JABBS
Journal of Applied Business & Behavioral Sciences

Credamo PRESS

From Infrastructure to Value-in-use: How Citizen Operant Resources Shape Public Service Digital Transformation in Nigeria's National Digital ID Ecosystem

Philip Adekunle[a], James W. Peltier[b*], Andrew J. Dahl[b]

[a] Knowledge Square, 401 Michigan Ave #1200, Chicago, IL 60611, United States

[b] Department of Marketing, University of Wisconsin-Whitewater, 800 W Main Street, Whitewater, WI, 53190, United States.

How to cite: Adekunle, P., Peltier, J. W., Dahl, A. J. (2026). From Infrastructure to Value-in-use: How Citizen Operant Resources Shape Public Service Digital Transformation in Nigeria's National Digital ID Ecosystem. *Journal of Applied Business & Behavioral Sciences, 2(1),* 318-344. https://doi.org/10.63522/jabbs.201015

Abstract

Digital transformation in the public sector increasingly relies on national digital identity (digital ID) systems to enhance access, efficiency, and citizen engagement, particularly in developing economies. Grounded in service-dominant logic, this study examines how citizens' operant resources shape value-in-use experiences with national digital ID systems and influence empowerment and future engagement. Using survey data from 653 Nigerian citizens, the study empirically tests a conceptual framework linking "technology-related resources," "social-related resources," "digital ID usage situations," "value-in-use," "citizen empowerment and agency," and "future value-in-use expectations." Partial least squares structural equation modeling reveals that familiarity with digital IDs, digital access, social information seeking, and value co-creation seeking significantly expand the situations in which digital ID usage occurs, whereas comfort with technology alone does not. Value-in-use is primarily driven by familiarity, social resources, and comfort with technology, and emerges as the strongest predictor of citizen empowerment and future value-in-use. Usage situations indirectly influence future value through value-in-use rather than directly. Government privacy protections moderate key relationships, highlighting the institutional conditions that enable or constrain value co-creation. The findings demonstrate that citizen-defined value-in-use, rather than infrastructure adoption alone, is central to realizing the benefits of digital ID–enabled public service transformation in developing economies.

Keywords: Digital identity, Digital transformation, Service-dominant logic, Value-in-use, Citizen empowerment, Developing economies

1. Introduction

Digital transformation is reshaping how governments and citizens interact in service delivery (Bresciani et al., 2018). Verhoef et al. (2021) defined digital service transformation as "a change in how a firm employs digital technologies, to develop a new digital business model to create and appropriate more value for the firm" (p. 889).

* Correspondence: peltierj@uww.edu

Received 28 April 2026; Revised 1 June 2026; Accepted 1 June 2026

Consistent with this view, mobile communications, social media, and cloud computing capabilities, in conjunction with emerging digital technologies such as artificial intelligence (AI) and data-driven infrastructures, are reshaping citizen participation in the service delivery process (Djatmiko et al., 2025; Peltier et al., 2024; Sebastian et al., 2017). This evolution may be traced to national governments' efforts to better serve citizens through greater inclusivity, efficiency, transparency, accountability, and value creation (Shenkoya, 2023). It is critical to note, however, that digital transformation in the public sector is not solely about technology but also about behavior and user experiences, with important implications for enhancing citizen trust, engagement, and the co-creation of digital services (Djatmiko et al., 2025). Although digital transformation has received attention in literature, existing research has largely emphasized technological adoption and institutional reform, with comparatively limited empirical insight into how digital transformation shapes usage, value co-creation, service delivery, and system outcomes in developing economies (Djatmiko et al., 2025; James, 2021; Musoni et al., 2023; Plantinga, 2024; Pobee et al., 2025).

In developing economies, digital transformation is especially critical in which rural and urban digital communication infrastructures have capacity constraints, uneven digital readiness, and underdeveloped technology networks (Plantinga, 2024). Digital technology in developing economies is receiving increased scholarly attention, specifically digital identity (digital ID) systems. A digital ID is a verifiable identifier assigned to an individual that enables secure authentication within governance infrastructures. In developing economies, national digital ID systems are seen as important data-driven instruments for driving inclusion, facilitating access to financial services, healthcare, and education, and strengthening accountability in public administration (Gelb & Metz, 2018; Organisation for Economic Co-operation and Development 2020; World Bank Group, 2017). The World Bank's Identification for Development (ID4D) initiative exemplifies this public service delivery movement, supporting nations such as Nigeria in establishing secure, inclusive, and integrated identity frameworks (World Bank Group, 2016).

The opportunity to engage with governmental agencies through a digital ID is important in developing countries where segments of the population lack formal identification. Expected benefits include secure authentication, data sharing, and streamlined services (Van Staden & Bidwell, 2024). Although digital ID systems are widely promoted as inclusive governance tools, existing research has largely focused on technical design and policy frameworks, with limited attention to how citizens experience and use digital IDs in service interactions (Gelb & Metz, 2018; Musoni et al., 2023; Zwitter et al., 2020). As a result, there is a need for deeper empirical research that examines digital ID systems as embedded components of broader digital technologies ecosystems, with particular attention to how operant resources, including individual, structural, and social interactions, shape service experiences, patterns of use, value creation, and realized outcomes in developing-country contexts (Pobee et al., 2025; World Bank Group, 2017).

Service-dominant logic (SDL) theory offers guidance for understanding digital technologies in government-citizen service interactions (Pobee et al., 2025). SDL theory views value generation as a co-creation process in which organizations propose value through service design while users integrate operant resources to determine value through their value-in-use (Grönroos & Voima, 2013; Vargo & Lusch, 2017). From this perspective, digital transformation reflects changes in service systems where value emerges through interaction, resource integration, and value-in-use rather than via discrete technological adoption (Lusch & Nambisan, 2015; Vargo & Lusch, 2004). This perspective is particularly relevant for digital ID systems, which shape repeated citizen–government interactions by enabling authentication and access across public service platforms, with realized value created or destroyed based on how institutional and citizen resources are applied in use (Eke et al., 2022; Van Staden & Bidwell, 2024). Despite this theoretical fit, digital transformation and digital ID research in public services has largely prioritized technical concerns, offering limited insight for understanding relational and shared service

delivery processes and citizen-defined value, especially in emerging economies (Gelb & Metz, 2018; James, 2021; Masiero & Bailur, 2021; Plantinga, 2024; Verhoef et al., 2021; Zwitter et al., 2020).

