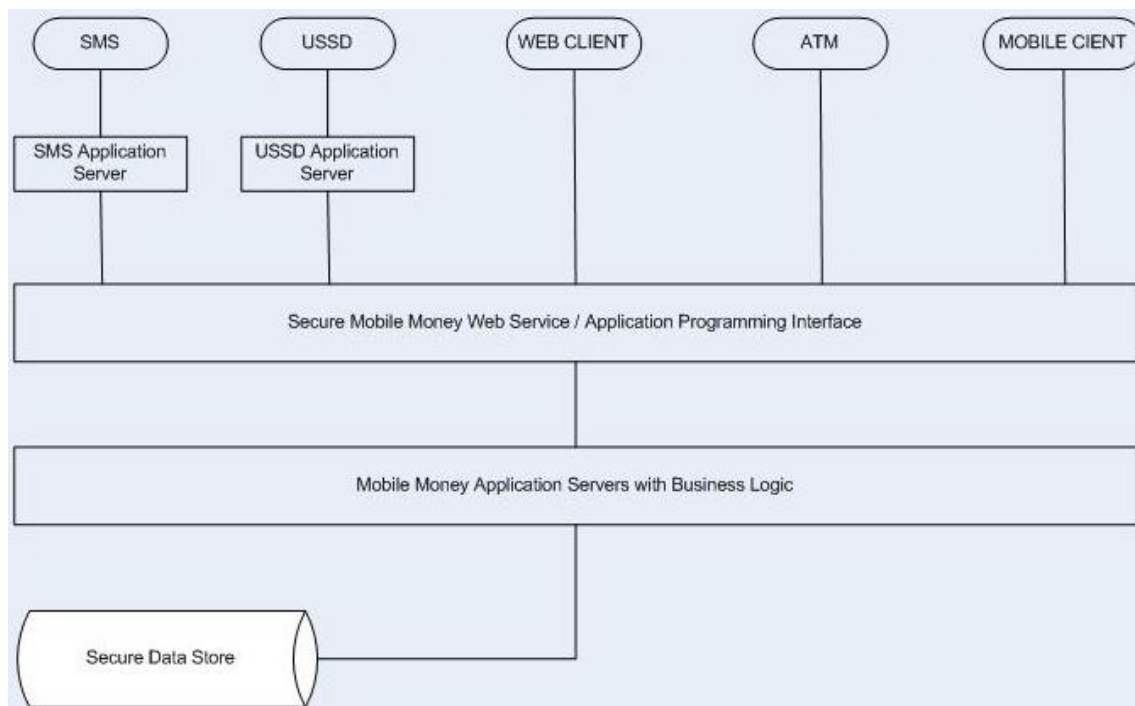


Figure 1. Mobile money architecture.

2009; Ngugi et al., 2006, Colombant, 2011), the proposed model for Nigeria will be a combination of account-based and electronic currency systems.

Presently, Nigeria is at the verge of adopting mobile money implementation. Consequently, the central Bank of Nigeria (CBN) has given approval in principle (AIP) to sixteen organizations (banks, telecoms operators and exchange firms) to set the pace for a smooth takeoff of the system. When fully implemented, it might come in any of the following names such as M-Teller, M-Naira etc. (Okoegwale, 2011).

SYSTEM DESIGN OVERVIEW

The operations of mobile money all over the world are virtually the same but for some environmental factors. Therefore, the level of adoption of mobile phones in Nigeria, being the highest in Africa notwithstanding, the percentage of the banked populace is abysmally low, therefore, there is dire need for a payment system that is simple to use, very reliable and efficient.

Presently in Nigeria, all the Telecoms operators offer SMS, USSD and EDGE (Enhanced Data for GSM Evolution) for data services (Multimedia Messages Services (MMS), Wireless Application Protocol (WAP) and Internet) (Etisalat, 2010). Therefore, the needed platform for mobile money implementation is readily available.

M-PESA works via SMS and USSD commands. Thus, mobile money commands can be implemented by

sending SMS or made available as application software on the handsets of customers rendered by all the operators (William and Suri, 2010). Therefore, the adoption will not lead to any form of social exclusion. Usability is enhanced in the design and the user does not have to memorise commands.

DESIGN METHODOLOGY

3-tier architecture was employed. Django and Python were used as the front-end, Apache HTTP was used as the Web server (Middleware) and MySQL was used as the data store (Back-end). The usability of the system was tested among a few select group and the results shown in Figures 4 and 5. The proposed architecture is presented in Figure 1.

