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The Impact Of Technology Trust On The Acceptance Of Mobile Banking Technology Within Nigeria

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ABSTRACT

With advancement in the use of information technology seen as a key factor in economic development, developed countries are increasingly reviewing traditional systems, in various sectors such as education, health, transport and finance, and identifying how they may be improved or replaced with automated systems. In this study, the authors examine the role of technology trust in the acceptance of mobile banking in Nigeria as the country attempts to transition into a cashless economy. For Nigeria, like many other countries, its economic growth is linked, at least in part, to its improvement in information technology infrastructure, as well as establishing secure, convenient and reliable payments systems. Utilising the Technology Acceptance Model, this study investigates causal relationships between technology trust and other factors influencing user's intention to adopt technology; focusing on the impact of seven factors contributing to technology trust. Data from 1725 respondents was analysed using confirmatory factor analysis and the results showed that confidentiality, integrity, authentication, access control, best business practices and non-repudiation significantly influenced technology trust. Technology trust showed a direct significant influence on perceived ease of use and usefulness, a direct influence on intention to use as well as an indirect influence on intention to use through its impact on perceived usefulness and perceived ease of use. Furthermore, perceived ease of use and perceived usefulness showed significant influence on consumer's intention to adopt the technology. With mobile banking being a key driver of Nigeria's cashless economy goals, this study provides quantitative knowledge regarding technology trust and adoption behaviour in Nigeria as well as significant insight on areas where policy makers and mobile banking vendors can focus strategies engineered to improve trust in mobile banking and increase user adoption of their technology.

Keywords: Technology trust, Mobile banking, Technology Acceptance Model, User adoption, Confirmatory factor analysis.

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1. INTRODUCTION

Nigeria's cashless policy was initiated by the Central Bank of Nigeria (CBN) in a bid to foster economic development by transitioning the nation into a more transparent and financially inclusive economy, characterised by modernised cashless payment systems, reduced cost of banking services and improved effectiveness of monetary policy in the nation [97]. To achieve this cashless economy, cashless payment systems such as mobile banking were introduced as information technology infrastructures to provide customers with more convenient and secure alternatives to the traditional cash-heavy payment options. The overall expectation from CBN was a rapid nationwide acceptance of these cashless payment systems. However, despite the beneficial attributes of a cashless society, cashless payment systems have failed to achieve a satisfactory level of patronage within the nation [4]. In previous years, precursors of cashless payment systems such as telephone banking and internet banking faced several challenges hindering their widespread adoption such as inadequate awareness of the technology amongst Nigerians and poor literacy levels.

Other factors include inadequate investment in required infrastructure and a lack of effort from the financial institutions to increase customer sensitisation towards these services [40] [97]. Furthermore, electronic card technology, a variant of the cashless payment systems, contributed to the widespread reluctance to adopt cashless payment systems in the nation as the prevalence of card fraud during this period resulted in a nationwide distrust in the cashless payment system. Statistics provided by the [27] reported that card fraud cost the Nigerian financial system a total of N323.39 billion between 2000 and 2008, and a significant portion of these fraud cases were a result of security vulnerabilities in the magnetic stripe card technology in use at the time. These vulnerabilities, as well as advancements in technology, led countries such as the United Kingdom, United States, Hong Kong and Canada to discontinue magnetic-stripe cards in favour of the more secure chip and pin card technology.

Likewise, in a bid to address this dwindling confidence in the cashless payment system as well as the prevalence of fraud in the nation, CBN mandated the replacement of magnetic-stripe cards with chip-and-pin cards as well.

The result was a significant decrease in card fraud in the nation to N21.72 billion in 2009 and a further decline to N14.96 billion in the subsequent year [27]. By 2014 chip-and-pin card technology had accounted for a 90% reduction in card fraud [17]. However, despite the service being offered only to customers with active bank accounts, more than 50% of eligible Nigerians were still not using electronic payment cards, resulting in the chip and pin card technology failing to reach the expected penetration rate amongst Nigerians [25]. Moreover, with 46.3% of 173.6 million Nigerians still without active bank accounts and considered to be financially excluded [26], a significant cross-section of Nigerians, especially those living in remote areas inaccessible to financial institutions, are still using the traditional cash-heavy banking system.

This traditional banking system is considered a catalyst for various criminal activities such as robberies, kidnappings and election rigging [97]. In addition, handling and processing cash through this system was costing the Nigerian economy N114 billion naira a year in 2009 with a predicted increase to over N200 billion by 2016 [19]. In light of this, a cashless payment channel with a high potential to penetrate into the banked and unbanked Nigerian population was required. This is where Nigeria's high mobile telecommunication density and mobile phone penetration proved advantageous for its financial institutions. Cashless policy publications made by the [69] show that the nation has experienced a year-on-year increase in mobile subscribers since 1999. Specifically, mobile phone penetration exhibited an 84.9% penetration in urban areas as well substantial penetration of 55.6% in rural areas where a large percentage of unbanked Nigerians reside [26]. In light of Nigeria's growth in the mobile telecommunications sector, Nigerian's mobile phone environment was identified as a suitable facilitator for the introduction of mobile banking and expected to experience a swift uptake amongst both the banked and unbanked with the aim of transitioning the country into a cashless economy.

1.1 Mobile Banking And Adoption Challenges In Nigeria

In a global context, the banking industry has undergone several transformations over the years and, in addition to the introduction of new technologies, services and products, the use of information technology has changed the way several bank processes are executed as well as helping to improve customer convenience, service delivery and banking operations [93]. In particular, cashless payment systems have helped reduce traditional costs as manual banking operations were now being handled by computational technology systems that ensured process efficiency and data accuracy. Consumers also benefitted as they no longer had to queue for extended periods at bank branches to perform certain banking transactions such as cash withdrawals and bill payments [60].

By definition, mobile banking is a cashless payment channel, which gives customers the ability to experience banking services through telecommunications devices without the necessity of being physically present within a bank [83]. For the purpose of this research, this definition is considered as an appropriate perspective on mobile banking because it highlights mobile banking's reliance on telecommunication devices as well the convenience of performing banking operations virtually without the constraints of time or physical location. Much like its cashless predecessors, mobile banking has faced adoption challenges in the Nigerian environment. Some of the main barriers identified by [4] and [2] include: low education and literacy levels, lack of required skills, prevalence of online crimes, frequent power interruptions and a lack of adequate complaint resolution. In addition to these highlighted challenges, lack of confidence and trust were also revealed as significant barriers hindering increased adoption of the technology.