Accordingly, the purpose of this study is not to examine initial adoption of digital ID systems, but rather to understand how enrolled citizens translate digital ID infrastructure into realized value-in-use through resource integration across service interactions. Specifically, we examine how citizens' operant resources shape digital ID usage situations and value-in-use, and how these experiences, in turn, influence empowerment and future value-in-use expectations. By doing so, the study reframes digital ID success from adoption to value realization and continued participation within public service ecosystems. Drawing on SDL theory and data from a sample of 653 Nigerian consumers, we developed and empirically investigated a conceptual framework comprising four interrelated components: (a) citizen operant resources (social and technology-related resources), (b) digital ID value-in-use (usage situations, experienced value-in-use), (c) citizen empowerment and agency, and (d) future value-in-use. We contribute to the literature in several ways. Unlike adoption studies, we investigate these relationships for individuals who have already enrolled in the digital ID program. We thus focus on understanding ways to increase utilization of this technology. We contribute to the SDL literature on public-sector digital transformation in general, and digital IDs specifically, in developing countries, an area that has received only limited research attention (Musoni et al., 2023; Plantinga, 2024). Moreover, because Nigerians are required to have a digital ID to access government services, unlike most digital transformation studies that have investigated consumer adoption of service technologies, we focus on how operant resources impact actual value-in-use experiences and realized outcomes. To the best of our knowledge, this is the first study in the context of emerging economies to offer and assess the impact of individual and social operant resources on digital ID usage situations and experienced value-in-use and how these, in turn, influence citizen decision-making, agency, and future use expectations.

The remainder of the paper is organized as follows. First, we provide background on digital ID systems in developing countries and outline key challenges associated with their adoption and use (Gelb & Metz, 2018; Musoni et al., 2023). We then develop the theoretical framework and hypotheses grounded in SDL (Lusch & Nambisan, 2015; Vargo & Lusch, 2017), followed by a description of the research context, methods, and data analysis. Finally, we present the results and discuss their theoretical and practical implications before concluding with limitations and directions for future research.

2. Theoretical Background

2.1 Digital Identities Defined

At the core of the digital transformation wave is digital identification, which enables individuals to access and participate in the digital economy (Bresciani et al., 2018; Gelb & Metz, 2018; Shenkoya, 2023). Digital IDs are defined as virtual representations of an individual's identity, stored electronically and authenticated through mechanisms such as biometrics, passwords, or two-factor authentication, enabling individuals to verify their identity, access digital services, and engage securely online, which offers an efficient and trusted framework for managing personal information (Gelb & Metz, 2018; World Bank Group, 2017). They are a verifiable, state-recognized identifier enabling authentication within digital governance infrastructures (OECD, 2020; Pobee et al., 2025; World Bank Group, 2017). Digital IDs play a critical role in the modern digital economy, acting as a cornerstone for security and personalization (Djatmiko et al., 2025; Verhoef et al., 2021). These IDs come in various forms, including government-issued electronic ID cards or passports, self-sovereign identities, digital wallets, and online accounts. Digital identification systems incorporate advanced digital technologies like biometrics, blockchain, and smart cards (Sebastian et al., 2017). Digital IDs deliver enhanced convenience, improved security by mitigating identity theft and fraud, greater efficiency via process automation, and stronger

privacy through controlled personal data sharing (Atick, 2016; Van Staden & Bidwell, 2024). They enhance identity verification and authentication processes essential for access to digital services across healthcare, finance, education, and public services, fostering security, trust, interoperability, citizen engagement, and inclusive economic growth. As digital economies grow, public supervision becomes crucial for sustaining this growth (Pobee et al., 2025; Shenkoya, 2023).

2.2 Digital Identities in Developing Economies

Digital IDs are particularly important in developing economies where segments of the population have historically lacked formal identification and where rural and urban digital communication infrastructures face capacity constraints, uneven digital readiness, and underdeveloped technology networks (Plantinga, 2024; Pobee et al., 2025). Within such settings, digital identification systems function as mechanisms for establishing verified, state-recognized identities that allow individuals to engage with the digital economy through secure authentication embedded in digital governance infrastructures (Gelb & Metz, 2018; OECD, 2020; World Bank Group, 2017). By providing individuals with a verified identity, digital IDs enable access to essential public and private services that would otherwise remain inaccessible, including healthcare, finance, education, social welfare, and public administration (Atick, 2016; Musoni et al., 2023). Beyond access, digital IDs support service interaction by delivering enhanced convenience through streamlined access, improved security through the mitigation of identity theft and fraud, greater efficiency through process automation and reduced paperwork, and stronger privacy through controlled personal data sharing (Atick, 2016; Van Staden & Bidwell, 2024). In developing economies, digital IDs are also instrumental in promoting inclusive economic growth and social development by facilitating broader inclusion, expanding economic participation and opportunity, and supporting progress toward achieving the United Nations' Sustainable Development Goals (Pobee et al., 2025). At the institutional level, digital IDs contribute to more effective governance by reducing fraud, improving service delivery, and strengthening transparency and accountability. Digital IDs support the administration of public benefits, taxation, and regulatory compliance, thereby reinforcing trust in public institutions and sustaining digital transformation initiatives (Eke et al., 2022; Gelb & Metz, 2018; Masiero & Bailur, 2021; Verhoef et al., 2021; World Bank Group, 2017).

National IDs vary widely across countries, specifically those in Africa. While their design reflects local priorities, common themes include biometric foundations, digital transformation, multi-purpose functionality, and tensions around privacy, adoption, and state capacity. Table 1 synthesizes evidence from selected African countries. Across these countries, digital ID reforms are consistently framed as tools to improve public service delivery, welfare targeting, and formal-sector participation. However, outcomes vary substantially depending on the extent to which systems are embedded within effective governance arrangements, supported by inclusive enrollment pathways, and safeguarded by credible privacy protections.

