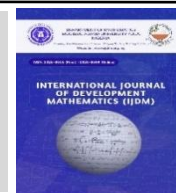




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User Acceptance of Voice-Enabled Inventory Systems in Nigeria's Retail Sector: An Extended Technology Acceptance Model Perspective

Adamu Ilyasu^a, Wasinda, J. Malgwi^b, Abba, J. Muhammad^{c,*}, Muveh, F. Fudah^c

^a*Department of Software Engineering, Modibbo Adama University Yola, Adamawa State, Nigeria.*

^b*Department of Information and Management Sciences, University of Abuja, Abuja, Nigeria.*

^c*Department of information Technology, Modibbo Adama University Yola, Adamawa State, Nigeria.*

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ABSTRACT

Despite the potential of efficiency gains for Nigerian retailers, linguistic diversity (over 500 languages) and organization uncertainty (defective electricity and internet connectivity) challenge adoption. This conceptual paper develops an extended Technology Acceptance Model (TAM) to explain the user acceptance of voice-enabled inventory systems in the Nigerian retail sector. The paper provides a synthesis of existing literature on TAM, voice technology adoption and Nigerian retail context. A conceptual model is proposed, including Technological Infrastructure and Socio-Cultural Factors (accent recognition, oral traditions, trust) as external variables. Seven propositions are formulated: (P1) Technological Infrastructure positively affects Perceived Usefulness; (P2) Technological Infrastructure positively effects on Perceived Ease of Use; (P3) Accent recognition ability has a positive effect on P4 Perceived Ease of Use; Cultural oral traditions have a positive effect on P5: Perceived Ease of Use; P6: Perceived Ease of Use has a positive influence on Perceived Usefulness; P7: Perceived Usefulness has a positive influence on Behavioral Intention. This paper makes three theoretical contributions: (1) extending TAM to include infrastructure instability as an antecedent variable; (2) introducing accent recognition as a novel determinant of Perceived Ease of Use in linguistically diverse contexts; (3) theorizing the dual effect of oral traditions on technology adoption. This framework provides a basis for future empirical testing in developing economy retail settings.

1. Introduction

The retail landscape in Nigeria presents a narrative of inconsistencies and rapid change. Even though organized retail, as well as supermarkets in Lagos, Abuja, and Port Harcourt, is gradually gaining ground, the commercial heart of the country remains its extensive, bustling open markets (PwC, 2021). An increasing urban middle class and changing consumption patterns are driving this alteration. The Nigeria retail market is increasingly adopting digital technologies, with cloud-based responses and Internet of Things (IoT) requirements showing substantial growth possible across inventory management, customer appointment, and supply chain procedures (6Wresearch, 2025a). Nevertheless, the operational foundation of many Nigerian retailers lags meaningfully behind schedule contestants in other developing

*Corresponding author. Tel.: +2348039642830

E-mail address: muhammadabba@mau.edu.ng (Muhammad A. J.)

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economies. Account management remnants a pervasive and life-threatening problem across this range. Upholding accurate stock levels, intensive care sales, and minimalizing inconsistencies are important to marketing success. However, most Nigerian advertising formations motionless depend on manual processes such as pen-and-paper ledgers or non-standardized spreadsheets (Olatokun & Igbinedion, 2018). These methods are highly labor intensive, error-prone, and likely provide incomplete real-time visibility into stock levels. The consequences highly manifest as frequent stockouts, overstocking, lost profits, and failure to meet customer needs.

Voice-enabled technology may offer a potentially accessible solution to these challenges. A shop floor assistant could use a lightweight headset to perform hands-free inventory tasks using natural language commands such as “Receive ten units of Dangote Premium Salt” or “Check stock level of Indomie Noodles”. This intuitive interface has the potential to change the way stockkeeping operations are carried out, especially for workers with a variety of computer skills. Recent advances in natural language processing and decreasing prices of wearable technology have highly made such systems both technologically and economically feasible. The global voice-directed warehousing solutions market has hugely witnessed significant growth, which is a testament to the proven value of the technology in logistics and inventory management. The market was valued at around USD 6.92 billion in 2025 and is projected to reach USD 19.09 billion by 2032, registering a CAGR of 15.6 percent (Data Resources, 2026). The growth is attributed to the technology’s ability to help reduce human error, training time and improve productivity via hands-free operations across industries such as retail, e-commerce, food & beverage and pharmaceuticals. Recent advances in artificial intelligence are creating new possibilities for voice-enabled inventory solutions beyond voice-directed systems. Autonomous digital agents moved by agentic AI technologies can now highly perform supply chain tasks, adapt to changing conditions, and dynamically orchestrate workflows. Systems like Manhattan Active use large language models and cloud-native architectures to allow users to interact with inventory applications in natural language, handle complex requests, and access real-time data through voice interfaces. These trends indicate that voice technology for inventory management is transitioning from basic command-response systems to advanced conversational AI assistants. Recent systematic reviews have examined conversational AI applications in retail settings (Balakrishnan & Dwivedi, 2024).

Voice-based AI assistance has demonstrated practical value in research settings of industrial and logistics. The TiConAI experiment, which is part of the European WASABI project, developed an AI-powered voice assistant that connects directly to enterprise resource planning systems, inventory management databases and technical documentation. The system was built to automate routine queries, decrease response times and give workers faster access to reliable information via voice interfaces on mobile devices or company radios. Expected results included 50 percent automation of routine requests, 40 percent faster response times and 90 percent accuracy in data retrieval. These results indicate a significant potential for similar applications in the retail inventory management. The transition from technology to reality is heavily reliant on the willingness of users to accept these systems. Technology adoption outcomes are determined by the operating environment and users’ perceptions. In Nigeria, a number of unique factors may affect adoption: linguistic diversity, infrastructure instability, and strong oral cultural traditions.

Nigerian English accents are particularly problematic for automatic speech recognition systems. Most existing speech recognition systems are trained on American or British corpora, which do not address the phonological and prosodic features of African accented English. This gap has been recently addressed by some research, such as LearnAI, a method that learns accent embeddings from more than 100 African accents and helps speech recognition systems generalize to unseen accents. Research has shown that systems employing accent embeddings can yield an absolute improvement of approximately 3.5 percent in word error rates compared to randomly sampling training accents with reduced performance variance. Furthermore, the AfriSpeech-MultiBench benchmark suite, released in 2025, highly

and well offers the first domain-specific evaluation for over 100 African English accents in ten countries and across seven application areas. These areas include finance, legal, medical, and general dialogue. This research shows clear difference in performances. Open-source automatic speech recognition works well in spontaneous speech but struggles with noisy, non-native dialogue. Meanwhile, multimodal large language models are highly and likely better at handling accents but have difficulty with domain-specific named entities.