One reason for this lack of trust stems from less than acceptable levels of security, integrity, availability and best business practices resulting in low confidence in mobile banking technology amongst Nigerians, and inevitably a low adoption rate of the technology [72]. This mistrust was also reflected in a survey conducted by [25]. In the survey, Nigerians were asked to categorically state the reason why they had not adopted the technology and the published results revealed that 3.3% of respondents feared the charges associated with using the services, 10% said they had no need for the services, 15% considered it unreliable, 25% believed they lacked adequate knowledge to operate mobile banking services and 35% stated they lacked trust in the technology. With lack of trust emerging as a significant factor in the slow rate of mobile banking, the slow uptake of mobile banking in Nigeria creates a problem scenario where investigating the role trust plays in influencing the adoption of mobile banking in the nation will help in understanding the acceptance trends of customers and identifying areas where stakeholders should focus in order to improve the penetration rate of mobile banking in Nigeria.

Similar to its cashless predecessors, mobile banking was expected to be adopted quickly amongst Nigerians because of its benefits, such as increased banking convenience and accessibility, as well as the high rate of mobile subscribers in the nation. However, the adoption rate of mobile banking failed to meet the expectations of CBN and mobile banking vendors and a lack of trust in the technology was highlighted as a major factor hindering customers from adopting the technology [18]. Therefore, this research aims to use appropriate theories and research frameworks to identify the factors contributing to both users' trust in mobile banking technology and to the level of impact trust, and any other factors, have on mobile banking adoption in Nigeria.

In the sections hereafter, the authors review relevant literature regarding technology trust and the Technology Acceptance Model, all of which provide theoretical contributions to this study's research model, as well as detailing the methodology adopted in instrument preparation, data collection and data analysis, and finally drawing conclusions from this study.

2. LITERATURE REVIEW

Despite the presence of extensive literature on the influence of technology trust on technology adoption trend in developed countries, there exists a lack of thorough investigations into user adoption behaviour towards innovations in developing countries like Nigeria. However, these existing studies provide a theoretical background and motivation for investigating the influence of technology trust on mobile banking adoption in Nigeria.

Jaradat and Twaissi [42] adopted the technology acceptance model to examine mobile banking adoption tendencies in Jordan amongst 275 users and non-users. The sample group compromised of only university students and company employees and trust, as well perceived usefulness, perceived ease of use and behavioural intention were the factors considered in the hypothesised model. This study revealed a positive relationship between consumers trust in the technology and their attitude towards its use. Therefore, increased trust in mobile banking resulted in an increased willingness to use the technology in Jordan. There were also positive relationships uncovered between perceived usefulness and attitude towards use as well as positive relationships between perceived ease of use and attitude towards use. Ultimately, the study revealed that with consumer's attitude towards mobile banking exhibiting positive relationships with trust, perceived usefulness, perceived ease of use and behavioural intention, consumer's actual use of mobile banking technology was significantly influenced by these factors.

Masrek et al's [58] study of 312 Malaysian mobile banking users considered trust and satisfaction with mobile banking technology to be determined by three antecedents namely: the mobile network, the mobile banking website and the mobile phone. Results from this study revealed technology trust as a significant contributor to adoption tendencies in the country and contributes further empirical evidence to the theoretical notion that the presence of technology trust increases the rate of adoption of the technology in question.

Kazemi et al's [46] study into the factors affecting Isfahaninan mobile banking adoption also adopted the technology acceptance model and examined the impact of trust, compatibility and perceived risk on consumer's intention to adopt the technology. A survey of 310 respondents revealed a positive relationship between consumer's intention to use mobile banking and their perceived usefulness, perceived ease of use and compatibility.

However, unlike previous research such as the works of [6] and [42], this study revealed trust as having an insignificant effect on consumer's intention to adopt the technology. Kazemi et al's [46] study also did not did not take into consideration the relationship between the factors considered and consumer's actual use of the technology, therefore resulting an inability to determine if the existing relationships between the factors considered ultimately resulted in consumers actually using mobile banking. Demographic characteristics such as age, gender, education level or technology competency were also not considered and their direct or indirect influence on consumer's behaviour towards mobile banking could not be determined.

In [100] examination of mobile banking adoption in China, confirmatory factor analysis and the technology acceptance model measure the influence of trust with distinctive components, and the inclusion of structural assurances, ubiquity and flow as contributing components to trust, helped in providing a more detailed overview of trust as a factor being measured. Structural assurance comprised of consumer's willingness to trust mobile banking based on existing technological and legal frameworks regulating the service. Flow considered the holistic sensation that people feel when they act with total involvement and ubiquity measured the consumer's adoption tendencies of mobile banking based on its availability. The survey results from a sample size of 300 revealed structural assurance was the main factor affecting consumer's trust of mobile banking and trust also had a mediating effect on the relationship between structural assurances and Flow. The study also revealed perceived usefulness and ubiquity's significant relationship with Flow. This means that the presence of sustainable technological and legal frameworks to govern mobile banking in China has a positive effect on user's trust in the technology and these regulatory frameworks also affect consumers' willingness to engage in mobile banking based on trust. In the end, the results showed that trust had a significant relationship with flow and usage intention, which ultimately impacts actual usage among users in China.

Similar to [100] study, [56] included structural assurances as a contributing factor to trust in mobile banking. Using the technology acceptance model, with trust as an external variable, 210 surveys were distributed to both users and non-users of mobile banking and the results showed that structural assurances was a significant contributor to trust in mobile banking and trust, as well as perceived usefulness and perceived ease of use all contributed to the user's intention to use mobile banking. These results, despite lacking the consideration of other contributing factors to trust such as confidentiality and access control, provides another evidence of trust's role in the adoption of the technology but not the user's actual use of the technology.

Zhenhua and Shaobo's [99] research distinctively measured trust in mobile banking adoption by considering trust in technology, structural assurance and trust in mobile banking vendors as factors contributing to the overall trust in mobile banking adoption. The study was conducted by surveying 438 online banking customers in China and similar to results from [100], structural assurances showed a significant effect on the user's trust in mobile banking but trust did not have a direct impact on consumer's intention to use the technology which differs from the results of [56]. However, trust had an indirect effect on intention to use the technology through its influence on perceived usefulness, which had a significant effect on intention to use.

These reviewed studies substantiate the importance of considering technology trust as an important factor which influences technology adoption behaviour but also highlight the lack of extensive studies on technology adoption studies in developing countries, consequently leading to a lack of validated knowledge on user trust and adoption trends towards innovations like mobile banking in countries like Nigeria. In addition, these studies reveal a lack of consensus on the factors which act as antecedents to technology trust as a concept as [100], [56] and [57] all investigated the influence of technology trust on mobile banking adoption but with differing antecedents for technology trust. Therefore, there is a necessity for studies which address these existing issues by studying technology trust and adoption behaviour towards new technology like mobile banking in emerging user environments using theoretically grounded antecedents for technology trust which can be consistently adopted in further related studies. Ultimately, these studies will lead to improved insight into the technology adoption trends in developing countries like Nigeria.