Table 1. Digital Identity Systems in Africa

Country	Digital ID System	Use Case	Key Uses	Outcomes
Nigeria	National Identity Number (NIN)	Foundational ID for interoperability	**(1)** Banking/Know Your Customer access, **(2)** SIM registration, **(3)** Public service authentication, **(4)** Travel/credential verification, **(5)** Health/welfare integration (Eke et al., 2022)	**Positive:** Supports formalization and service linkage at scale. **Negative:** Enrollment bottlenecks; access barriers; trust deficits; exclusion of offline/rural populations (Eke et al., 2022; Okunoye, 2022).
Ghana	Ghana Card /Digital ID-linked service ecosystem	Government service modernization	**(1)** Digital access to services, **(2)** Online authentication, **(3)** Cross-agency coordination, **(4)** Service redesign for citizens (Pobee et al., 2025)	**Positive:** Transaction efficiency, complementarities, and service novelty can increase citizen satisfaction and value creation. **Negative:** Inclusion gaps and uneven access may constrain value realization for underserved users (Pobee et al., 2025).
Uganda	National Identification and Registration Authority (NIRA) ID	Civil identification and service participation	**(1)** Credential verification, **(2)** Eligibility confirmation, **(3)** Financial authentication, **(4)** Registration for civic participation (Mayega et al., 2025; Van der Straaten et al., 2018)	**Positive:** Enables service participation and financial inclusion, with measurable social and economic value. **Negative:** Benefits are uneven across population groups; privacy and surveillance concerns may persist even with legal safeguards (Mayega et al., 2025; Van der Straaten et al., 2018).
South Africa	National ID ecosystem (biometric trajectory)	Identity assurance and governance modernization	**(1)** Civil identity verification, **(2)** Public service authentication, **(3)** Cross-sector access control, **(4)** Formal identity assurance (Musoni et al., 2023)	**Positive:** Strong identity assurance potential and administrative coordination gains. **Negative:** Privacy dilemmas intensify as biometric and integrated systems expand; governance choices strongly shape legitimacy and adoption (Musoni et al., 2023; Karmwar & Kunwar, 2025).

(Table 1. continued)

Country	Digital ID System	Use Case	Key Uses	Outcomes
Ethiopia	Fayda digital ID	Foundational identity and inclusion	**(1)** Enrollment and verification, **(2)** Public service authentication, **(3)** Financial inclusion enablement, **(4)** Fraud reduction (Musoni et al., 2023)	**Positive:** Scalable platform with inclusion-oriented objectives and strong potential for national coverage. **Negative:** Capacity and rollout risks may generate uneven access, delayed benefits realization, and enrollment barriers (Musoni et al., 2023).
Kenya	Huduma Namba	Digital identity modernization	**(1)** ID consolidation intent, **(2)** Eligibility verification, **(3)** De-duplication **(4)** Public sector coordination (Gelb et al., 2016; Musoni et al., 2023)	**Positive:** Intended to support de-duplication and improved service access. **Negative:** Governance, legal contestation, and regulatory gaps undermine legitimacy and rollout effectiveness (Gelb et al., 2016; Musoni et al., 2023).

2.3 Empirical Findings in Developing Economies

Despite their widely cited benefits, the implementation of digital identification systems within public-sector digital transformation initiatives in developing economies remains constrained by persistent challenges related to privacy, institutional capacity, and structural inequality (Musoni et al., 2023). Because digital IDs require the collection and processing of sensitive personal data, robust data governance and privacy safeguards are essential for sustaining public trust, particularly in contexts where regulatory frameworks and administrative capacity may be weak (Dixon, 2017; Eke et al., 2022). At the same time, uneven digital readiness, infrastructural limitations, and disparities in digital literacy constrain effective participation and risk reinforcing existing inequalities, especially among rural and marginalized populations (James, 2021; Plantinga, 2024; World Bank Group, 2017; Zwitter et al., 2020). Notwithstanding these constraints, empirical research suggests that digital IDs reshape administrative processes and service delivery by enabling secure authentication and more efficient coordination across public and private systems, particularly in settings where formal identification has historically been limited (Gelb & Metz, 2018; OECD, 2020; Plantinga, 2024; World Bank Group, 2017). However, the literature has predominantly emphasized technical design, system adoption, and policy architecture, offering limited empirical insight into how citizens experience and use digital IDs in everyday service interactions. In particular, evidence remains scarce regarding how operant resources, including individual capabilities, structural conditions, and social dynamics—shape usage situations, value-in-use, engagement, empowerment, and realized outcomes within developing-country contexts (James, 2021; Masiero & Bailur, 2021; Osborne, 2018; Pobee et al., 2025).

2.4 Digital Identities and Service-Dominant Logic Theory

Specific to public service exchange, SDL implies value co-creation is an interactive, beneficiary-determined process that is not embedded in technologies but rather emphasizes citizen-centered value creation (Osborne, 2018;

Skålén & Trischler, 2025; Vargo & Lusch, 2004). Accordingly, value co-creation emerges through use and interaction in the service exchange as users integrate their operant resources within the broader public service ecosystem (Vargo & Lusch, 2016; Virtanen & Jalonen, 2024). Consistent with this perspective, beneficiaries ultimately determine the value of public services through lived experiences or value-in-use (Grönroos & Voima, 2013; Skålén & Trischler, 2025; Vargo & Lusch, 2017), which are contextually shaped by the operant resources users integrate into the public service interaction (Hasche & Höglund, 2025). Specific to digitally enabled public operant resources often manifest via users' digital and technology competencies and socialized learning that enable them to effectively navigate the service ecosystems, explaining why outcomes diverge even when the digital infrastructure is similar across users (James, 2021). The SDL theory also highlights the importance of repeated service interactions to help users refine their resource-integration strategies that shape both functional value-in-use benefits and experiential outcomes that in turn influence continued engagement over time (Dahl et al., 2023).

Applied to digital transformation, SDL shifts the focus from technology adoption to the exploration of how service encounters are reconfigured via digital information flows and processes that shape how users integrate resources and ultimately realize value (Lusch & Nambisan, 2015; Manser Payne et al., 2021; Peltier et al., 2020; Verhoef et al., 2021). As public service encounters become technology-mediated via digital IDs, individual citizens' roles in the public service exchange become more consequential, with value outcomes shaped by how effectively individual users engage and participate in the interaction process (Larivière et al., 2017; Peltier et al., 2020; Pobee et al., 2025). The SDL resource-integration view is especially consequential for digital transformation in developing economies, where institutional capacity constraints and unequal access may create persistent participation gaps consistent with uneven readiness conditions (Osborne, 2018; Virtanen & Jalonen, 2024). The digital transformation outcomes in these contexts may hinge not only on infrastructure readiness but also on realizing value co-creation and usage, which is likely to depend on citizens' abilities to effectively integrate operant resources such as digital competence and service-navigation capability (Grönroos & Voima, 2013). Notably, this framing aligns with the current study's conceptual model by linking citizens' operant resources to value-in-use experiences that shape empowerment, agency, and future usage expectations.