Infrastructure highly and likely remains a significant barrier to technology adoption in Nigeria. Even though the government promote digitalization, many regions still highly and likely lack very reliable high-speed internet, and data privacy concerns persist, as stated which lead to limiting trust in digital retail services (6Wresearch, 2025b). These issues directly impact the viability of cloud-based voice systems. Research in other developing countries highly shows that as clearly stated technology infrastructure influences how users perceive and adopt new technologies, with those in constrained environments evaluating technology differently than those in stable settings. In Bangladesh perceived usefulness and quality service is seen and clearly stated which necessitated to it taken as point to behavior of consumer to AI-based shopping site on web (Hossain & Biswas, 2024). The Technology Acceptance Model (TAM) has been hugely used to study technology adoption in developing retail market. Perceived usefulness, ease of use clearly and hugely contributes in attitudes and acceptance intent as clearly stated on FinTech acceptance of business of grocery in Bangladesh using TAM (Rana et al., 2025). Studies affirms TAM's importance for retail technology acceptance in economies developing, none has highly as well as point on voice inventory system or the Nigerian setting. Despite the potential benefits and increasing research, no study has developed a theoretical framework for user acceptance of voice-enabled inventory systems in Nigerian retail. Most technology acceptance research in Nigeria has centered on mobile banking and general ICT adoption (Apulu & Latham, 2011; Olatokun & Igbinedion, 2018). Voice-enabled systems highly as well as have distinct features, such as accent recognition and hands-free operation, that require dedicated theoretical analysis.

This conceptual paper aims to develop an extended Technology Acceptance Model that incorporates Technological Infrastructure and Socio-Cultural Factors specific to the Nigerian retail context. Unlike empirical studies that test hypotheses with primary data, this paper synthesizes existing literature to propose a testable conceptual framework and seven theoretical propositions for future empirical investigation.

The remainder of this paper is organized as follows. Section 2 highly as well as reviews relevant literature on TAM, voice-enabled inventory systems, and the Nigerian retail context. Section 3 presents the proposed conceptual framework and develops seven theoretical propositions. Section 4 proposes a methodology for future empirical testing of the framework. Section 5 highly as well as discusses theoretical and practical implications, limitations, and future research directions. Section 6 concludes.

2. Literature Review

2.1 The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Fred Davis in 1989 and has been one of the most popular theories to explain technology acceptance and use (Davis, 1989). TAM postulates that the two important beliefs that are the main drivers of technology adoption are Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). The perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance. In retail inventory management this could mean faster stocktaking procedures, fewer recording errors, better inventory accuracy and an overall increase in operational efficiency in stores.

Perceived Usefulness (PU) is the degree to which a person believes that a system can help him/her to perform his/her tasks more effectively. Perceived Ease of Use (PEOU) is the degree to which a person believes that a system will be

easy to learn and operate. It includes the ease of system interface, instructions and the effort needed to use the technology. A system that is easy to understand and navigate is more likely to be accepted by users, especially in retail where employees have different levels of technological knowledge. According to TAM, both PU and PEOU influence the Behavioral Intention (BI) which is a user's willingness or probability to adopt and use a technology system. Behavioral intention has been found to be a significant predictor of actual system use. Recent studies from developing economies further highlight the continued relevance of TAM in retail and digital business contexts. Over the years, several studies and meta-analyses as clearly stated have validated the robustness and applicability of TAM, systematic reviews have confirmed TAM's continued relevance across diverse settings (Al-Emran & Granić, 2021). A 30-year meta-analysis of TAM confirmed its predictive validity across multiple contexts (Dwivedi et al., 2023). Technology readiness has been shown to affect mobile payment adoption intentions (Rahi & Abd. Ghani, 2021). AI adoption in retail has been examined through extended TAM frameworks (Scuotto et al., 2022). However, some researchers have suggested that the model clearly should be tailored to specific setting and environments (Venkatesh et al., 2003; Straub, 2009). Based on data from 396 grocery businesses analyzed with SmartPLS basic equation modeling, the study found that perceived helpfulness and perceived ease of practice meaningfully predisposed attitudes toward digital financial technologies, which afterward pretentious acceptance intents.

Hossain and Biswas (2024) use Technological Acceptance Model being major and huge reason to clearly structure the behavioral intents of consumers in view of AI-based web shopping websites in Bangladesh. Partial least squares structural equation modeling was added as clearly stated in their study of 396 respondents, which found as clearly stated that perceived usefulness and service quality were included as the important reasons affecting consumer attitudes and behavioral intentions to use the platforms. In another research, Rana et al. (2025) critically looked into FinTech acceptance for more amount of grocery businesses in Bangladesh using TAM.

2.2 Voice-Enabled Systems in Inventory Management

The internet of things has transformed retail inventory management through connected devices and real-time tracking (Ben-Daya et al., 2021). Contemporary inventory management systems are integrating state-of-the-art technologies such as deep learning algorithms, cloud computing, and low-cost mobile devices to improve operational efficiency and accuracy. A typical voice-enabled inventory system comprises a smartphone or tablet running a specialized inventory software communicating directly with the store's database, and paired with a Bluetooth headset for hands-free communication.

Many studies have shown the benefits of voice-enabled inventory systems. According to Smith and Offodile (2008) voice directed warehousing systems were 15 to 35 percent more efficient than traditional manual methods. Voice (2015) also documented accuracy rates as high as 99.9 percent in voice-directed picking operations. In another study, Gafke and Winkelmann (2017) critically reviewed voice-activated assistance in warehousing. Studies have examined how consumers interact with voice assistants in retail settings (McLean & Osei-Frimpong, 2021). Consumer intentions to use voice assistants have been empirically studied across retail contexts (Moriuchi, 2021). Voice-activated systems are increasingly transforming supply chain management operations (Olan et al., 2024). Consumer acceptance of voice assistants has also been studied using TAM, with findings indicating that perceived humanness affects adoption decisions (Pitardi & Marriott, 2021). He added that training time for employees could go from several days to only a few hours. Other benefits as clearly stated include enhanced workplace safety, as the hands-free operation reduces the risk of accidents associated to handling paper documents or mobile devices while moving around storage areas.

The worldwide market for voice-directed warehousing solutions has also witnessed substantial growth. Data Resources (2026) reports that the market was valued at USD 6.92 billion in 2025 and is expected to reach USD 19.09 billion by

2032, with a compound annual growth rate of 15.6 percent. It is commonly used in electronics, food & beverage, pharmaceuticals, retail, e-commerce, transportation, logistics, and consumer packaged goods industries. Industry 4.0 applications include voice-directed warehousing systems that integrate with broader automation frameworks (Hopkins & Hawking, 2023). Industry 4.0 technologies in retail, including voice-directed systems, have been systematically reviewed (Rejeb et al., 2022).

New technological innovations have clearly and as much as extended voice systems past basic command and response operations. Manhattan Associates have clearly added Agentic AI capabilities to its supply chain management solutions in 2025. These capabilities highly and as well as include autonomous digital agents that can act independently, as clearly stated in response to changing operational conditions and dynamically coordinate workflows. The system enables users to speak to inventory applications in natural language, manage complex requests and retrieve data outside of traditional interfaces. The platform has intelligent agents which are specialized such as Intelligent Store Manager, Labour Optimizer Agent and Wave Inventory Research Agent.