2.1 Trust

The introduction of cashless payment systems, like mobile banking, has created a unique mobile environment for customers and financial institutions where trust in these technologies is considered a major contributing factor in users' adoption decisions The reason why trust has become an important factor in mobile banking technology adoption is because mobile banking creates a mobile commerce structure with no need for physical exchange of cash for services, bank branches and face-to-face interaction between merchants, customers and banks [98]. With an absence of these components, which are all fundamental constituents of the traditional financial environment, users are expected to adopt mobile banking and forgo the conventional cash-heavy methods of transaction in favour of carrying out their financial activities through mobile devices and mobile communication networks; thereby creating a dependence on these mobile infrastructures and their vendors to perform reliably and securely [51].

This dependence also creates vulnerability in the users adopting this technology and before a user can adopt the technology, the individual must be willing to expose themselves to this vulnerability with minimal fear of penalties [78]. In the mobile banking environment, adopters experience a wide range of benefits, such as convenience, increased satisfaction and real-time access to funds anywhere and at any time, but also expose themselves to the risk such as security vulnerabilities, network unavailability and privacy issues [51]. This is where trust in the technology comes into focus, as users are less willing to expose themselves to these vulnerabilities and to be dependent on mobile banking if they do not trust the technology to perform reliably and securely.

Trust allows users to put themselves in situations they cannot totally control with the expectation of receiving benefits while also permitting themselves to face the risk of disappointment and harm [43]. Trust is therefore essential in mobile banking technology implementation and adoption because when trust in the technology is established, users are more likely to allow themselves to experience these benefits despite the potential risks [50]. With trust in these technologies acting as a significant factor in user adoption decisions, a relationship emerges between trust, user adoption and project success where the presence of technology trust leads to a willingness to adopt higher adoption rates and implementation success. Inversely, a lack of trust will result in less willingness to adopt, lower adopting rates and the consequent failure of the project [51].

2.2 Types of Trust

Trust is a multidimensional concept and [63] identified three categories of trust namely institutional, personal and cognitive-based. [81] was also able to categorise trust into three distinct types and these mirror the classifications of [63] and [67], as well as the categories adopted in research conducted by [52]. The three categories are organisational, personal and technology trust. Organisational trust is defined as an institutional-dependant or sociological-based trust, which describes an individual's willingness to trust, based on a reliance on appropriate structural assurances such as legal frameworks, security measures and best business practices as conditions which determine if they can trust a particular information technology infrastructure [63] [47][30]. Personal trust, or personality-based trust, focuses on the psychological aspect of trust and considers personality-based factors as determinants of users' propensity to trust and adopt technology [61]. It stems from the fundamental understanding that each user has a unique personality formed from inherent traits, behaviours and experiences resulting in the individual's overall character, as well as defining the individual's degree of willingness to trust [80].

Personal trust, in contrast to organisational trust, considers the individual when focusing on user adoption behaviour and bases its assumptions, theories and conclusions on the psychological uniqueness between various users [53]. In comparison to organisational trust and person trust, technology trust considers the relationship between the user and the information technology in question. [64] defined technology trust as an individual's willingness to depend on technology based on the positive characteristics of the technology and its ability to perform its intended tasks. This also reiterates the definition from [50] whose study into trust and mobile banking adoption was based on the premise that technology trust is a belief that allows individuals to willingly become vulnerable either to the bank or banking technology after taking into account the positive business characteristics of the bank and how these characteristics and been translated and embedded into the bank's mobile banking technology.

Both personal and organisational trust provide worthwhile areas of investigation in relation to their influence on users' behaviour towards adopting technology. However, considering these classifications of trust, technology trust was chosen as the focus of this study because the authors aimed to investigate and understand the relationship that exists between users and mobile banking technology based on their interaction with the technology, their experience with its various characteristics and the culminating impact of these interactions and experiences on the level of trust they have in the technology. This study therefore considers the impact of individual's trust on user perception as well as the attributes of mobile banking technology itself such as confidentiality and data integrity [50] With technology trust being the focus of this study, identifying appropriate contributing factors is essential [64], and using a set of factors to measure technology trust is an approach, which has been used by previous researchers. This study extends this approach by identifying appropriate contributing factors to provide a comprehensive understanding of technology trust and its role in mobile banking adoption.

2.3 Antecedents of Technology Trust

Seven specific antecedents have emerged as the most fundamental antecedents of technology trust. These factors, identified and adopted by [65], [14], [55] and [73] are Confidentiality, Integrity, Authentication, Non-repudiation, Access control, Availability and Best business practices [75]. The reseachers were able to adopt these seven factors while investigating technology trust's role in business-to-business electronic commerce and [39] implemented these classifications on technology trust's antecedents while researching the factors determining online trust and participation in e-commerce.

Based on their adoption in existing literature as well as their individual definitions, these seven factors will be used to investigate technology trust in this study. In addition to these factors being previously applied by [75] and [39] in areas of study relating trust and e-commerce, the authors consider these seven factor as appropriate and comprehensive antecedents of technology trust which can also be applied to trust and mobile banking adoption studies because these seven factors individually characterise significant determining aspects of technology trust and, when considered as contributing factors to technology trust, provide a wholesome theoretical explanation of the concept as well as a relate to the real world challenges affect user trust in technology.

Confidentiality refers to privacy issues and determines customer trust based on the mobile banking information technology being able to protect transactions and personal data from unauthorised access, disclosure and manipulation. Integrity refers to mobile banking transaction accuracy, as customers are more likely to exercise trust if all transaction operations are consistently carried out without being distorted. Authentication determines a customer's propensity to trust as it refers to the legitimacy of mobile banking transactions and the perception that all the elements involved in the transaction are genuine. Non-repudiation refers to systems that ensure the parties involved in a transaction cannot deny having participated in the transaction after participating in the transaction. Access control defines the infrastructures set up to ensure transactions are carried out without intrusions and disruptions. Best business practices focuses on the institutional aspects of mobile banking and leads customers to have more confidence in mobile banking based on regulatory infrastructures and operations, which govern mobile banking. Availability refers to customer's willingness to trust based on the regular presence of mobile banking infrastructure as issues such as a weak or absent signal, faulty devices and outright absence of mobile banking service will lead to diminished customer confidence in mobile banking.

The authors adopted these factors as determinants of technology trust not only because of the theoretical suggestions made by existing researchers but also because they coincides with practical issues facing user trust and adoption of mobile banking and other cashless payment systems in Nigeria as well. Security and privacy issues are significant issues which determine if users could trust and adopt online transactions in favour of traditional physical transactions and confidentiality, integrity, non-repudiation, access control and authentication antecedents are specific antecedents which relate to the security and privacy issues in Nigeria's cashless payment systems.