SMS: The SMS functions by sending text messages from the sender to the recipient and vice versa through SMS application server. The SMS is the most widely used service on the mobile network.

USSD: This is similar to SMS. But instead of the user sending text messages, they are issued as commands to the network provider. There are two approaches to this, the short code and the menu command. With the short code approach, the user sends a text code as *444# for example on the handset and the list of menu items appears. Alternatively, the telecoms providers have the mobile applications developed for most of their operations from where a user selects from. The list of USSD commands available from providers in Nigeria are listed in Table 1.

Web client: The web client provides an interface for users who may wish to perform online transactions.

ATM: The ATM is also another means by which users may access

Table 1. USSD commands from Nigerian telecoms providers.

Providers	Commands	Services
Etisalat	Services	Services
MTN	MTN services	MTN SIM Plus
Glo	Magic Plus	My Services
Airtel	Applications	Services

their account.

Mobile clients: Similar to web clients, they are installable applications on the user's mobile phone.

From Table 1, both SMS and USSD options are available in Nigeria but the most widely used is the SMS.

Design consideration for the Nigerian market

Nigeria is the largest black populace of the world with a total population of about 150 million. The illiteracy level is put at 70%, the percentage of the unbaked is estimated at 80%, and about 80% of the populace are rural dwellers (Okoegwale, 2011; DFID report, 2006). From the foregoing, for mobile money to succeed in Nigeria, the target should be the rural dwellers that are illiterates and lack access to basic social amenities of life.

M-PESA started in Kenya as agent-based system but with the tremendous growth, there are considerations for both banks and agents because of logical security (fraud), cost of re-balancing and travel cost to the nearest banks branch, physical security (theft and robbery) and agency sustainability (Okoegwale, 2011). Therefore the proposal for Nigeria involves:

1. Smartcard-based national ID card – to serve as ATM and National ID card.
2. All Nigerians have a national ID card that doubles as the ATM card in this case.
3. ATMs are located at public places all over the federation (banks, microfinance banks, post offices/postal agencies).
4. Both SMS and the ATM card serve a 2-factor authentication, for security against identity theft.
5. ATMs are manned by agents to validate identity.
6. Services are not for much profit, only the sender pays commission.
7. The recipient pays nothing for delivery.
8. Power supply at remote locations through solar energy.
9. Infrastructure provided via PPP as part of corporate social responsibility, which attracts reduced tax from government.

The implementation model is shown in Figure 2.

SYSTEM IMPLEMENTATION

Application development prototype

The various operations are separated into user and agent modules. The user module involves: registration, check balance, transaction history, change PIN, transfer funds and load account. The agent module comprise: register user, cashout ticket and cashout history.

The typical prototype application has the items listed as follows:

Begin

Display Menu
Switch (Choice)

Case 1:

“balance [pin]”; Break;

Case 2:

“transfer [amount] [receiver] [pin]”; Break;

Case 3:

“paybill [amount] [receiver] [pin]”; Break;

Case 4:

“transfer [amount] [receiver] [pin]”; Break;

Case 5:

“reload [scratch-card-pin] [pin]”; Break;

Case 6:

“cashout [amount] [pin]”; Break;

Endcase

End

Screenshot of cashout transaction

Cashout history is reported on both the user's handset (as SMS) and the administrator's system (Figure 2).

Mobile money implementation model

The model has 7 activities labeled a, b, c, d, e, f, and g (Figure 3).

Activity a: The sender sends money by filling a prescribed form on his phone and sends same to his banker.

Activity b: The banker verifies the details of the account and if satisfactory notifies the recipient via sms of the transfer and the sender's account debited.

Activity c: The bank also notifies the consortium (clearing house) of the transfer. The clearing house serves as the link between the various participating banks and MTOs in Nigeria.

Activity d: The consortium sends notification to the agents at the rural locations so that adequate fund can be made available for disbursement.

Activity e: The recipient proceeds to the nearest ATM in the rural location for disbursement under the supervision of the agent to authenticate the recipient and offer assistance.

Activity f and g: The ATM sends notifications to the sender and recipient respectively, of the transfer.