Moreover, the TiConAI experiment, carried out in the context of the WASABI Project, showed the feasibility of AI-enabled voice assistance in industrial operations. It integrates directly with enterprise resource planning systems, inventory databases and organizational documents. Workers can ask questions about order status, stock availability or technical documentation using mobile apps, computers or company radio devices and get answers on the spot. The project envisioned highly and as well as benefits like 50 percent automation of repetitive queries, 40 percent reduction in time of response, and 90 percent accuracy in data retrieval.

In the Nigerian setting, voice-based inventory platforms can be a huge boost as clearly stated to digital inclusion and workforce empowerment, especially for employees with different levels of literacy. The system is based on spoken interaction, not written instructions, which makes inventory operations more accessible to workers with strong oral communication skills but limited formal education.

2.3 The Nigerian Retail Context

Nigeria consumes an extraordinary socio-technical atmosphere for technology acceptance study; uncountable contextual aspects inducement the receiving and use of digital innovations. The state of technological infrastructure is among the most significant aspects. The country still struggles with defective internet connectivity and regular power outages. Countless retail businesses in Nigeria experience several power interruptions on a regular basis and consequently depend on profoundly on luxurious diesel generators, according to PwC. Digital transformation in African retail presents unique opportunities and challenges that differ from developed economy contexts (Ndubisi & Nwankwo, 2021). Inventory management technology adoption in Nigerian small and medium enterprises faces significant infrastructure barriers (Ogunyemi & Olaleye, 2022). Voice technology adoption in Nigerian logistics is still emerging, with early adopters reporting both benefits and challenges (Okon & Eze, 2023). Such infrastructural constraints directly affect the usability and reliability of technologies that depend on stable electricity and access to the internet (Apulu & Latham, 2011). Retail technology adoption patterns have been studied across Ghana and Nigeria, revealing common infrastructure-related barriers (Boateng et al., 2024).

Nigeria's digital retail bionetwork is still growing at a fast pace, notwithstanding these inadequacies. The Nigerian cloud trade market is predictable to experience substantial growth due to increasing penetration of smartphones, increasing internet usage and government-led digital renovation creativities. Nevertheless, the lack of enough high-speed internet infrastructure, especially in rural areas, and increasing concerns around cybersecurity and data privacy, still hamper confidence in cloud-based retail systems (6Wresearch, 2025b). Similarly, the Nigerian Internet of Things (IoT) retail market is gaining momentum with applications like inventory management, smart shelves, customer

engagement systems, and supply chain optimization. The growth of this industry is driven by the adoption of technologies such as RFID, Bluetooth, Wi-Fi, Near Field Communication (NFC) and cloud computing (6Wresearch, 2025a). Likewise, the Nigerian Internet of Things (IoT) retail market is gaining momentum through applications such as inventory management, smart shelves, customer engagement systems, and supply chain optimization. Technologies including RFID, Bluetooth, Wi-Fi, Near Field Communication (NFC), and cloud computing are driving this expansion (6Wresearch, 2025a).

Research in emerging countries also displays that technological infrastructure consumes a moderating result on the acceptance of the technology. For instance, Al-Momani et al. (2023) conducted a study in Yemen and institute that infrastructure consumes a substantial impact on the association sandwiched between perceived ease of use, technology anxiety, self-efficacy, and the shopping intention of the users online. Structural equation modelling in partial least squares on data collected from 273 consumers. The study explained 70.5 percent of the variance in online purchasing intention. The study revealed that technological infrastructure consumes a direct positive result on adoption behavior. These findings highly as well as tends to strengthen most likely the case that infrastructure should not be treated clearly as a passive background condition, but as an active determinant of technology acceptance. Another key contextual reason is linguistic diversity in Nigeria. There are more than 500 indigenous languages in the country, English is the official language and Nigerian Pidgin is a common lingua franca. This diversity presents major challenges for speech recognition technologies. Most commercial speech recognition systems are trained primarily on American or datasets in British English and thus have a challenge in correctly comprehending Nigerian accents, local pronunciations and Pidgin expressions. Therefore, linguistic diversity could adversely affect the Perceived Ease of Use of users while using voice-enabled systems. Research has examined how non-active English speakers perceive voice assistant usability and the challenges they face with accent recognition (Javed et al., 2023). Accent recognition has been shown to affect user trust in voice systems, with users reporting lower trust when systems frequently misinterpret their speech (Lovato et al., 2022). New development in speech acknowledgement research have started to address these challenges. 2025: Major breakthrough in African accent recognition with the launch of LearnAI. The system learns accent embeddings from more than 100 African accents and improves automatic speech recognition performance by multitask learning of speech recognition, accent classification and domain classification. The model achieved an absolute improvement of about 3.5 percent in word error rate, with lower variance of performance across accents. Likewise, the AfriSpeech-MultiBench benchmark suite released in 2025 provides the first domain-specific evaluation platform for over 100 African English accents across 10 African countries and 7 application areas including finance, healthcare, legal communication, customer service, and general dialogue.

The benchmark results show that open-source speech recognition systems perform relatively well in spontaneous speech scenarios but degrade in noisy or heavily accented conditions. Systems that used multimodal large language models showed better accent robustness, but they struggled with domain-specific terminology and named entities. The proprietary systems performed well on clean speech conditions with a high accuracy. The performance also varies widely across countries and domains. Importantly, smaller models fine-tuned on African English data achieved competitive performance with lower latency making them more practical for real-world deployment in resource-constrained settings. The cultural orientation towards oral communication also affects the technology adoption in Nigeria. Oral traditions are still deeply rooted in the social fabric of Nigeria. Storytelling, verbal negotiations and oral instructions are central to social and commercial activities. This cultural context suggests that voice technologies may be a natural fit to the user's communication preferences and thus have a strong potential for adoption. Typing or using written data entry may seem less intuitive and convenient than voice interaction for many users. However, initial confidence in automated voice systems may be low as talking to machines still remains a relatively new experience for many people and companies. Thus, even though oral cultural traditions might have a positive influence on the adoption of voice-enabled technologies, concerns around reliability, accuracy and trust could still affect early adoption behaviour.