These security issues are particularly pertinent is Nigeria as the afore-discussed issues of fraud and corruption have caused Nigerian user to be inherently wary of online transactions as credit card details and other sensitive information could exploited by criminals, exposing them to threats such as identity theft, fraud, forgery and repudiation [71] [44]. Availability is another theoretical antecedent of technology trust, which has been highlighted as one of the challenges Nigeria's cashless policy must overcome. Yaqub et al, [97] and [5] note that unprecedented mobile network failures and repeated power outages hinder the efficiency and reliability of cashless payment systems like mobile banking, which in-turn diminishes the positive perceptions Nigerian banking customers have about mobile banking, leading to a lose of trust in the technology and reduced adoption rate. In addition, [97] suggests that the high cost of Internet access also poses a threat to innovations such as mobile banking as the technology depends on mobile devices using internet connection to utilise the service.

The concept of best business practices is comparable to [63] categorisation of organisational trust and [100] description of structural assurances as all these concept refer to user trust being dependent on legal and regulatory frameworks which govern mobile banking technology ad protect user interests as well. The issue of customer services and complaint resolution processes as contributed to the best business practices issues in Nigeria, which cause the lack of trust in mobile banking technology. Regha and Ntia [76] state that financial institutions inability to adequately address user complaints and enquiries causes operational deficiencies which ultimate lead to a lack of trust in cashless payment systems. In addition, [97] also agree with these suggestions by concluding that these operational deficiencies have led to the resistance in mobile banking adoption as appropriate legal and regulatory frameworks which address transactions made through cashless payment systems are lacking in Nigeria. These seven theoretical factors, which also show real-world manifestations, have therefore been considered as determinants of technology trust Nigeria and were included in this study's research model with the aim of specifically understanding technology trust and mobile banking adoption in Nigeria.

3. TECHNOLOGY ACCEPTANCE MODEL

User acceptance is arguably the biggest barrier to the success of new information technology [32]. Concerning investigating technology adoption, several theoretical frameworks have been used by researchers to analyse and understand the factors influencing user acceptance of technology. Some of these frameworks include the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM).

These models adhere to the principle, which suggests that user behaviour intention is a direct determinant of actual behaviour and behaviour intention is in turn determined by salient beliefs and perceptions. The TAM is a framework designed based on the TRA and has been applied by researchers as a tool in determining the acceptance of information technology [23][94]

Despite the TRA and TPB being adequate frameworks for studying technology adoption trends, the authors considered TAM as most appropriate for this study. Various studies have applied TAM in information technology acceptance related research [23] [24] [7] [92] [68] and it is researchers agreeable an appropriate framework for investigating user adoption behaviour because of its comprehensive structure and its consistently successful implementation. In addition, the framework's versatility also makes it applicable in various areas of user adoption studies because researchers can modify it to relate to the desired research area in question [70]. Another major appeal of TAM to researchers is the components of the framework, and the causal links between these components [24] [85].

These components include perceived usefulness; which refers to how helpful the individual thinks the technology will be in aiding him/her in achieving their aim and perceived ease of use; which refers the individual's assumptions of the level of difficulty, which will be experienced when trying to use the information technology [96]. Despite the TRA and TPB being useful frameworks for investigating user adoption behaviour, the principles and structure of the TAM is more suited for studying user adoption in online environments such as the mobile banking context in Nigeria [23] as it not only allows the study to accommodate the concept of technology trust as an external variable but also allows the investigation of causal relationships between technology trust, perceived ease of use, perceived usefulness and user adoption.

Several researchers have included the Trust component in a modified TAM with the aim of investigating the relationship between trust in technology and user adoption behaviour. Evidence can be found in [30] research into trust and the use of the TAM in Online Shopping, [96] research into the impact of trust on customer's adoption of online shopping and [9] study on the effect of trust on the success of IT reform in Chile. Figure 1 is a representation of the TAM whose structure and theoretical premise will contribute to this study's research model.

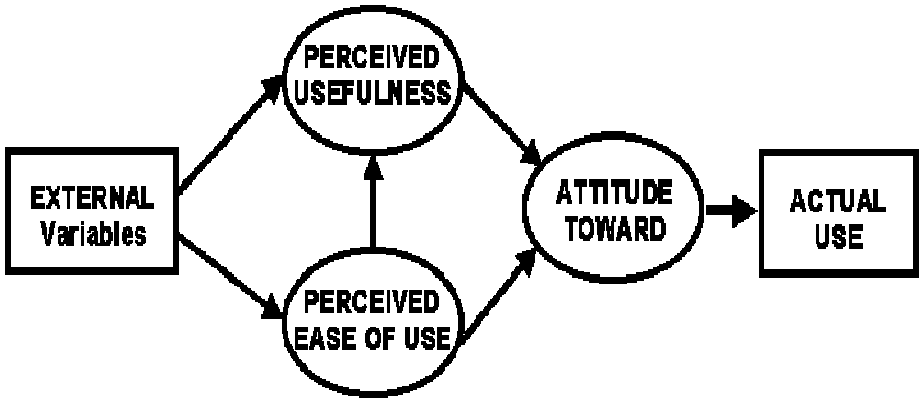

Figure 1: The Technology Acceptance Model

3.1 Research Model

Based on the theoretical contributions from the TAM, the designed model for use in this study integrates technology trust as an external variable which is determined by seven contributing factors namely: confidentiality, integrity, authentication, access control, non-repudiation, best business practices and availability. Figure 2 is a representation of the research model with further details of the hypothesised relationships provided thereafter.