Usability test

Usability evaluation is an attempt to measure the user's

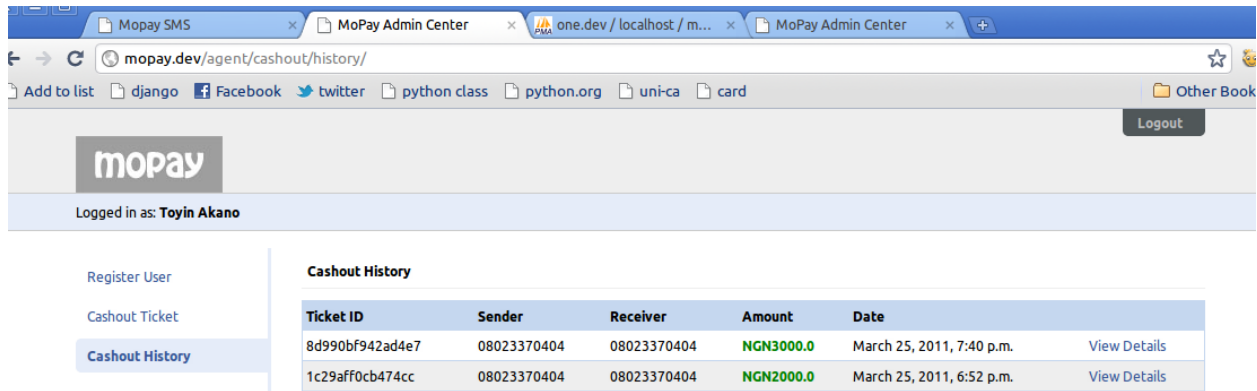


Figure 2. Screenshot showing cash out made by an agent.

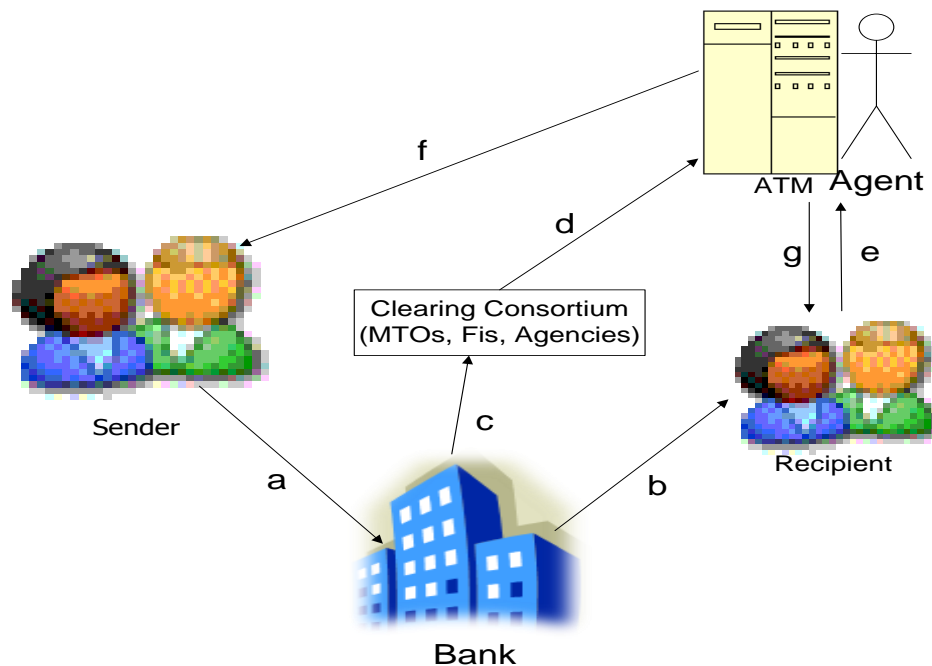


Figure 3. Mobile money implementation model.

perception of the mobile money system after an interaction experience. This is to help assess the quality of human interaction with the system. According to ISO 924-11(1998), usability is the extent to which specified users can use a system to achieve specified goals with effectiveness, efficiency and satisfaction. Also, Lindgaard (1994) presented it as the perception of a system’s ease of learning and use from both the experienced and inexperienced users’ viewpoint.

The reason for undertaking a usability testing was to assess the performance of the system components and also to obtain timely feedback that can be used to improve the system.