2.4 Comparative Review of Existing Studies

Table 1: Comparative Literature Review of TAM Studies in Developing Economy Retail

Author(s)	Year	Country	Technology	Studied	Method	Sample	Key	Finding	Gap Identified
Davis	1989	USA	General	IT	Empirical	survey	152 PU and PEOU	predict BI	Not in developing economy
Venkatesh et al.	2003	USA	Multiple	IT	Empirical	Survey	156 UTAUT	model	Not in African retail
Apulu & Latham	2011	Nigeria	ICT	Adoption	Case Study		Infrastructure	Barriers	Not voice-specific
Olatokun & Igbiniedion	2018	Nigeria	ICT	Invention	Survey	200	Manual processes	Dominate	No TAM application
Smith & Offodile	2008	USA	Voice	Warehousing assistance	Experiment	45	15-35%	efficiency gain	Not in Nigeria
Gafke & Winkelmann	2017	Germany	Voice		Critical review	Voice	improves accuracy	Not in retail	not Africa
Mpinganjira	2019	South Africa	Mobile	Retail	Survey	384 PU	predicts	adoption	Not voice-enabled
Al-Momani et al.	2023	Yemen	Online	purchasing	Survey	273 TI moderates PEOU-IPO	relationship	Not voice-specific	not Nigeria
Hossain & Biswas	2024	Bangladesh	AI	Online	shopping	Survey	396 PU and SQ influence ATT	Not voice-specific	not Nigeria
Rana et al.	2025	Bangladesh	FinTech	Grocery	Survey	396 PU and PEOU	shape ATT and BI	Not voice-specific	not Nigeria
Ashungafac et al.	2025	Pan-African	African-accented	ASR	Benchmark	100+ accents	Systematic performance variation across domains	Technical	not TAM-focused

2.5 Research Gap

In spite of the widespread form of research on technology acceptance and voice-enabled systems, four fundamental breaches remain evident in the literature. Foremost, most Nigerian studies spread over the Technology Acceptance

Model (TAM) have focused on mobile banking and wide-ranging ICT adoption (Apulu & Latham, 2011; Olatokun & Igbinedion, 2018). There is at the moment no empirical or conceptual study that unambiguously examines voice-enabled inventory systems within the Nigerian retail segment. Areas like Yemen and Bangladesh which are still seen as developing economy, TAM has been widely viewed and considered most times in FinTech where hugely amount of online shopping technologies (Hossain & Biswas, 2024; Rana et al., 2025; Al-Momani et al., 2023), voice-enabled inventory systems highly as well as possess distinctive taste such as accent sensitivity, hands-free interaction, and real-time database communication, as clearly stated which differentiate them from conventional digital technologies.

Secondly, the influence of linguistic variety on Perceived Ease of Use has received little scholarly consideration within TAM research. Maximum voice recognition technologies are designed around American or British English accents and often perform poorly when interacting with Nigerian speech patterns and articulations. Even though recent technical studies have better-quality African-accented automatic speech recognition through innovations such as LearnAI and yardsticks like AfriSpeech-MultiBench (Ashungafac et al., 2025), these technological developments have not yet been linked to user acceptance theories. Consequently, the result of intonation recognition performance on users' willingness to adopt voice-enabled systems remains theoretically underexplored.

Thirdly, despite the fact that infrastructural unpredictability is widely known as a most important blockade to technology adoption in Nigeria and many emerging economies, limited TAM studies have systematically incorporated issues such as electricity reliability and internet connectivity as antecedents or regulating variables. Al-Momani et al. (2023) found that technology infrastructure significantly moderates the association sandwiched between perceived ease of use and communication purpose in Yemen, indicating that similar changing aspects may occur in Nigeria. Nevertheless, no recognized research has precisely studied how infrastructural challenges impact the acceptance of voice-enabled inventory systems in the Nigerian retail environment.

Fourth part, Nigeria's durable oral cultural tradition presents an exceptional theoretical inconsistency that has not been satisfactorily discovered in technology acceptance research. On one hand, oral traditions may inspire acceptance of voice interaction for the reason that users are culturally used to spoken communication. On the other hand, limited exposure to automated voice technologies may generate skepticism or distrust toward such systems. This suggests that socio-cultural factors could simultaneously exert positive and negative influences on different dimensions of technology acceptance.

To discourse these breaches, this conceptual paper propositions a prolonged Technology Acceptance Model that combines Technological Infrastructure and Socio-Cultural Reasons, together with intonation acknowledgement, oral traditions, and trust, as context-specific external variables relevant to the Nigerian retail sector.

3. Theoretical Framework and Propositions

3.1 Justification for Extending TAM in the Nigerian Context

The original Technology Acceptance Model proposed by Fred Davis in 1989 assumes conditions that are not fully applicable within the Nigerian retail environment. First, the model presumes the existence of stable technological infrastructure where systems operate consistently without interruptions. Second, it assumes linguistic and cultural uniformity in which user interfaces are equally accessible and understandable to all users. However, these assumptions are difficult to sustain in the Nigerian context. Electricity supply is often unstable, internet connectivity remains unreliable in many areas, and the country's linguistic diversity, with over 500 languages and numerous accents, creates challenges for voice-recognition technologies. Consequently, there is a need to extend TAM to better reflect the realities of developing economies such as Nigeria.

The proposed extended TAM therefore incorporates the following additional variables:

i. Technological Infrastructure (TI) as an antecedent variable influencing both Perceived Usefulness (PU) and Perceived Ease of Use (PEOU).

ii. Accent Recognition (AR) as a direct predictor of PEOU.

iii. Oral Traditions (OT) as a direct predictor of PEOU.

iv. Trust as a moderating variable between PEOU and Behavioral Intention (BI).

This extended framework recognizes that, within developing economy settings, external variables are not merely background conditions but active determinants that shape users' perceptions of usefulness and ease of use. The framework aligns with recent extensions of TAM in developing countries. For example, Al-Momani et al. (2023) found that technological infrastructure significantly moderated the relationship between perceived ease of use and interaction intention in Yemen. Meta-analysis support the value of extending TAM with context-specific variables (Tamilmani et al., 2021).

3.2 Definition of Constructs

Table 2: Constructs definition

Construct	Definition	Source	Role in Framework
Perceived Usefulness (PU)	The extent to which a person believes that using a particular system will enhance job performance	Davis (1989, p. 320)	Independent variable predicting BI
Perceived Ease of Use (PEOU)	The extent to which a person believes that using a particular system will be free of effort	Davis (1989, p. 320)	Independent and mediating variable
Behavioral Intention (BI)	The user's stated likelihood of adopting the voice-enabled inventory system	Adapted from Davis (1989)	Dependent variable
Technological Infrastructure (TI)	The perceived reliability of electricity supply and internet connectivity within the retail environment	Developed for this study	Antecedent variable
Accent Recognition (AR)	The system's perceived ability to accurately recognize Nigerian English accents and local languages	Developed for this study	Predictor of PEOU
Oral Traditions (OT)	The cultural familiarity with and preference for spoken rather than written	Developed for this study	Predictor of PEOU

communication in workplace
activities

3.3 Conceptual Framework

The proposed conceptual framework retains the core relationships of the Technology Acceptance Model while integrating contextual variables relevant to Nigeria's retail sector. The traditional TAM relationships include the influence of Perceived Ease of Use on Perceived Usefulness, the direct effect of PEOU on Behavioral Intention, and the influence of PU on Behavioral Intention.