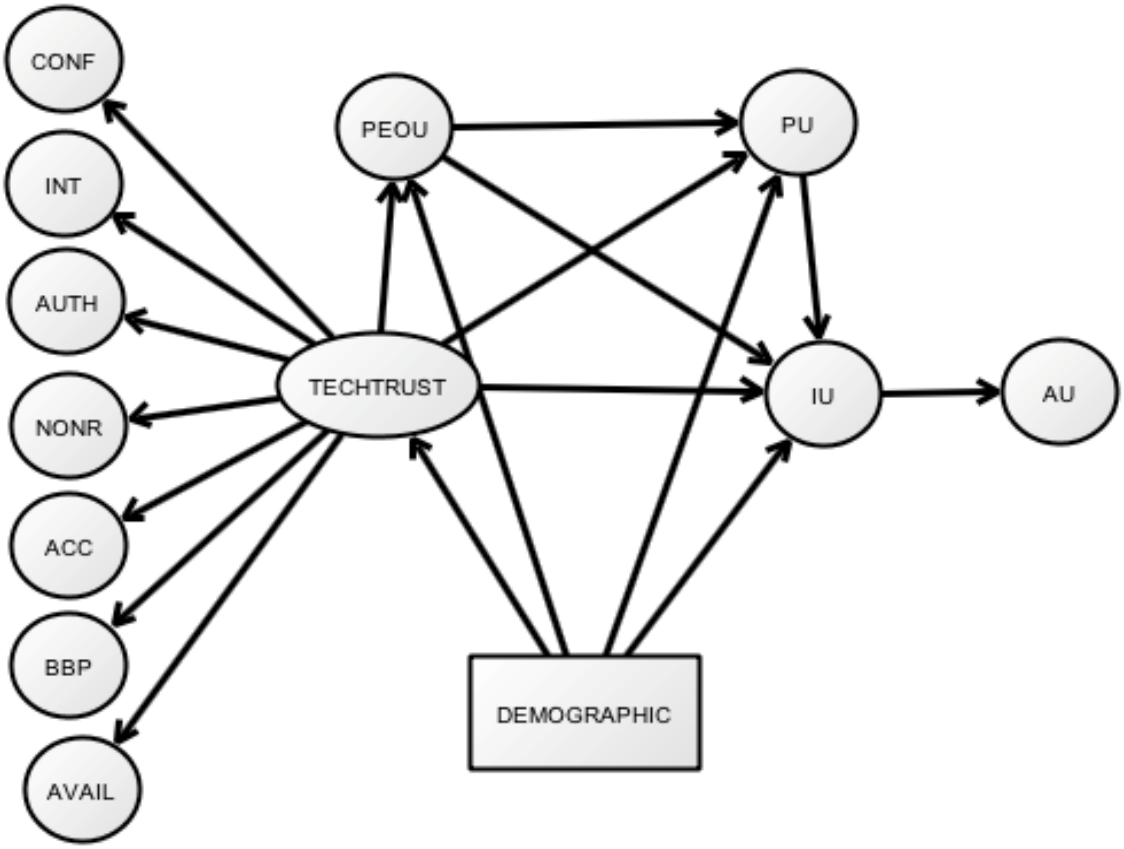

Figure 2: Conceptual research model

Considering the suggested causal relationships shown in Figure 2, a set of hypothesis have been generated which will be tested in the final structural equation model. Technology trust has been theoretical argued to influence users' intention to adopt new technology as researchers such as [43] and [50] suggest that increased levels of trust in technology leads to an increased willingness to adopt the technology. The notion that a relationship exists between technology trust and mobile banking leads to the first hypothesis of this study:

- **H1:** Technology trust in mobile banking has an effect on customers' intention to use mobile banking in Nigeria.

The second and third hypotheses in this study take their theoretical grounding from assertions made by [74] that trust in technology positively influences perceived ease of use and, in turn, perceived ease of use positively influences intention to adopt technology. Perceived ease of use is defined as the level of difficulty a user considers to be required in utilising a certain technology [23] and regarding mobile banking in this study, the rationale supporting the link between technology trust and perceived ease of use is based on the premise that users will consider the technology to be trustworthy if it requires minimal effort to utilise the technology, ultimately leading to increased intention to adopt the technology as well [79] [11].

- **H2:** Technology trust has a significant effect on perceived ease of use of mobile banking in Nigeria

- **H3:** Perceived ease of use has a significant effect on intention to use mobile banking in Nigeria

Perceived usefulness is defined as the degree to which a user considers that a certain technology will improve his/her job performance [23]. The theoretical link between technology trust, perceived usefulness and intention to use has been investigated by researchers such as [74] and the fourth and fifth hypotheses of this study is based on the rationale that an increased perceived of mobile banking's usefulness will result in increased trust in the technology and ultimately increased intention to adopt the technology.

- **H4:** Technology trust in mobile banking has a significant effect on customers' perceived usefulness of mobile banking

- **H5:** Perceived usefulness of mobile banking has a significant impact on intention to use mobile banking in Nigeria

As stated earlier, [75] suggested seven contributing factors to technology trust which coincide with propositions from [65], [14], [55] and [73] as well. The rationale of these seven relationships, in relation to mobile banking adoption in Nigeria, is based on the argument that confidentiality is a significant contributor to technology trust because the ability of the technology to protect transactions and personal data from authorised access will lead to an increased trust in the technology as users consider the technology to possess adequate privacy protection measures. Integrity influences technology trust based on the notion that the reliability of mobile banking's operations and accuracy of financial transactions will lead users to increasingly trust the technology and utilise it as well.
Furthermore, authentication measures have been suggested to improve users technology trust as introducing measures which prove that transactions on mobile banking are genuine and legitimate will lead users to lower their perception of the untrustworthiness of mobile banking and increase their intention to adopt the technology. Regarding access control, the establishment of authorisation infrastructures which ensure that transactions and conducted without interruptions leads to increased perception of the trustworthiness of mobile banking. Best business practices is another antecedent of technology trust which bears theoretical similarities with the concept of structural assurances and organisational trust as these concepts all focus on user's trust in technology being significantly influenced by the presence of regulatory infrastructures and institutional policies to govern the use of technology. Regarding mobile banking, best business practices focuses on the measures the financial institutions put into place to handle customer complaints satisfaction issues and maintain a an appropriate standard of operation which leads to users' trusting both the organisation and the technology and adopting the technology as well.

Non-repudiation is also stated to be an antecedent of technology trust because user's willingness to trust the technology will theoretically increase if measures are put into place to ensure that participants in a transaction are unable to deny participation in that transaction, leading to increased accountability, technology trust and technology adoption. Lastly, availability is said to influence technology trust because, based on its definition, this antecedent focuses on the regular presence of the mobile banking services and the consistent availability of mobile banking, through stable internet connection and device functionality will increase user's technology trust in the service. In summary, these seven antecedents all theoretically contribute to technology trust and the fifth hypothesis in this study will focus on empirically determining the validity of this assertion.

- **H6:** Seven antecedents, namely confidentiality, integrity, authentication, availability, non-repudiation, best business practices and access control, significantly contribute to technology trust in mobile banking in Nigeria.

The theorised relationship between perceived ease of use and perceived usefulness has been studied by researchers in relation to various forms of information technology such as

internet banking, and online shopping with results both proving and rejecting the notion that perceived ease of use influences perceived usefulness. Specifically, results from [29] study into e-mail acceptance while [36] study into mobile banking adoption showed a statistically significant influence of perceived ease of use on perceived usefulness. Regarding mobile banking in Nigeria, the authors argue that users who consider mobile banking to require minimal effort to utilise will in turn consider the technology to be useful as well. This notion was also supported by researchers such as [41] and [68] and forms the basis for the sixth hypothesis of this study

- **H7:** Perceived ease of use has a significant effect on perceived usefulness of mobile banking in Nigeria

In keeping with the framework of the TAM, this research includes both intention to adopt and actual adoption for empirical evaluation as with the aim of objectively examining data for both variables and revealing the existence or non-existence of a relationship with regards to customers intention to use mobile banking and their actual adoption of the technology in Nigeria.