Although underexplored at the level of citizen value-in-use mechanisms in the extant literature, SDL's principles are particularly salient to exploring value-in-use experienced from large-scale, public-sector digital transformation such as digital IDs. Following SDL, the current study positions digital IDs as an enabling institutionalized infrastructure that helps support citizen–government interactions across multiple public and private service contexts (Espinosa & Pino, 2025; Plantinga, 2024; Skålén & Trischler, 2025). Although possessing a digital ID can unlock citizens' access to public services, SDL implies that public service ecosystem value co-creation and users' value-in-use are contingent on repeated interactions across specific service usage contexts (Dahl et al., 2023; Gelb & Metz, 2018; Van Staden & Bidwell, 2024). Moreover, SDL and digital transformation imply that citizens' participation and realized value-in-use from digital IDs are likely to depend on whether the digitally enabled service ecosystem supports meaningful user engagement and agency across specific use cases rather than merely deploying new infrastructure (Djatmiko et al., 2025; Espinosa & Pino, 2025; Plantinga, 2024). SDL theory also suggests that the benefits of digital ID and value co-creation may be undermined if operant resources are poorly integrated (Pobee et al., 2025), explaining in part why citizens' value-in-use outcomes may vary across users under common national digital ID infrastructures (Van Staden & Bidwell, 2024; Zwitter et al., 2020). Following SDL, we contend this relationship may be especially pronounced in developing economies where value-in-use is likely to depend on how effectively individual Nigerian citizens integrate relevant operant resources (e.g., digital competence, informational support, social resources) to reduce friction and successfully navigate public service ecosystems that translate digital ID value propositions (e.g., secure authentication, service

access) into meaningful service outcomes (Eke et al., 2022; Grönroos & Voima, 2013; James, 2021; Masiero & Bailur, 2021; Vargo & Lusch, 2016).

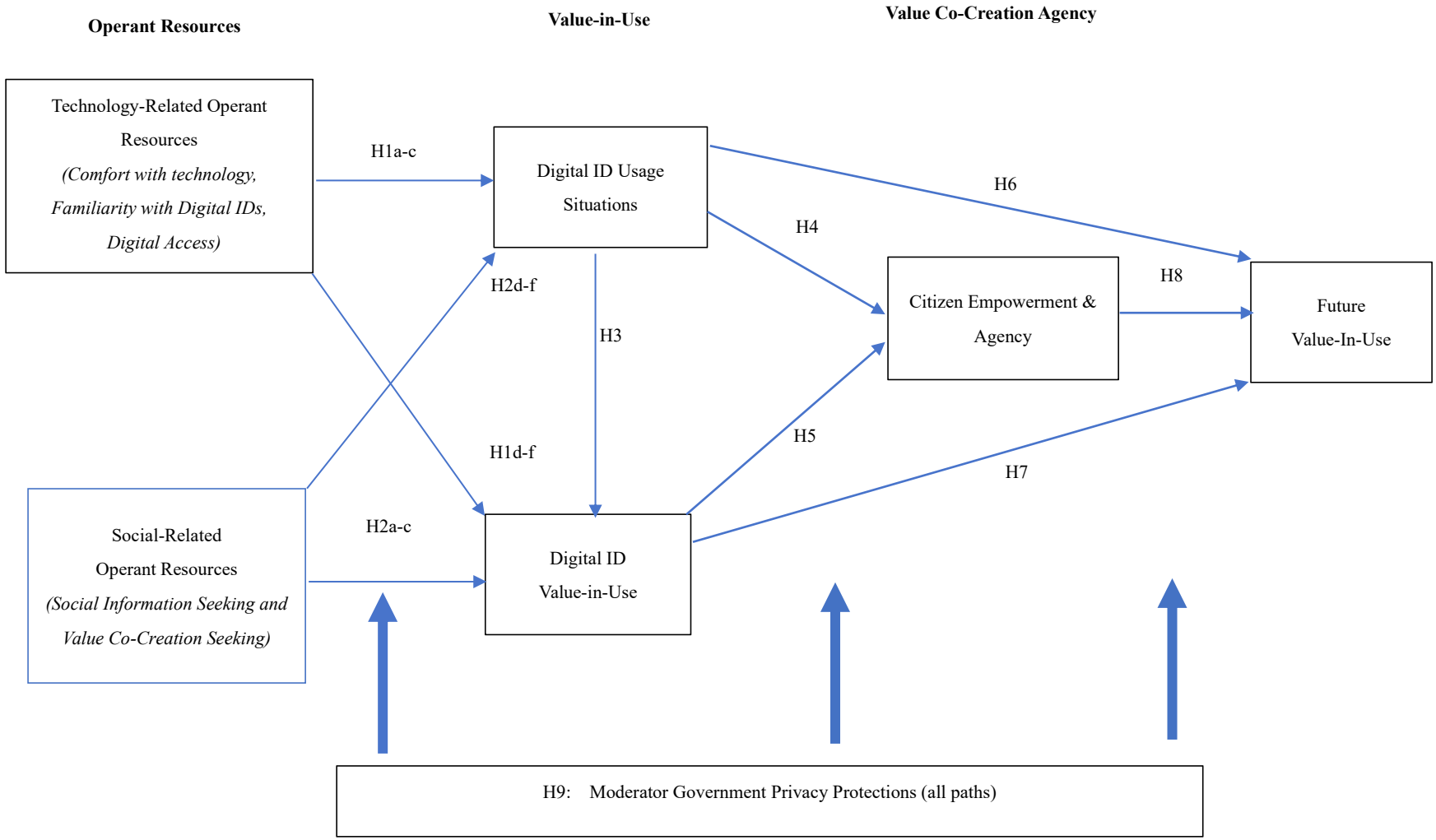
3. Citizen Operant Resources and the Digital Identity Value-in-Use Journey