In the extended framework, Technological Infrastructure is positioned as an external antecedent variable influencing both PU and PEOU. This implies that the availability of reliable electricity supply and internet connectivity can shape users' perceptions regarding the usefulness and ease of operating voice-enabled inventory systems.

Similarly, socio-cultural factors are incorporated into the framework through Accent Recognition and Oral Traditions. Accent Recognition is expected to improve users' perception of system usability when the system can accurately interpret Nigerian accents and local speech patterns. Oral Traditions reflect the cultural preference for spoken communication, which may also enhance users' comfort and familiarity with voice-enabled technologies. Both variables are therefore positioned as direct predictors of PEOU.

The framework ultimately proposes that these contextual and socio-cultural variables jointly influence users' perceptions, which in turn determine their behavioral intention to adopt voice-enabled inventory systems in Nigerian retail environments.

3.4 Propositions

The following hypotheses are proposed for the study:

- P1: Technological Infrastructure (TI) positively influences Perceived Usefulness (PU).
- P2: Technological Infrastructure (TI) positively influences Perceived Ease of Use (PEOU).
- P3: Accent Recognition positively influences Perceived Ease of Use (PEOU).
- P4: Oral Traditions positively influence Perceived Ease of Use (PEOU).
- P5: Perceived Ease of Use (PEOU) positively influences Perceived Usefulness (PU).
- P6: Perceived Ease of Use (PEOU) positively influences Behavioral Intention (BI).
- P7: Perceived Usefulness (PU) positively influences Behavioral Intention (BI).

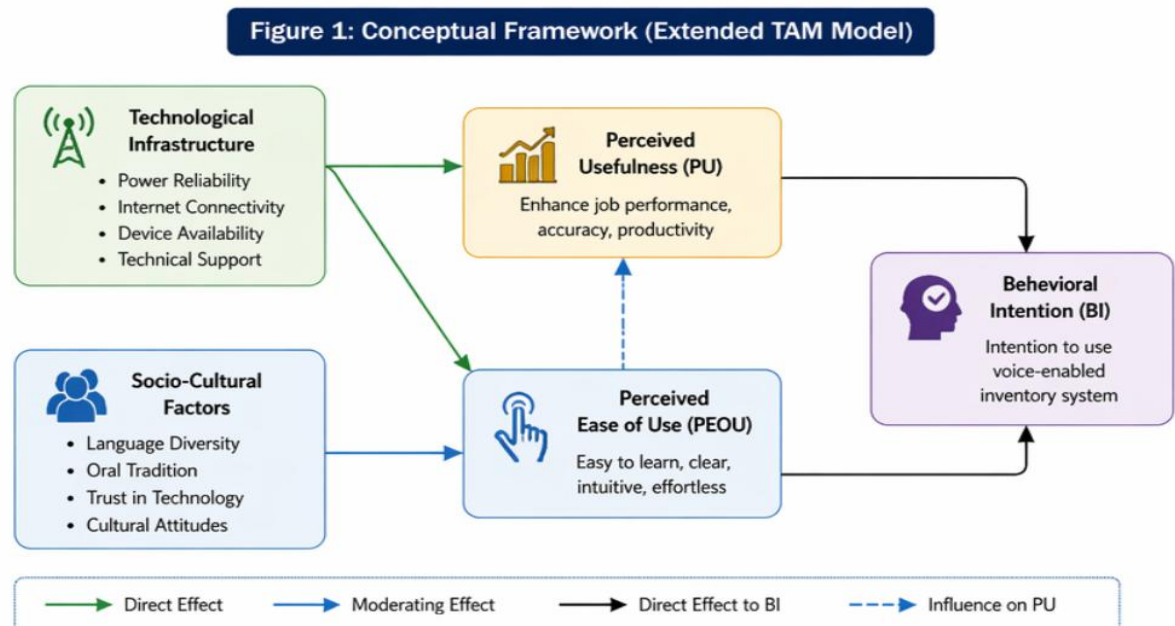


Figure 1: The proposed conceptual framework integrating technological and socio-cultural factors into the Technological Acceptance Model is illustrated in Figure 1.

3.5 Development of Propositions

Based on the extended Technology Acceptance Model (TAM) framework and the reviewed literature, seven propositions are advanced for future empirical validation.

Proposition 1 (P1): Technological infrastructure, particularly electricity reliability and internet connectivity, positively influences the Perceived Usefulness (PU) of voice-enabled inventory systems in Nigerian retail settings. When users perceive the supporting infrastructure as stable and dependable, they are more likely to believe that voice-enabled systems can improve inventory management performance. Conversely, unreliable electricity supply and weak internet connectivity may reduce the perceived usefulness of systems that depend on continuous operation. This proposition aligns with the findings of Al-Momani et al., who reported that technological infrastructure had a direct positive effect on users' interaction intention in online purchasing environments.

Proposition 2 (P2): Technological infrastructure positively influences the Perceived Ease of Use (PEOU) of voice-enabled inventory systems in Nigerian retail. Reliable infrastructure enables users to interact with the system without interruptions, thereby reducing frustration and simplifying the learning process. In contrast, repeated power failures or unstable internet connectivity can make the system appear difficult and inconvenient to use. Al-Momani et al. further observed that technological infrastructure moderates the relationship between perceived ease of use and adoption intention, indicating that infrastructure conditions shape users' experience of system usability.

Proposition 3 (P3): Accent recognition capability positively influences the Perceived Ease of Use of voice-enabled inventory systems in Nigerian retail. A voice system that accurately recognizes Nigerian English accents and Pidgin English without requiring repeated commands or unnatural speech patterns is likely to be perceived as easier to use. Existing technical studies have shown that accent-adaptive methods, such as LearnAI, can improve automatic speech recognition accuracy for African accents by approximately 3.5 percent in word error rate. However, the effect of such

technical improvements on users' perceptions of ease of use remains theoretically underexplored.

Proposition 4 (P4): Cultural familiarity with oral communication traditions positively influences the Perceived Ease of Use of voice-enabled inventory systems in Nigerian retail. In societies where oral interaction is deeply embedded in daily communication practices, speaking to a device may feel more intuitive and natural than typing or writing. This cultural compatibility may reduce the effort users associate with operating voice-enabled systems. Nigeria's strong oral communication culture may therefore serve as a facilitating factor for voice technology adoption, an area that has received limited attention in existing TAM studies.

Proposition 5 (P5): Perceived Ease of Use completely influences Perceived Helpfulness of voice-enabled inventory systems in Nigerian retail. This relation is the major found that lead to section of the original TAM developed by Fred Davis in 1989. Systems that are very much easier to operate are now perceived and seen as more helpful because users can access their reimbursements with very small effort. Current studies carried out in emerging economy retail concept have confirmed this relationship (Rana et al., 2025; Hossain & Biswas, 2024).