- **H8:** Customers intention to use mobile banking has a significant effect on their actual use of mobile banking

Inclusion of demographics variables: Rogers [77] classification of adopters provides further descriptions on the possible characteristics of innovation adopters. Including demographic variables such as age and gender and investigating their relationship with technology trust in Nigeria, as well as mobile banking adoption in the country, will help validate the existence of relationships between these variables as well as categorise the types of adopters and non-adopters in Nigeria. Variables to be included are: Age, Sex, Marital status, Employment status, Education level, Technology competence, Ethnicity, Mobile phone, Bank account, Mobile banking user

- **H9:** Demographic variables play a significant role in the relationships between technology trust and other contributing factors to mobile banking adoption

4. METHODOLOGY

For the purpose of this study, a quantitative survey was designed to gather data from respondents in Nigeria. To develop the survey, the researcher drafted a group of questions from previous research in related technology adoption studies. In addition to the 11 variables to be measured, 10 pieces of demographic information were also included as variables and tested for their influence on technology trust and mobile banking acceptance in Nigeria. After drafting this set of prospective questions from existing literature, a Q-sorting exercise was carried out.

The aim of this exercise was to reduce the number questions which will be in the final survey by identifying questions which are relevant to the research, ultimately resulting in the removal of questions which were not appropriate either due to reasons of clarity or relevance. During the Q-sorting exercise, the prospective questions for the final survey were given to a group of academic staff for validation. The academic staff, called the P-set, was selected based on their research expertise and familiarity with several concepts of trust, information technology and technology acceptance.

The validation process involved each participant reading slips of paper containing one of the prospective questions and placing the question in one of the eleven variable-labelled categories based on their opinion of the question and the variable they think it is designed to measure. At the end of the exercise, the results from the P-set were recorded and a total of 5 academics were involved in the Q-sorting exercise as the P-set. Questions with a 50% or higher rate of placement in the right category were included in the final survey and questions with a less than 50% rate of placement in the right category were ultimately removed. A total of 51 out of a possible 81 questions achieved a right-placement rate lower than 50% and were consequently excluded from the final survey. In total, the final survey instrument contained 40 questions, which comprised of 10 demographic information items as well as 30 items which measured the 12 variables in the research model, namely: TechTrust, CONF, INT, AUTH, ACC, NONR, BBP, AVAIL, PEOU, PU, IU and AU. Table 1 in the appendix shows the variable and survey item mapping for the final questions in the survey

4.1 Data Collection

A total of 2256 surveys were distributed to both users and non-users of mobile banking in Nigeria. Respondents were chosen using convenience sampling as this sampling method allowed the authors to easily gather data as well manage time and costs while acquiring data from a large cross-section of Nigeria. The study was conducted in Abuja, the Federal Capital Territory of Nigeria and comprised of respondents from the state's six local councils namely: Abaji, Gwagwalada, Kuje, Bwari and Kwali. The authors chose Abuja as its sample area because it provided access to a comprehensive cross-section of various demographics in Nigeria, which this study aims to investigate.

In particular, Abuja consists of an adequate representation of Nigeria's three main ethnic groups, namely: Ibo Hausa and Yoruba, unlike areas such as northern, eastern and south-western regions of the country which are predominantly inhabited by the Hausas, Ibo and Yorubas respectively. In addition, Abuja consists of both urban and rural settlements, which will provide an adequate representation of the technology trust and adoption trends across a wide variety of socio-demographic segmentations as well.

Considering the cashless policy aimed to encourage the adoption of mobile banking amongst all Nigerians, the survey was distributed to both users and non-users of mobile banking as data collected from both categories of Nigerians provided essential data on the technology trust and adoption behaviour of current and prospective users of the technology. The survey was designed based on previous studies in mobile banking adoption and consisted of two sections. Section A consisted of ten questions which focused on various distinct demographic characteristics of the respondents and section B focused on gathering data for each of the 11 variables in the model. Each of the survey items in section B was scored on a five-point Likert scale, (1 = strongly disagree; 2 = disagree; 3= neutral; 4 = agree; and 5 = strongly agree) apart from three questions pertaining to respondents actual use of mobile banking which was measured by providing the participants with five options measuring the frequency of their mobile banking usage. In summary, the survey consisted of 40 questions and a total of 1725 surveys were deemed usable out the 2256 distributed.

4.2 Data Analysis

Considering the research model and hypotheses to be evaluated, Structural Equation Modelling (SEM) was adopted in this current study, as the characteristics of the statistical technique are appropriate for analysis of the models and data presented in this study. The aim of adopting SEM is to explore the relationships between factors and their scale items as well as the theorised relationships between variables such as PU, PEOU, TechTrust and Intention to use. In addition, factor analysis was performed to assess the construct validity of the model and regression analysis was used to analyse the data.

Considering this study into technology trust and mobile banking adoption is supported by extensive theories, as well as a theoretical model with generated hypotheses, CFA is considered to be the most appropriate analysis procedure to be used as it is a potent data analysis tool which explicitly allows the authors to validate hypotheses in order to resolve factor analytic problems based on theoretical suggestions. To validate how well the research model fits with the data obtained for analysis, a set of model fit indices will be used as the criteria for evaluating the model's goodness of fit. Table 2 provides a summary of the goodness of fit criteria.

Table 1: Goodness of fit criteria

Model fit criteria	Threshold	Reference
Tucker Lewis index (TLI)	≥0.90	Bentler and Bonett [12]
Comparative fit index (CFI)	≥0.90	Bentler, [13], Hu and Bentler, [37]
Root mean square error of approximation (RMSEA)	≤0.05	Brown and Cudeck [16]
Factor loadings	≥0.45	Hair et al [34]

5. RESULTS AND DISCUSSION

Table 3 in the appendix shows the overview of the sample characteristics of the respondents. From the 1,725 respondents, 805 were male accounting for 46.7% of the sample population with female making up the rest of the 53.3%. A test for common methods bias was also conducted using Haram's single factor method and the test showed a 22.463% of variance which is less than the 50% threshold, indictating a lack of systematic error with the survey instrument, its items and the data collected.

5.1 Measurement Level Evaluation

From figure 3, it is clear that the relationships between the seven antecedents of technology trust and technology trust itself constitute a hierarchical second-order factor component to the research model. Consequently, CFA was used to validate the hierarchical component of the model first before evaluating the entire model. Table 4 shows the model fit values of the hierarchical model before and after the unsatisfactory items were removed and it is necessary to note that in order to achieve optimal model fit values, certain variables and scale items were removed from the model, which had unsatisfactory values [34]. Firstly, AVAIL was removed as it showed a factor loading of 0.20 on TechTrust, which is less than the stipulated cut-off criteria of 0.45. ACC26, a scale item measuring ACC, was also removed as it showed a factor loading of -0.280, indicating that the factor negatively influences the ACC construct. Its deletion still left two scale items to measure ACC, which is considered acceptable [48].

After achieving satisfactory model fit indices with the hierarchical model, CFA was also used to evaluate the entire model and final overall model achieved a significant chi-square value of 927.872 with 309 degrees of freedom at a probability level of $p< 0.001$. Table 5 shows all factor loadings and regression weights in the measurement level of the model's analysis, including the final factor loadings in the hierarchical model. In addition, the overall model was tested for reliability and validity using composite reliability and the average variance extracted. The values for both estimations are also shown in Table 5.