Despite increasing investments in national digital IDs, limited research offers insight into the citizen-level mechanisms via which digital IDs influence value-in-use across public service encounters in developing economies (Gelb & Metz, 2018; James, 2021; Masiero & Bailur, 2021; Osborne, 2018; Plantinga, 2024). Drawing on SDL, our framework (see Figure 1) conceptualizes how citizens' operant resources help shape digital ID value-in-use experiences, which in turn influence empowerment or agency and future value-in-use expectations in a developing-economy context (Grönroos & Voima, 2013; Vargo & Lusch, 2004, 2017). We position digital ID public value creation as a user-determined, interaction-based process in which digital IDs function as enabling institutionalized infrastructures, while realized value depends on citizens' context-specific resource integration during repeated service exchanges (Dahl et al., 2023; Osborne, 2018; Skålén & Trischler, 2025). We conceptualize this digital ID value-in-use journey as an interactive, multi-stage process through which citizens integrate technology-related and social operant resources to navigate digital ID-enabled service interactions, experience functional and experiential value-in-use outcomes (including agency), and form forward-looking expectations that shape continued participation (Dahl et al., 2023; Peltier et al., 2020). In the current study, we conceptualize value-in-use to include both citizens' frequency of using digital IDs across specific usage situations and their evaluation of the benefits experienced through usage (Dahl et al., 2023; Grönroos & Voima, 2013; Vargo & Lusch, 2017). Accordingly, our model outlines four interrelated value co-creation components: (a) citizens' operant resources (social and technology-related resources), (b) digital ID value-in-use (usage situations and experienced value-in-use), (c) citizen empowerment and agency, and (d) future value-in-use.

3.1 Technology-Related Operant Resources and Value-in-Use

Technology-related operant resources reflect citizens' ability to function within technology-mediated service encounters, including comfort with technology, familiarity with digital IDs, and digital access (Dahl et al., 2023; James, 2021; Lusch & Nambisan, 2015). The SDL theory suggests that when consumers possess these operant resources, will enable more effective resource integration during the service exchange, which should expand citizens' abilities to engage in a wider range of digital ID usage situations and increase the likelihood of realizing favorable value-in-use outcomes (Grönroos & Voima, 2013; Lusch & Nambisan, 2015; Vargo & Lusch, 2017). For developing economies, this is especially critical, given the likely greater diversity in digital readiness and access (James, 2021). Citizens with stronger technology-related operant resources should be better able to identify relevant use cases and engage in technology-mediated service exchanges, thereby broadening engagement across specific usage situations (Dahl et al., 2023). Technology-related resources should also strengthen citizens' ability to integrate resources during service interactions, increasing their likelihood of realizing value-in-use (Grönroos & Voima, 2013). Research in the context of SDL suggests that technology-related operant resources, such as comfort with technology, familiarity with a specific technology, and access to digital platforms, positively affect the usage and value-in-use (Dahl et al., 2023; Manser Payne, Dahl, & Peltier, 2021; Swan et al., 2019, 2024). Therefore, citizens with stronger technology-related operant resources should be better able to navigate the digital ID service ecosystem, encounter fewer barriers, and translate digital ID functionality into meaningful benefits.

Figure 1. Citizen–Government Digital Identity Service Delivery Value Co-Creation Framework



H1a: Comfort with technology is positively related to citizens' digital ID usage situations.

H1b: Familiarity with digital IDs is positively related to citizens' digital ID usage situations.

H1c: Digital access is positively related to citizens' digital ID usage situations.

H1d: Comfort with technology is positively related to citizens' digital ID value-in-use.

H1e: Familiarity with digital IDs is positively related to citizens' digital ID value-in-use.

H1f: Digital access is positively related to citizens' digital ID value-in-use.

3.2 Social-Related Operant Resources and Value-in-Use

Social-related operant resources reflect citizens' ability to draw on socialized learning and relational support to help them navigate service ecosystems, including social information-seeking and value co-creation (Grönroos & Voima, 2013; Osborne, 2018; Peltier et al., 2020; Skålén & Trischler, 2025). The SDL theory implies that citizens' social resource integration can shape both the contexts in which digital IDs are used and the value-in-use ultimately realized in different contexts (Grönroos & Voima, 2013; Osborne, 2018; Skålén & Trischler, 2025). Digitally enabled ecosystems also rely heavily on information flows between users, service providers, and others, with research suggesting that co-created information helps shape evaluations and usage-related outcomes of technology-mediated services (Peltier et al., 2020). Social resource integration should therefore expand the situations in which citizens can successfully utilize digital IDs, particularly when complexity or uncertainty exists (Osborne, 2018; Peltier et al., 2020). Similarly, social information and co-creation seeking should also strengthen citizens' value-in-use by reducing uncertainty, enabling better decisions, and increasing their ability to integrate relevant resources during specific usage situations (Dahl et al., 2023; Grönroos & Voima, 2013). Although limited, research suggests that social information seeking, along with individual/social joint information seeking and collaborative value co-creation impact digital usage and digital value-in-use (Carew et al., 2025; Dahl et al., 2023; Vander Schee et al., 2025). Hence, in the digital ID context, citizens who more actively seek information and co-create solutions with others should be better positioned to identify relevant use cases, navigate procedural complexity, and convert digital ID access into lived functional and experiential benefits.

H2a: Social information seeking is positively related to citizens' digital ID usage situations

H2b: Value co-creation seeking is positively related to citizens' digital ID usage situations.

H2c: Social information seeking is positively related to citizens' digital ID value-in-use.

H2d: Value co-creation seeking is positively related to citizens' digital ID value-in-use.

3.3 Digital Identity Usage Situations and Value-in-Use

The SDL theory suggests that repeated, contextually embedded service interactions help citizens refine their resource-integration strategies for engaging with service ecosystems, influencing both value-in-use and continued engagement (Grönroos & Voima, 2013). Public service logic also holds that citizens' repeated participation across digital ID service contexts builds interactional competence, thereby reducing barriers to value co-creation (Osborne, 2018; Skålén & Trischler, 2025). As citizens use digital IDs across a broader range of situations, they should have more opportunities to realize benefits that help them formulate their value-in-use perceptions and other outcomes that affect continued usage (Dahl et al., 2023). Moreover, repeated use across varied situations can strengthen citizens' ability to interpret and act on information flows that structure technology-mediated service encounters, thereby enhancing resource integration and experienced value-in-use (Peltier et al., 2020). Also, SDL recognizes that poor fit between citizen resources and ecosystem processes can surface as co-destruction in specific usage contexts, suggesting that usage situations are a critical pathway through which value-in-use is realized (Skålén & Trischler, 2025). Thus, using digital IDs across more contexts should enhance the value-in-use experienced by citizens.

H3: Digital ID usage situations are positively related to digital ID value-in-use.