A trial experiment was undertaken with 30 users. We

had 20 educated audience and 10 market traders. The entire participants gave their formal consent to participate in the experiment, and were taken through a 10 minutes tutorial session at the commencement of the experiment. Participants were asked a few questions related to their knowledge of mobile phones and their ability to send SMS. The experiment questionnaire has 17 questions, which were specifically adapted for the system context. The questionnaire was designed to capture users’ impression of the mobile money system and users satisfaction with the system. The participants were required to rate each item in the questionnaire on a scale of 1 to 5 (5-excellent, 2-good, 3-satisfactory, 4-unsatisfactory, 1-poor). Based on the question, participants were asked

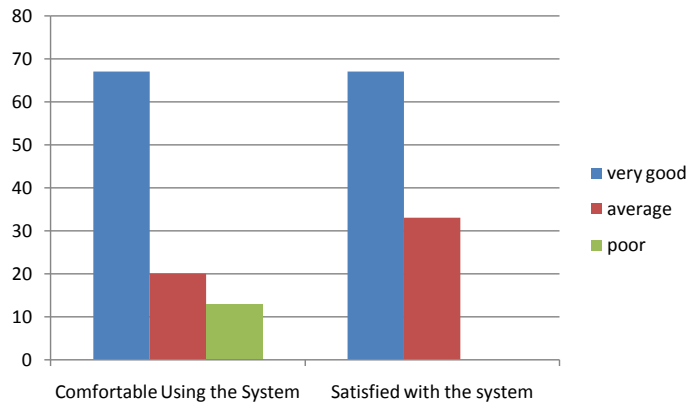


Figure 4. Summary of user's satisfaction with the mobile money system.

before filling the questionnaire:

- 80% of the participant claimed to have a very good familiarity with mobile devices and its basic functions.
- 80% claimed to have knowledge of SMS.
- 30% rated their familiarity with mobile devices and SMS as average.
- 10% claimed to have little or no knowledge of SMS; they basically use their phones to receive calls only.

USER'S SATISFACTION

From our experiment, 67% of the sample population responded that they felt comfortable using the system by giving a rating of 5 (excellent) and 4 (good). 20% gave their ratings of 3 (satisfactory). 13% gave their ratings as 2 (unsatisfactory) and 1 (poor). 67% of the sample population responded that they are satisfied with the system giving a rating of 5 (excellent) and 4 (good) and 33% gave their rating as 3 (satisfactory). The report is presented in Figure 4.

EASE OF USE

Also, from our experiment, 87% of the sample population responded that they felt the system was simple to learn how to use by giving a rating of 5 (excellent) and 4 (good). 13% gave their rating as 2 (unsatisfactory) and 1 (poor). 93% of the sample population responded that it was easy to get the information they needed from the system giving a rating of 5 (excellent) and 4 (good) and 7% gave their rating as 2 (unsatisfactory) and 1 (poor). 80% of the sample population responded that the overall system was easy to use by giving a rating of 5 (excellent) and 4 (good). 6% gave their ratings of 3 (satisfactory). 14% gave their rating as 2 (unsatisfactory) and 1 (poor). The report is presented in Figure 5.

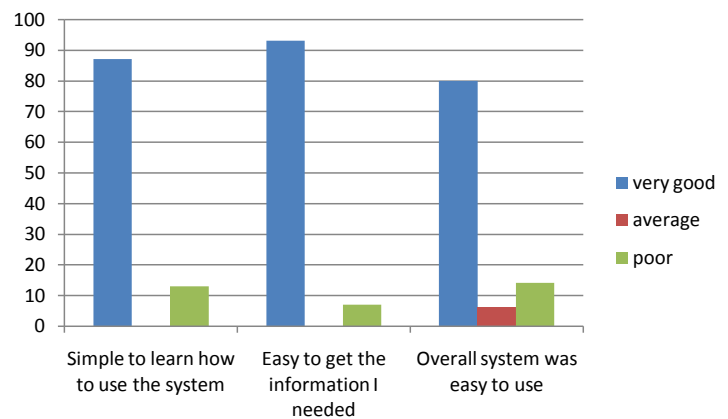


Figure 5. Summary of user's ability to use the mobile money system with ease.

CONCLUSION

The adoption of mobile money is one sure way to enhance e-Inclusion and alleviate poverty. The proposed framework took into cognizance the level of literacy of the rural dwellers which is very paramount to conducting electronic transaction of whatever form. The framework combines both agency and banking-based system such that assistance can be readily offered to customers on one hand as well as offering an introduction to banking culture via the operations of the ATM.