Table 2: Initial and final Model fit indices for hierarchical second order model

Model	TLI	CFI	RMSEA
Initial second order model	0.930	0.940	0.048
Final second order model	0.960	0.966	0.042

Note: RMSEA = Root mean square error of approximation; TLI = Tucker Lewis index; CFI = Comparative fit index.

Table 3: Final factor loadings for measurement level

Construct	Items	λ	S.E	$(\Sigma \lambda_i)^2$	CR	AVE
TRUST (Second order factor)	Confidentiality	0.753	0.26	22.231	0.940	0.624
	Integrity	0.908	0.48			
	Authentication	0.701	0.23			
	Non-repudiation	0.730	0.19			
	Best business practices	0.876	0.07			
	Access control	0.747	0.19			
PEOU	PEOU31	0.583	0.55	4.112	0.765	0.500
	PEOU32	0.803	0.26			
	PEOU33	0.642	0.45			
PU	PU35	0.805	0.21	2.338	0.821	0.586
	PU34	0.724	0.30			
AU	AU38	0.704	0.67	5.756	0.805	0.646
	AU39	0.795	0.41			
	AU40	0.900	0.31			
IU	IU37	0.759	0.35	2.503	0.791	0.627
	IU36	0.823	0.31			
CONF	CONF13	0.809	0.32	5.392	0.827	0.602
	CONF12	0.809	0.28			
	CONF11	0.704	0.53			
INT	INT16	0.643	0.39	4.260	0.782	0.476
	INT15	0.675	0.46			
	INT14	0.746	0.34			
AUTH	AUTH25	0.722	0.41	2.202	0.741	0.551
	AUTH24	0.762	0.36			
NONR	NON19	0.743	0.33	3.709	0.728	0.419
	NON18	0.550	1.20			
	NON17	0.633	0.45			
BBP	BBB60	0.629	0.47	6.864	0.797	0.430
	BBB55	0.662	0.37			
	BBB36	0.681	0.46			
	BBB27	0.648	0.45			
ACC	ACC28	0.787	0.28	2.283	0.776	0.571
	ACC27	0.724	0.38			

Note: λ=Standardised factor loadings; S.E=Error variance; CR= Composite reliability; AVE=Average Variance Extracted

Extracted (AVE) values for TRUST, CONF, AUTH, ACC, PEOU, PU, AU and IU were all above the 0.40 threshold, satisfying convergent validity requirements for this constructs. Despite INT, NONR, and BBP all showing AVE values below the 0.5 threshold, [28], [95] and [38] state that convergent validity for these constructs is still acceptable if the composite reliability of the constructs is above 0.6 as seen in Table 5

5.2 Discriminant Validity

Malhotra [54] describes discriminant validity as the extent to which a construct does not correlate with other constructs, which it is not theoretically related to in a study. Fornell & Larcker [28] also contribute by stating AVE can be used to measure discriminant validity by a comparison of the AVE of a particular construct with the shared variance e between that construct and other constructs in the study. If the value of the AVE is higher than the value of the shared variance between both unrelated constructs then discriminant validity has been achieved [15]. Table 6 shows the AVE values for each construct in the study is well above the shared variance between that construct and any other construct in the model with all covariance significant at $p<0.001$.

Table 4: Discriminant validity

Var.	CONF	INT	AUTH	BBP	NONR	ACC	PEOU	PU	IU	AU
CONF	.602									
INT	.294	.476								
AUTH	.256	.191	.551							
BBP	.261	.227	.234	.430						
NONR	.226	.205	.252	.250	.419					
ACC	.302	.220	.277	.245	.220	.572				
PEOU	.191	.187	.218	.201	.188	.199	.500			
PU	.191	.167	.171	.168	.179	.167	.312	.586		
IU	.266	.222	.226	.198	.211	.202	.300	.331	.627	
AU	.226	.196	.178	.173	.158	.164	.208	.204	.321	.646

This proves that each construct is distinct from all other constructs in the model and ultimately establishes discriminant validity. Given that discriminant and convergent validity have been established, the construct validity of this study has been proven. The model was subsequently evaluated on a structural level with demographic variables introduced into the model as moderators to examine the hypothesised influence these factors have on the relationships between latent constructs in the model.

5.3 Structural Level Evaluation

Subsequent to evaluating the models in the measurement level, the model was evaluated on a structural level and this stage in the SEM process is aimed at evaluating causal relationships and proving or disproving the study's hypotheses based on the results from the assessment.

It is necessary to note that the introduction of the ten demographic variables did not alter the significance of the hypothesised relationships in the structural model as the p-values of the relationships between TechTrust and PEOU; TechTrust and PU; TechTrust and IU; PEOU and IU; PU and IU; and IU and AU all remain significant at less than 0.001. Table 7 shows the model fit indices for the structural model and the values show that the structural model achieved a satisfactory TLI, CFI and RMSEA values when all control variables were introduced.

Table 5: Initial and final structural model fit indices

Model	TLI	CFI	RMSEA
Model fit values	.901	.917	.034
RMSEA = Root mean square error of approximation; TLI = Tucker Lewis index; CFI = Comparative fit index.			

5.3 Hypotheses Evaluation

Subsequent to achieving satisfactory model fit values for the structural model, the next step is to evaluate the hypotheses of this study based on regression weights, which signify the degree of influence between independent and dependant variables, and p-values, which indicate the level of significance of the relationships. Table 9 below shows a summary of the final regression path coefficients, their corresponding levels of significance, and the related hypotheses.

Table 6: Hypotheses evaluation

Hypotheses	Hypothesised Relationships	Standardized regression weights	S.E	P-Value	Remarks
H1	TechTrust→IU	.231	.060	***	Accepted
H2	TechTrust→PEOU	.578	.049	***	Accepted
H3	PEOU→IU	.141	.042	***	Accepted
H4	TechTrust→PU	.552	.047	***	Accepted
H5	PU→IU	.506	.042	***	Accepted
H6	Technology trust antecedents→Techtrust	.746	.060	***	Accepted by CONF
		.901	.040	***	Accepted by INT
		.728	.053	***	Accepted by NONR
		.873	.054	***	Accepted for BBP
		.702	.057	***	Accepted for AUTH
		.743	.056	***	Accepted by ACC
		.200	.044	***	AVAIL removed
H7	PEOU→PU	.390	.060	***	Accepted
H8	IU→AU	.301	.027	***	Accepted
H9	Demographic factors→IU	-.154	.033	***	Accepted for Mbanking
		-.046	.009	.016	Accepted for Education
	Demographic→AU	.970	.016	***	Accepted for Technology
		-.559	.040	***	Accepted for Mbanking
		.052	.017	.002	Accepted for Marital
		0.46	.026	.006	Accepted for Gender
	Demographic factors→TechTrust	-337.	.027	***	Accepted for Mbanking
		.131	.014	***	Accepted for Technology
		.069	.005	.005	Accepted for Employment
		.048	.010	.047	Accepted for Ethnicity
	Demographic factors→PEOU	-.065	.007	.013	Accepted for Employment
		.077	.009	.002	Accepted for Education
		-.094	.031	***	Accepted for Mbanking
		-.093	.017	***	Accepted for Age
		.047	.157	.049	Accepted for Phone
	Demographic factors→PU	-154.	.035	***	Accepted for Mbanking
		.051	.010	.034	Education
		.054	.018	.030	Technology
		-.046	.007	.050	Employment
		-.055	.020	.021	Marital