3.4 Antecedents of Citizen Empowerment and Agency

Citizen empowerment and agency reflect how capable and confident citizens feel in navigating government interactions as well as exercising influence within technology-mediated encounters (Grönroos & Voima, 2013; Hasche & Höglund, 2025; Osborne, 2018; Virtanen & Jalonen, 2024). The SDL theory suggests repeated opportunities for usage and positive value-in-use experiences strengthen perceived capability and confidence in future interactions (Dahl et al., 2023; Osborne, 2018; Skålén & Trischler, 2025). Public service logic argues that empowerment emerges when citizens can meaningfully integrate resources and experience within the service ecosystem (Osborne, 2018; Virtanen & Jalonen, 2024). In digital ID-enabled ecosystems, empowerment should increase as repeated digital ID use helps citizens become more efficient at integrating resources, reducing uncertainty, and increasing control over service encounters (Grönroos & Voima, 2013). Similarly, when citizens feel empowered, they are more likely to feel capable of fully engaging in value co-creation across subsequent service exchanges (Hasche & Höglund, 2025). Conversely, SDL suggests empowerment can erode when service interactions undermine user competence, trust, or goal attainment, and value co-destruction may occur (Echeverri & Skålén, 2011; Plé & Cáceres, 2010). Accordingly, both digital ID usage situations and digital ID value-in-use should positively shape citizen empowerment and agency.

H4: Digital ID usage situations are positively related to citizen empowerment and agency.

H5: Digital ID value-in-use is positively related to citizen empowerment and agency.

3.5 Antecedents of Future Value-in-Use

Future value-in-use reflects citizens' forward-looking expectations that continued engagement with digital IDs will generate beneficial outcomes across future service encounters (Dahl et al., 2023). The SDL theory implies that both past usage contexts and realized value-in-use provide informational inputs that shape anticipatory evaluations of future outcomes (Dahl et al., 2023; Grönroos & Voima, 2013; Vargo & Lusch, 2017). Consistent with SDL's emphasis on ongoing service exchange and iterative value realization, both usage situations and experienced value-in-use should inform future value-in-use expectations (Dahl et al., 2023; Peltier et al., 2020; Vargo & Lusch, 2017). Similarly, citizen empowerment and agency are central to SDL's positioning of beneficiaries as active participants in service exchange rather than passive recipients of technology-enabled services (Osborne, 2018; Skålén & Trischler, 2025). When citizens experience greater agency in digital ID encounters through confidence, perceived control, and meaningful participation, they should be more likely to anticipate continued benefits and sustain engagement over time (Hasche & Höglund, 2025; Osborne, 2018; Skålén & Trischler, 2025). Thus, usage situations, value-in-use, and empowerment and agency should each positively shape future value-in-use.

H6: Digital ID usage situations are positively related to future value-in-use.

H7: Digital ID value-in-use is positively related to future value-in-use.

H8: Citizen empowerment and agency are positively related to future value-in-use.

3.6 The Moderating Role of Government Privacy Protections

Government privacy protections reflect citizens' perceptions that institutional safeguards, policies, and enforcement mechanisms will protect sensitive personal information and constrain misuse within digital ID-enabled service exchange (Zwitter et al., 2020). Digital IDs require citizens to disclose and rely on sensitive personal data, making privacy and data protection a persistent constraint on participation and value realization (Dixon, 2017). From an SDL perspective, institutional arrangements such as governance safeguards can either enable or undermine effective resource integration and value co-creation (Osborne, 2018). When citizens perceive stronger government privacy protections, they should be more willing to engage across usage situations and more

able to translate operant resources into favorable value-in-use and empowerment outcomes. Conversely, perceptions of weak privacy protections may dampen these relationships by increasing perceived risk, reducing participation, and heightening the likelihood of value co-destruction, particularly in digitally mediated service contexts (Plé & Cáceres, 2010; Zwitter et al., 2020).

H9: The relationships between technology-related and social-related operant resources, digital ID usage situations, digital ID value-in-use, and citizen empowerment and agency will be stronger when perceived government privacy protections are higher.

Collectively, these hypotheses position operant resources as the primary micro-level mechanism through which digital ID–enabled public service ecosystems translate infrastructure into citizen-defined value.

4. Methodology

4.1 Data Collection and Sample

Respondents were drawn from a sample of adult Nigerian residents who had a National Identification Number (NIN), Nigeria's foundational digital ID system. Data were collected through an independently administered online survey designed to capture perceptions and experiences related to NIN. Screening questions were used to confirm that respondents were at least 18 years old and had a NIN, even if they did not frequently use it. The survey yielded a final sample of 653 usable responses after data screening, including the removal of incomplete submissions and responses exhibiting straight-lining. The respondent profile is reported in Table 2. As a note, in Nigeria, the largest percentage of individuals who have not opted to sign up for a digital ID are over 55 years old. Many of these individuals will never sign up for one.

Table 2. Profile of Respondents

Demographic Characteristics	Percentage
Gender	
Male	51%
Female	49%
Age	
18–24	22%
25–34	49%
35–45	21%
45+	8%
Income	
Under ₦50,000	20%
₦50,000 - Under ₦75,000	18%
₦75,000 - Under ₦100,000	18%
₦100,000 - Under ₦150,000	14%
₦150,000 - Under ₦200,000	12%
₦200,000 and over	18%
Urban vs Rural	
Urban	82%
Rural	18%

4.2 Measures

Research on national identity systems has been limited, with little systematic empirical measurement, particularly regarding value co-creation, operant resources, and value-in-use. While no established measures exist for the present context, constructs and items were adapted from studies conducted in other settings, with wording refined to ensure conceptual consistency and contextual relevance. The final survey instrument used in this study is thus original and was developed through an inductive process informed by discussions with the Nigerian government, an examination of literature from other empirical contexts, and a pilot study of 50 citizens. Except where noted, all scales use a 5-point agreement scale.

Familiarity with National IDs: A four-item scale that captures perceived knowledge and awareness of the national identification system (adapted from Manser Payne et al., 2021). This measure asked, "How familiar are you with Nigeria's NIN related to the following…" (1 = Not at All Familiar to 5 = Very Familiar).

Comfort with Technology: A seven-item scale that assesses comfort using new technologies, ease of using digital devices and applications, internet use, and general attitudes toward technology improving everyday life (adapted from Dahl et al., 2023; Manser Payne et al., 2018; Swan et al., 2024). This is a general technology comfort assessment and not specific to any one technology.

Digital Access: A five-item original scale that measures how frequently respondents use digital technologies for common activities, including making purchases, accessing government services, checking emails, conducting work-related tasks, and visiting company webpages. This measure asked, "How frequently do you use the internet to do the following…" (1 = Never to 5 = Very Frequently). We conceptualize digital access not as physical connectivity, but as functional access reflected in how often individuals use internet-enabled services, indicating their ability to access digital ID–enabled services when needed.