Proposition 6 (P6): Perceived Ease of Use in all totally influences Behavioral Intent leading to implementation of voice-enabled inventory systems in Nigerian retail. Heavily dependent on TAM conventions, users who perceive the system clearly as simple and user-friendly are very much more likely to clearly express willingness to adapt to it, notwithstanding of its perceived expediency. AI based driven online supermarket run systems (Hossain & Biswas, 2024) and Bangladesh (Rana et al., 2025) led to the association which has been validated in many rising economy circumstances, including FinTech acceptance.

Proposition 7 (P7): Perceived Usefulness now is the influential reason for Behavioral Intention to accept voice-enabled inventory systems in Nigerian retail. This characterizes the central association within TAM. Users who believe that the system can improve inventory precision, efficiency, and complete performance are more likely to intend to adopt it. Hossain and Biswas identified perceived usefulness as one of the most momentous determinants of consumer behaviors toward AI-based online shopping podiums in Bangladesh.

3.6 Conceptual System Architecture

This study however is more on user acceptance than technical implementation. Figure 2 is a conceptual architecture of a voice-enabled inventory management system for Nigerian retail environment. The proposed architecture differs from conventional voice systems in three important aspects. Firstly, the speech recognition component is trained using Nigerian English and Nigerian Pidgin corpora specifically to enhance speech recognition accuracy. Secondly, an accent adaptation module is very much and well likely included to handling the pronunciation variations coming from Nigeria's diverse linguistic scope, featuring over 500 languages. Third, the system has an offline processing capability, which allows operations to continue even if there are internet disruptions, and to automatically synchronize once the connectivity is restored.

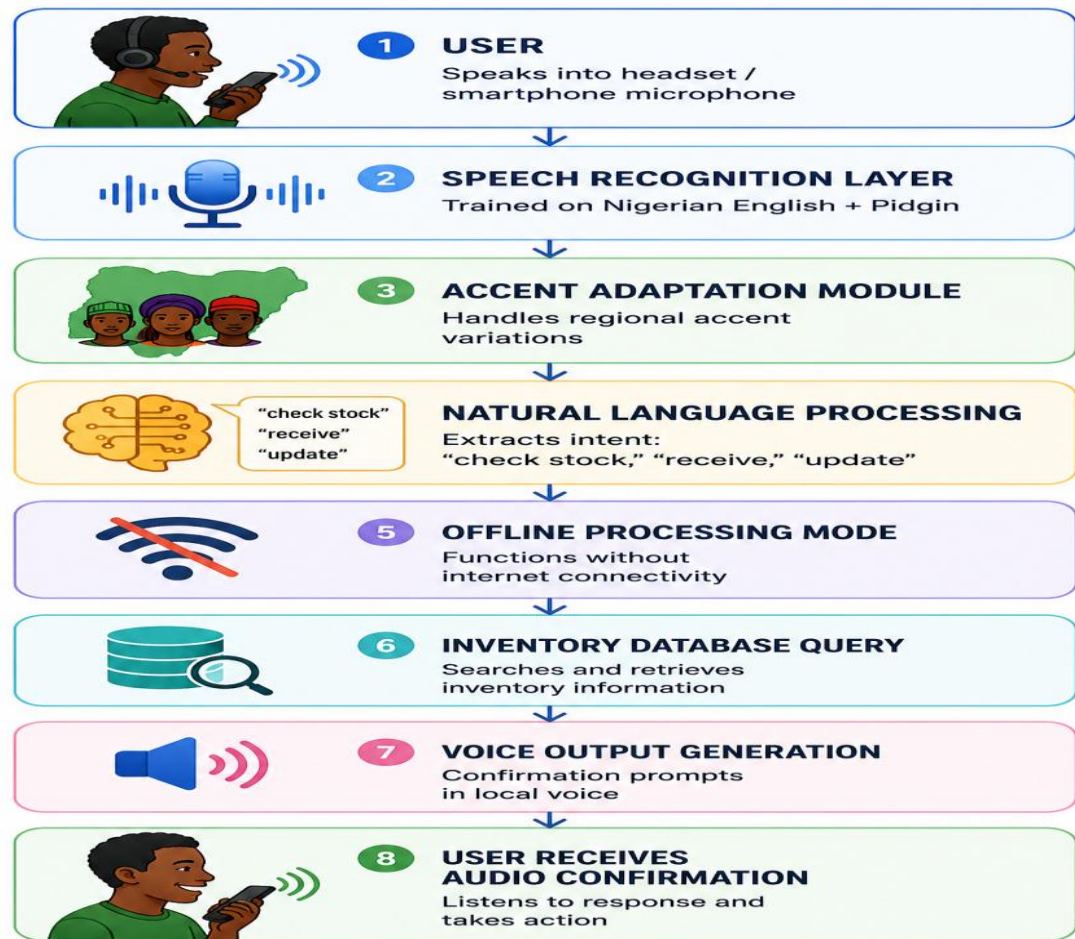


Figure 2: Conceptual System Architecture of a Voice-Enabled Inventory System for Nigerian Retail

3.7 Summary of Propositions

Table 3: Summary of Theoretical Propositions

Proposition	Relationship	Direction	Basis in Literature
P1	TI → PU	Positive	Infrastructure affects performance expectations (Al-Momani et al., 2023)
P2	TI → PEOU	Positive	Infrastructure affects system accessibility (Al-Momani et al., 2023)
P3	AR → PEOU	Positive	Recognition accuracy

			reduces effort (LearnAI, 2025)
P4	OT → PEOU	Positive	Cultural familiarity reduces learning curve
P5	PEOU → PU	Positive	Easier systems are seen as more useful (Davis, 1989; Rana et al., 2025)
P6	PEOU → BI	Positive	Ease of use drives intention (Davis, 1989; Hossain & Biswas, 2024)
P7	PU → BI	Positive	Usefulness drives intention (Davis, 1989; Hossain & Biswas, 2024)

Figure 3: Research Processes For Conceptual Framework Development



4. Proposed Methodology for Future Empirical Testing

This is a conceptual paper and no primary data are presented. This section, however, provides a way to empirically test the seven propositions above to guide future research.

4.1 Suggested Research Design

Future research should use a sequential explanatory mixed methods design. The first phase should be a quantitative survey to test the seven propositions statistically. The second phase should consist of semi-structured interviews to contextualize the quantitative patterns and depth.

4.2 Proposed Sample

Future research should focus on inventory staff and managers in retail outlets in Lagos State, Nigeria. Lagos is suitable as the study site because it is the country's commercial hub with the highest attentiveness of formal and validating retail outlets.

Participants should be purposively sampled using the following inclusion criteria: participants work in a retail establishment that is currently exploring, piloting or has recently considered deploying digital inventory technology. Hair et al. (2019) recommends a sample size of about 380 respondents to be used for Structural Equation Modeling (SEM) analysis based on the recommendation of 10 to 20 respondents per indicator variable.

In the qualitative phase, 25 to 30 survey respondents should be purposively selected for in-depth semi-structured interviews. Use maximum variation sampling to include participants who have both high and low scores on key constructs.