The usability test of the system is highly encouraging as it offers good user satisfaction and ease of use. This framework can be adopted by any developing nation that wants to embrace mobile money.

The future research of the work is to evaluate empirically the factors that will lead to acceptable adoption of mobile money among rural dwellers amidst the current level of mistrust and instability in the banking sector.

REFERENCES

- Ayo CK (2009). "Information Systems and Technologies", McKay Educational Series, 649p.
- Buse S, Tiwari R (2006). Mobile banking stages a remarkable come back, Press Release, assess date Feb. 2007, available at: http://www.uni-hamburg.de/m-commerce/banking/index_e.html.
- Colombant N (2011). Development Experts Ring Up Kenya's Mobile Money Success Story Published on Tuesday 15th February 2011, available at: <http://www.voanews.com/english/news/africa/Development-Experts-Ring-Up-Kenyas-Mobile-Money-Success-Story-116240079.html>
- DFID Report (2006). Country Profile: Africa, Retrieved October 2006, available at: <http://www.dfid.gov.uk/countries/africa/nigeria.asp>
- Drake PM, John K, Doreen T, Muyingi HN (2008). "A model for electronic money transfer for low reserved environment", accessed July. 2011, available at: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=4696138
- Etisalat (2011). Mobile Application Service Provider (MASP) Service Handbook, accessed Sept. 2010, available at: <http://www.etisalat.com.ng/handbook/MASPHandbook.pdf>
- GSMA (2008). "Introduction to MMT", access date may 2011, available at: http://www.gsmworld.com/documents/GSMA_Introduction_to_MMT_0908.pdf.

- GSMA (2009). "Mitigating the Risks that Accompany Mobile Money." Mobile money for the unbanked: Quarterly update 1 (March): 35–36. http://www.gsmworld.com/mmu/mmu_quarterly_update.pdf.
- GSMA (2007). "Regulatory Framework for Mobile Money Transfers", <http://www.mobilemoneyexchange.org/Files/8e31752b> http://www.itu.int/ITU-D/ict/statistics/material/graphs/Global_mobile_cellular_00-09.jpg.
- Ignacio Mas and Dan Radcliffe, Bill, Melinda Gates Foundation (2010). "Mobile Payments go Viral: M-PESA in Kenya", access date may 2011, available at: http://siteresources.worldbank.org/AFRICAEXT/Resources/258643-1271798012256/M-PESA_Kenya.pdf
- ISO 9241-11 (1998). "Ergonomic requirements for office work with visual display terminals (VDT's), Guidance on usability, International Organization of Standardization.
- ITU (2009). "World Telecommunication/ICT Indicators Database", access date May 2011, available at:
- Jenkins B (2008). "Developing Mobile Money Ecosystems." Washington, DC: IFC and the Harvard Kennedy School. accessed July. 2011, available at: http://www.hks.harvard.edu/m-rcbg/papers/jenkins_mobile_money_summer_008.pdf.
- Lindgaard G (1994): "Usability testing and system evaluation- A guide for designing useful computer systems", Chapman and Hall, London.
- NCC (2011). Subscriber Data, accessed July. 2011, available at: http://www.ncc.gov.ng/index5_e.htm.
- Ngugi B, Pelowski M, Ogembo JG (2010). "M-PESA: A Case Study of the Critical Early Adopters' Role in the Rapid Adoption of Mobile Money Banking in Kenya", EJISDC, 43, 3, 1-16.
- Okoegwale Emmanuel (2011). Building Viable MobileMoney Agent Network in Nigeria, accessed May 2011, available at: www.Mobilemoneyafrica.com/?p3233.
- Porter S (2009). Mobile Remittances: A study of the Philipines and Tonga, [online], access date may 2011, available at: <http://www.microfinance-pasifika.org/assets/files/News/2010/January/Mobile-remittances.pdf>
- SanBoeuf L (2006). "Mobile Banking Services Reaching the Under- and Un-Banked", Iraq Private Sector Growth and Employment Generation and USAID, November 2006. available at: http://www.izdihar-iraq.com/resources/mfsummit/pres_reception_mobile_banking.pdf
- William J, Suri T (2010). "The Economics of M-PESA." access date may 2011, available at:<http://www.mit.edu/~tavneet/M-PESA.pdf>.