Social Information Seeking: A five-item scale capturing information search and social learning behaviors, specifically respondents' efforts to seek information about the NIN, observe others' usage, and complete the necessary steps to obtain the NIN (adapted from Dahl et al., 2021, 2023; Vander Schee et al., 2025).

Value Co-Creation Seeking: A six-item scale related to respondents' tendencies to suggest new solutions, provide feedback, participate in co-creation activities, and perceive innovative and value-enhancing outcomes resulting from their participation with government agencies or firms (adapted from Dahl et al., 2023; Swan et al., 2024). Value co-creation seeking is a general tendency to collaborate with government service providers, as digital ID value is co-created across broader service interactions that span both digital and non-digital contexts.

Digital Identity Usage Situations: A six-item scale assessing the situations in which respondents use their NINs, including service applications, license and passport renewals, tax filing, and other government services (adapted from Dahl et al., 2023; Manser Payne et al., 2018; Swan et al., 2024). This measure asked, "How frequently do you use your NIN to do the following…" (1 = Never to 5 = Very Frequently). As a note, some usage situations are more prevalent than others.

Digital Identity Value-in-Use: An eight-item scale reflecting the perceived benefits derived from using digital ID services, including improved access to government services, authentication for transactions, efficiency gains, service quality relative to time and effort invested, and responsiveness to user feedback (adapted from Dahl et al., 2023; Manser Payne et al., 2018; Peltier et al., 2020).

Perceived Citizen Empowerment and Agency: A four-item scale measuring respondents' perceptions of the government as enabling informed decision-making, encouraging shared decision-making, and empowering citizens in managing their digital ID services. This aligns with research by Dahl et al. (2021) and Swan et al. (2019, 2024) that shared decision-making leads to empowerment.

Future Value-in-Use: A five-item scale that assesses respondents' intentions to continue using digital ID services, collaborate with government agencies, remain informed about service updates, recommend services to others, and discuss digital ID services with peers (adapted from Dahl et al., 2023; Peltier et al., 2020). We

conceptualize future value-in-use as forward-looking expectations of continued value from digital ID services, reflected in intentions to continue using, engaging with, and recommending the services based on anticipated future benefits.

Perceived Government Privacy Protection: A six-item scale that measures perceptions of government efforts to protect personal information, data security, transparency of data protection policies, adequacy of privacy controls, communication regarding data use, and confidence in government security measures (adapted from Manser Payne et al., 2018, 2021).

5. Analysis and Results

5.1 Measurement Model Results

SmartPLS 4.0 was used to assess the validity and reliability of our measurement models. An extensive review of 239 articles by Sarstedt et al. (2022) found that partial least squares structural equation modeling (PLS-SEM) is valuable in most empirical studies, particularly for complex models with many indicators, constructs, and relationships. The authors further acknowledged that PLS-SEM is particularly valuable for research investigating technology acceptance and innovations. Model fit in partial least squares structural equation modeling (PLS-SEM) is assessed using standard measurement criteria, including internal consistency, convergent validity, and discriminant validity (Hair et al., 2014). As reported in Table 3, all indicator loadings were above the recommended 0.70 threshold and were statistically significant at $p < .001$, indicating acceptable indicator reliability. Measures of internal consistency were also satisfactory, with both Cronbach's alpha and composite reliability values exceeding 0.70 across all constructs. Convergent validity was supported, as the average variance extracted (AVE) for each construct and the overall model exceeded the 0.50 cutoff. Discriminant validity was supported using multiple approaches. First, the square root of the AVE for each construct exceeded the corresponding inter-construct correlations along the diagonal of the correlation matrix (Fornell & Larcker, 1981; see Table 4). Second, all heterotrait–monotrait ratios were below the conservative threshold of 0.85 (Hair et al., 2014; Henseler et al., 2016). In addition, the R^2 values for digital usage situations (0.18), digital value-in-use (0.47), citizen empowerment and agency (0.34), and future value-in-use (0.40) indicate acceptable levels of predictive validity (Hair et al., 2014). Consistent with Podsakoff et al. (2003), common method bias was assessed via Harman's single-factor test indicated that a single factor explained only 25% of the total variance. Additionally, applying the marker-variable technique within the PLS-SEM framework revealed no meaningful differences in structural path coefficients or R^2 values between models estimated with and without the marker variable. Finally, variance inflation factor values for all indicators were below 3.3 (Hair et al., 2014). Taken together, these findings suggest that common method bias was not a significant concern in this study.

Table 3. Descriptive Statistics, Item Coefficients, and Convergent Validity

Construct and Items	*M*	*SD*	Coef
Familiarity with National IDs (AVE = .786, α = .91, CR = .94)			
How the NIN works	4.21	1.0	.882
The benefits of having a NIN	4.29	1.0	.891
Why I should have a NIN	4.37	0.9	.885
Different ways I can use my NIN	4.24	1.0	.887
Comfort with Technology (AVE = .668, α = .92, CR = .93)			
Overall, I am comfortable using new technology	4.19	0.8	.830
It is easy for me to use a camera on a phone/tablet/computer	4.23	0.8	.784
I enjoy using new technology	4.17	0.8	.857
I feel comfortable using the internet	4.33	0.8	.844
I am comfortable using APPS on my computer/tablet	4.02	0.9	.758

(Table 3. continued)