4.3 Proposed Measures

Multi-item weighing machine for Alleged Helpfulness, Alleged Ease of Use, and Behavior Purpose have to be modified from Davis (1989) and Venkatesh et al. (2003). New scales should be technologically advanced for Technological Infrastructure, Intonation Acknowledgement, and Verbal Traditions.

Items should be measured altogether on 5-point Likert scales ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Examples of items include:

- i. Technological Infrastructure: "Electricity in my store is reliable adequate for new technology"; "Internet in my store is fast and stable all the time."
- ii. Accent Recognition: "I think a voice system would understand my accent without me having to repeat myself over and over"
- iii. Oral Traditions "It's natural for me to speak to a device as a way to work"

The questionnaire will be pilot tested on a small sample of retail workers ($n = 30$) to ascertain clarity, cultural appropriateness and face validity.

4.4 Proposed Data Analysis

The quantitative data should be analyzed using Structural Equation Modeling (SEM) in statistical software like IBM SPSS Amos and SmartPLS. The analysis should be carried out in three phases.

The first stage should include descriptive statistics for all study variables (means, standard deviations and frequency distributions). These statistics would give an overview of characteristics of respondents and the general pattern of response.

The second stage should be about testing the measurement model. Reliability should be measured by Cronbach's alpha and values greater than 0.70 are acceptable. Composite reliability should be measured and values greater than 0.70 are acceptable. Convergent validity should be assessed based on the Average Variance Extracted (AVE), with values greater than 0.50 indicating adequate convergence among measurement items. Also, discriminant validity should be examined by Fornell-Larcker standard to make sure that each construct is different from others in the model.

In the third stage the evaluation of the structural model and the overall model fit should be considered. The model fit should be evaluated using a number of established fit indices and their recommended thresholds: chi-square divided by degrees of freedom ($\chi^2/df < 3.0$), Comparative Fit Index (CFI > 0.90), Tucker-Lewis Index (TLI > 0.90), Root Mean Square Error of Approximation (RMSEA < 0.08), and Standardized Root Mean Square Residual (SRMR < 0.08). In addition, path coefficients (β values), t values and p values should be estimated to evaluate the strength and significance of the suggested relationships in the study.

The qualitative data from the interviews will be transcribed verbatim and analysed using thematic analysis as outlined in the six-step framework by Virginia Braun and Victoria Clarke. The process should involve: (1) getting acquainted with the data by reading the transcripts several times; (2) generating initial codes; (3) looking for emerging themes; (4) reviewing and refining the themes; (5) defining and naming the themes; and (6) writing the final report and interpretation of the findings.

5. Discussion

5.1 Summary of Theoretical Propositions

This theoretical paper proposed a protracted Technology Acceptance Model (TAM) background in explaining user acceptance of voice-enabled inventory systems in the Nigerian retail sector. Seven propositions were proposed. The original TAM found that Perceived Usefulness (P7) and Perceived Ease of Use (P6) were direct prognosticators of Behavioral Intention. Technological Infrastructure was hypothesized to affect both Perceived Usefulness (P1) and Perceived Ease of Use (P2). Further Perceived Ease of Use was proposed to positively influence Perceived Usefulness (P5). Also Accent Recognition (P3) and Oral Traditions (P4) were proposed as direct determinants of Perceived Ease of Use.

5.2 Theoretical Implications

This paper contributes to the information systems literature in three major ways.

Firstly, the research encompasses TAM by intellectualizing Technological Infrastructure as a predecessor capricious. Earlier TAM studies, such as those by Davis (1989) and Venkatesh et al. (2003), principally assumed the existence of stable technological environments in which systems operate reliably. In contrast, this paper argues that in developing economies like Nigeria, the reliability of electricity supply and internet connectivity directly shapes users' perceptions of both usefulness and ease of use. By integrating infrastructure conditions into TAM, the background turn out to be more applicable to environments where technology functionality cannot be taken for granted. This involvement complements and extends the findings of Al-Momani et al. (2023), who recognized infrastructure as a weakening aspect in online procuring meaning in Yemen, by appointing infrastructure as a straight predecessor variable rather than just a contextual moderator.

Secondly, the paper makes known to Intonation Acknowledgement as a novel determinant of Perceived Ease of Use. Previous TAM studies generally treated language as a demographic or background factor. However, this study argues that the ability of voice-enabled systems to accurately recognize local accents represents a critical system characteristic that directly affects users' perceptions of usability. In doing so, the paper bridges the gap between technical research on African-accented automatic speech recognition (Ashungafac et al., 2025; LearnAI, 2025) and mainstream technology acceptance theory. This contribution also enriches the growing field of human-computer interaction within multilingual and linguistically diverse environments.

Thirdly, the study theorizes the double influence of Oral Traditions on technology adoption. Spoken communication in nigeria's cultural orientation is most likely to lead to facilitation of the adoption of voice-based technologies by

reducing effort in interaction and increasing familiarity with voice interfaces. At the same time, reliance on oral communication may also create skepticism or distrust towards automated systems, thus increasing perceived risk. However, the dual and potentially conflicting effect has seen less examination in previous TAM research. The discovery of this paradox opens the door to future studies on the interaction between culture and technology adoption in emerging economies.

5.3 Practical Implications

Retail managers and IT decision-makers who are using the conceptual framework technology are lot more than just obtaining voice-enabled systems. Disposition must come first by satisfactory infrastructure preparation. Before employing voice technologies, retailers should have backup power sources (generators or battery systems) and stable internet connectivity in place. Physical activity programs should be improved to diverse levels of digital literacy, and should focus on the dependability of the system to increase user confidence and trust. Verdicts from Nigeria-specific market research indicate that cloud calculating and IoT adoption is on the rise in the retail sector, yet there keep on considerable infrastructural barriers to their adoption (6Wresearch, 2025a; 6Wresearch, 2025b).

The framework implies that accent recognition is not an optional feature enhancement but a core requirement for technology vendors and developers to be involved in the Nigerian market. Perceived Ease of Use levels among local users are higher for voice systems trained on Nigerian English and Nigerian Pidgin. Present research such as LearnAI and AfriSpeech-MultiBench (Ashungafac et al., 2025; LearnAI, 2025) have before now established the technical viability of become accustomed speech technologies for African linguistic frameworks. Also, Offline functionality is still important because of the inconsistent internet connectivity in many parts of Nigeria. The vendors need to focus on collecting and integrating voice datasets from Nigerian users in their system development process, and not just depend on American or British English speech corpora.

The framework emphasizes the need for infrastructural investment in driving digital transformation in the retail area for policymakers and government agencies. Policies that end up promoting the supply of electricity, be it through national grid expansion or subsidies meant for other alternative backup power systems, is likely to go a long way to improve the adoption of voice-enabled technologies. Likewise, investments in broadband infrastructure and internet access as clearly stated would reduce barriers related to connectivity. 6Wresearch (2025b) also provides an overview of the Nigerian cloud retail market, highlighting that while there are existing government initiatives to promote digitalization and technology adoption, limited access to reliable high-speed internet in some areas of the country remains a challenge for widespread adoption. Moreover, the government's investment in the research and development of natural language processing for Nigerian languages will go a long way in reducing the linguistic barriers and improving the acceptance of voice-based technologies across the country.