Note: S.E=Standard error; P=Significance value; ***=p<0.001

In summary, from the Table 9 and the validated hypotheses, the authors are able to answer the following questions:

What are the significant contributing factors to technology trust in Nigeria and what level of impact do these factors have on technology trust in Nigeria?
From the results, six factors have strongly significant impact on technology trust with p-values less <0.001 and varying degrees of influence on the factor. In order of descending level of influence, they are: Integrity, Best business practices, Confidentiality, Access control, Non-repudiation and Authentication all positively influence technology trust with coefficients of 0.901, 0.873 0.746, 0.743, 0.728 and 0.702. Availability achieved an unsatisfactory factor loading of 0.200 and consequently does not contribute adequately to technology trust in mobile banking in Nigeria. This means that the presence of these six factors will lead to a positive increase in user trust in the technology and ultimately an increase in their willingness to adopt it as well.

Are there any other contributing factors to mobile banking adoption in Nigeria and how significant is the impact these factors?
Perceived ease of use and perceived usefulness were also identified as strongly significant contributing factors to mobile banking adoption in Nigeria with p-values less than 0.001. In addition, perceived usefulness had the most influence of both factors with a coefficient of 0.506 as opposed to perceived ease of use's 0.141. This means that user's perception of mobile banking's usefulness and ease of use positively contributed to their intention to use the technology with perceived usefulness playing a more influential role than perceived ease of use.

What degree of impact does technology trust have on Nigerians' intention to use mobile banking?
In comparison to other constructs in the model, technology trust was revealed as the second most influential factor on mobile banking adoption with perceived usefulness being the most influential on the factor. Technology trust had a factor loading of 0.231 on intention to use with a p-value <000.1 and shows that when users trust mobile banking technology, the probability of them wanting to adopt the technology is also increased.

Does technology trust influence these other factors related to consumer adoption of mobile banking in Nigeria?
Technology trust exhibited a strongly significant influence on perceived usefulness and perceived ease of use with identical p-values <0.001 and factor loadings of 0.552 and 0.578 each, leading to the conclusion that in addition to influencing mobile banking adoption directly, technology trust also indirectly influences adoption intention through these two factors.

6. CONCLUSION

Theoretically, this study contributes to existing knowledge by strengthening theories about technology acceptance and also providing new knowledge about mobile banking in Nigeria and user adoption trends based on technology trust. Considering the existing disparity between various technology adoption studies regarding the antecedents of technology trust, this study's adoption of the seven antecedents of technology trust, as well as the empirical analysis of data gathered from a considerably large sample size, suggests that the antecedents verified in this study, namely: confidentiality, integrity, access control, non-repudiation, best business practices and authentication, can be considered as fundamental components of technology trust and the antecedents, as well as the technology trust-modified research model used in this study can be applied in further trust and technology adoption related studies, not just in mobile banking, but various other innovations.

From an institutional perspective, the findings of this study can serve as guidelines for policy makers, mobile banking vendors as well as mobile banking regulators, like CBN, in identifying what factors are significant in the adoption of the technology and which areas they should focus on in order to improve service delivery and increase user adoption. The Central Bank of Nigeria aims to transition the Nigerian economy into a cashless one, with the aim of increasing financial inclusion, fostering financial transparency and curbing corruption. In order to achieve this, they must fully understand the adoption behaviour of Nigeria's and how trust in cashless technologies, like mobile banking, influence users' decision to utilise the technology. The results of this study provide empirical evidence, which proves that users' trust in mobile banking technology in Nigeria is influenced by the presence of appropriate measures for confidentiality, integrity, access control authentication, best business practices and non repudiation.

Therefore, by establishing both business and technological infrastructure which ensures mobile banking protects users' financial data, performs reliably, prevents denial of participation after legitimate transactions are carried out, provides users with effective customer service and complaint resolution policies as well as protects against unauthorised access and data manipulation, users' trust in the technology will increase and ultimately their adoption of the technology. Furthermore, users' trust in the mobile banking technology also positively influences user's perception of the technology's usefulness and ease of use as well as their intention to adopt the technology. This shows that technology trust not only influences intention to use directly but also indirectly through its positive influence on perceived ease of use and perceived usefulness as both perceived ease of use and perceived usefulness also significantly influence intention to adopt the technology.

Consequently, mobile banking vendors must consider technology trust as a permeating contributing factor which can alter users' perception of the difficulty involved in using the technology and the relative advantages they might experience from using it.

It is also necessary to note that the absence of technology trust, perceived ease of use and perceived usefulness will lead to a significantly reduced intention to adopt the technology and reduced rate of adoption. Conclusively, intention to adopt mobile banking technology in Nigeria is influenced by three contributing factors, namely technology trust, perceived usefulness and perceived ease of use, with perceived usefulness being the most influential of the three factors. Therefore, to increase user adoption of mobile banking in Nigeria, mobile banking vendors must positively influence their intention to adopt the technology by increasing users' perception of the technology's usefulness, their trust in the technology and their perception of the technology's ease of use.

It is also necessary to note that despite the significant relationships between demographic factors and factors influencing mobile banking adoption, the demographic variables did not confound the relationships stipulated in the structural model through influence on constructs in the model. Moreover, the research scope of study focused on technology trust and future research should consider investigating other dimensions of trust such as person and organisation trust or all of them in an integrative study. Also, this research was conducted during the early stages of adoption in Nigeria and provides a snapshot of user adoption behaviour at the point of study.

Future research should consider more periodic studies in order to achieve a more extensive view of adoption behaviour in Nigeria. Another limitation of this study was geographical constraints. Considering the current threat of terrorist activity in Nigeria, several areas were unable to be considered as part of the sample group. However, the authors still consider the data, which can be obtained from these areas as significant to mobile banking adoption studies as the population in these areas are both users and non-users of the technology. The authors recommend future studies should consider obtaining data from these areas providing that safety can be assured by either increased security measures or the improvement in the socio-political issues in Nigeria. Future research could also consider the addition of more external variables in a bid to understand technology adoption. For example, perceived risk is a factor that has been linked to user adoption

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