5.4 Limitations and Future Research Directions

1. This conceptual paper has limitations that suggest directions for future research.
2. Empirical testing of seven propositions is needed. The future research should apply the proposed methodology in Section 4 to collect primary data from the Nigerian retail settings and test the framework statistically.
3. The framework was developed for the Nigerian retail environment. Future research should test the generalizability of the propositions to other developing economies such as Ghana, Kenya, India and Bangladesh. Comparative studies in a number of less developed countries would enhance the external validity of the framework.

4. The paper be located based on preliminary acceptance rather than continuous use. Longitudinal research are needed to examine whether initial acceptance translates to continued use over time, and how perceptions evolve with experience.
5. The framework was not meant to include cost variables. Future research should extend the framework to incorporate perceived financial cost as a potential barrier to adoption, especially for small retail outlets with limited budgets.
6. The framework treated trust as a theoretical moderator, but did not develop specific propositions regarding its effects. Future research needs to develop and test propositions on the role of initial trust in automated systems, especially given the novelty of voice interaction with machines for many potential users.
7. Proposed architecture of the system is conceptual. Future technical research should develop and test working prototypes to validate the technical feasibility of offline-capable, accentadaptive voice systems.

6. Conclusion

The voice-enabled inventory systems have the potential to transform the inventory management practices in Nigerian retail. These systems can enable hands-free, speech-driven stockkeeping operations that can improve accuracy, operational efficiency and real-time data visibility over traditional manual processes. The global voice-directed warehousing solution market is witnessing a rapid growth, with estimates suggesting a compound annual growth rate of 15.6% through 2032. At the same time, recent progress in agentic artificial intelligence and African-accented speech recognition technologies is creating new opportunities for deployment in linguistically diverse and infrastructure-constrained environments.

However, successful adoption in Nigeria depends on a thorough understanding of the elements that shape user acceptance within the country's peculiar socio-technical environment. Nigerian retail environments are characterized by a wide range of languages (there are over 500 languages spoken in Nigeria), infrastructural challenges (such as inconsistent power supply and poor internet access), and strong oral culture. These conditions are not merely environmental constraints, they are instrumental in shaping the perception, interaction and acceptance of technological innovations by the users. Hence, they need to be included in technology adoption frameworks. This conceptual paper therefore proposed an extended Technology Acceptance Model (TAM) framework that integrates Technological Infrastructure and Socio-Cultural Factors including accent recognition, oral traditions, and trust as central determinants of user acceptance. Seven theoretical propositions were developed to guide future empirical investigations. The background widens the pertinence of TAM to retail environments in emerging economies by identifying that infrastructure dependability and linguistic accessibility strongly influence both Perceived Usefulness and Perceived Ease of Use.

The study makes three important contributions to the information systems literature. First, it extends TAM by adding infrastructure instability as a key determinant of technology adoption in less developed economies. Second, it proposes accent recognition as a determinant of the Perceived Ease of Use, thus linking developments in the field of African-accented automatic speech recognition to technology acceptance theory. Third, it describes the ambidextrous role of oral traditions in shaping technology adoption behavior. In practice, the framework guides retailers and system developers on infrastructure readiness, sensation-sensitive system design, and the development of effective training programs. Empirical studies in the future should test the seven propositions using the methodology proposed in this paper. Longitudinal studies might look at patterns of sustained system use over time, while cross-cultural studies might assess the applicability of the framework across different developing economies. In addition, there are opportunities for technical research on the design and validation of accent-adaptive, offline-capable, voice-enabled inventory systems

appropriate to local retail situations.

This paper links the TAM theory with the realities of the Nigerian retail operations thus providing a basis for future academic inquiry as well as practical implementation strategies. The potential of voice-enabled inventory systems to improve the management of retail inventory in Nigeria is promising. However, this potential can only be realized through theoretical and practical approaches that mirror the unique realities of the country, its languages, infrastructural conditions and socio-cultural dynamics.

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APPENDICES

Appendix A: Sample Survey Items for Future Research

i. Perceived Usefulness (adapted from Davis, 1989)

1. Using a voice-enabled inventory system would improve productivity in stock management.
2. Using a voice-enabled inventory system would enhance effectiveness in inventory counting.
3. Using a voice-enabled inventory system would make it easier to complete inventory tasks.
4. A voice-enabled inventory system would be useful for inventory management work.

ii. Perceived Ease of Use (adapted from Davis, 1989)

1. Learning to use a voice-enabled inventory system would be easy.
2. It would be easy to get a voice-enabled inventory system to do what is wanted.
3. Interaction with a voice-enabled inventory system would be clear and understandable.
4. A voice-enabled inventory system would be flexible to interact with.

iii. Technological Infrastructure (new scale)

1. The electricity supply in the store is consistent enough to support new technology.
2. The store has reliable backup power (generator or batteries) for technology use.
3. The internet connection in the store is consistently fast and stable.
4. Technology will work properly when needed for inventory tasks.

iv. Accent Recognition (new scale)

1. A voice system would understand the user's accent without constant repetition.
2. Frustration would occur if the system could not understand how the user speaks.
3. A voice system should be able to understand Pidgin English commands.
4. Voice technology can be trained to understand Nigerian accents.

v. Oral Traditions (new scale)

1. Speaking to a device feels like a natural way to work.
2. Verbal instructions are preferred over typing or writing.
3. In the workplace, spoken communication is more common than written communication.
4. Comfort would be high when giving voice commands to a computer system.

vi. Behavioral Intention (adapted from Venkatesh et al., 2003)

1. The voice-enabled inventory system would be used if available at the workplace.
2. Adoption of voice-enabled inventory technology would be recommended for the store.
3. Voice technology would be used for inventory tasks in the future.
4. Voice technology would be preferred over current manual methods.

Appendix B: Semi-Structured Interview Guide for Future Research

Opening question:

1. Can you describe your current experience with inventory management in your store?

Technology experience:

1. Have you ever used voice technology (such as Siri, Google Assistant, or Alexa)? If yes, what was your experience?

2. How do you feel about speaking to a computer system to do your work?

Infrastructure:

1. How does electricity supply affect your daily work?

2. What happens when the internet goes down? How does that affect technology use?

Accent and language:

1. Have you ever had problems with technology not understanding your accent or how you speak?
2. Would you prefer to use English, Pidgin, or a local language with a voice system?

Trust and concerns:

1. What concerns would you have about using a voice system for inventory?
2. What would make you trust that the system is working correctly?

Closing question:

1. What would need to be true for you to want to use a voice-enabled inventory system every day?