Construct and Items	*M*	*SD*	Coef
I am comfortable using APPS on my phone	4.29	0.8	.829
New technologies make our lives easier	4.19	0.9	.815
Digital Access (AVE = .600, α = .84, CR = .88)			
Make a purchase	3.38	1.1	.775
Access government services	3.19	1.1	.779
Check emails	4.09	1.0	.782
For my job	3.76	1.2	.765
To visit company web pages	3.59	1.1	.774
Social Information Seeking (AVE = .547, α = .80, CR = .86)			
I have asked others for information on what NIN offers	3.14	1.3	.700
I have searched for information on where to obtain the NIN	3.32	1.3	.735
I have paid attention to how other people use the NIN	3.47	1.2	.764
I provided the necessary information so that I could obtain my NIN	3.32	1.3	.816
I answered all the questions in order to obtain my NIN	3.47	1.2	.690
Value Co-Creation Seeking (AVE = .613, α = .87, CR = .91)			
I frequently suggest new solutions for government agencies to modify a service	3.44	1.2	.722
I am satisfied with the outcomes of my co-creation activities with government services	3.33	1.1	.783
I add value when participating in co-creation activities with government agencies	3.56	1.1	.810
Co-creation activities I participate in frequently lead to innovative outcomes	3.79	1.0	.816
My participation in co-creation activities has led to noticeable improvements in services	3.70	1.1	.841
My feedback is frequently solicited by service providers	3.78	1.1	.717
Digital ID Usage Situations (AVE = .622, α = .88, CR = .91)			
For service applications	3.13	1.3	.823
To renew driver's licenses online	2.59	1.6	.795
To renew a passport online	2.84	1.6	.698
For filing of tax returns	2.52	1.5	.800
To renew a vehicle license	2.46	1.5	.792
To apply for any other government service	2.95	1.4	.817
Digital ID Value-in-Use (AVE = .531, α = .86, CR = .89)			
The National ID Number will make more government services available online	3.90	1.1	.711
Limits the data collected by individual websites or services to only the essentials	3.93	1.1	.716
Improves citizens' access to online government services	3.99	1.1	.713
Authenticates identity for payments and online transactions	4.08	1.0	.716
Replaces the need to give copies of my documents to government agencies	3.91	1.1	.711
Digital ID services provide good value for the time and effort invested	3.39	1.2	.752
Digital ID services consistently improve in response to user feedback	3.26	1.3	.750
Digital ID services enhance my ability to access essential information and services	3.43	1.2	.741
Perceived Citizen Empowerment & Agency (AVE = .773, α = .90, CR = .94)			
The government informs me of different options for managing my digital identity	3.15	1.4	.847
The government helped me to make informed decisions about obtaining the NIN	3.37	1.3	.889
The government encourages me to take an active role in managing my digital identity	3.36	1.3	.903
The government empowers me to make my own decisions regarding my digital identity	3.32	1.3	.877
Future Value-in-Use (AVE = .700, α = .90, CR = .92)			
I intend to continue using digital ID services in the future	4.07	1.0	.788
I am open to collaborating with government agencies to improve digital services	4.05	1.0	.834
I am committed to staying informed about updates and new digital ID service features	4.08	1.0	.845
I will recommend digital ID services to my friends and relatives.	4.09	1.0	.861
I would enjoy discussing digital ID services with others	4.07	1.0	.852
Government Privacy Protection (AVE = .699, α = .92, CR = .94)			
The government makes every effort to keep my information private	3.38	1.0	.779

(Table 3. continued)

Construct and Items	*M*	*SD*	Coef
The government protects the security of my personal data	3.38	1.0	.85
The government's data protection policies are transparent and easy to understand	3.33	1.0	.853
The government regularly informs me about how my data is used and protected	3.00	1.1	.807
The government's privacy controls are sufficient to protect my personal information	3.16	1.0	.861
I am confident in the government's security measures for handling my data	3.15	1.0	.779

Note. AVE = average variance extracted; CR = composite reliability; NIN = National Identification Number

Table 4. Discriminant Validity Fornell-Larcker Criterion

	1	2	3	4	5	6	7	8	9	10
1. Digital access	.775									
2. Value co-creation seeking	.268	.783								
3. Comfort with technology	.447	.206	.817							
4. Empowerment/agency	.063	.367	.095	.879						
5. Digital ID usage situations	.280	.261	.120	.325	.789					
6. Familiarity with digital IDs	.411	.331	.430	.219	.260	.886				
7. Future value-in-use	.235	.313	.276	.478	.276	.411	.837			
8. Social info seeking	.205	.305	.191	.413	.228	.285	.519	.739		
9. Privacy protection	.060	.416	.135	.381	.239	.199	.215	.121	.836	
10. Digital ID value-in-use	.291	.434	.323	.539	.387	.494	.585	.438	.380	.728

5.2 Structural Model Results

Model Fit: Model hypotheses were assessed using a bootstrap sample of 5,000 subsamples in SmartPLS (Hair et al., 2014), and fit indices were compared for the saturated and estimated models (Henseler & Schuberth, 2020). As shown in Table 6, the standardized root mean square value, the unweighted least square discrepancy, and geodesic discrepancy were below the 95% and 99% quantile for both the estimated and saturated models, suggesting a good fit.

Table 5. Discriminant Validity Heterotrait-Monotrait Matrix

	1	2	3	4	5	6	7	8	9	10
1.Digital access										
2.Value co-creation seeking	.306									
3.Comfort with technology	.518	.230								
4.Empowerment/agency	.079	.414	.101							
5.Digital ID usage situations	.306	.291	.123	.356						
6.Familiarity with digital IDs	.472	.370	.470	.240	.278					
7.Future value-in-use	.272	.354	.307	.525	.294	.456				
8.Social info seeking	.253	.360	.226	.477	.248	.334	.625			
9.Privacy protection	.104	.464	.147	.418	.262	.215	.23	.199		
10.Digital ID value-in-use	.337	.502	.367	.603	.423	.562	.66	.522	.428	

Table 6. Global Goodness of Fit, Confirmatory Composite Analysis, Bootstrap Quantiles

	Estimated Model	Hi95	Hi99	Saturated Model	Hi95	Hi99
SRMR	0.034	0.037	.038	0.032	0.034	0.035
d_{ULS}	1.79	2.07	2.24	1.59	1.79	1.90
d_G	0.625	0.69	0.72	0.629	0.692	0.724

Note. SRMR = Standardized Root Mean Square Residual, d_{ULS} = Unweighted Least Squares Discrepancy, d_G = Geodesic Discrepancy, Hi95/99 = The upper bound of the confidence interval.

Hypotheses Testing Direct Paths: As shown in Table 7, the paths from familiarity with digital IDs (β = 0.123, t = 3.1, p = 0.01), digital access (β = 0.206, t = 5.0, p = 0.001), social information seeking (β = 0.116, t = 2.9, p = 0.01), and value co-creation seeking (β = 0.091, t = 2.0, p = 0.05) had significant, positive effects on digital usage situations, supporting H1b–H1e; comfort with technology (H1a) was not supported. The paths from comfort with technology (β = 0.105, t = 2.7, p = 0.01), familiarity with digital IDs (β = 0.254, t = 7.0, p = 0.001), social information seeking (β = 0.256, t = 7.1, p = 0.001), and value co-creation seeking (β = 0.124, t = 3.2, p = 0.001) had significant, positive effects on digital value-in-use, supporting H2a–b and H2d–e; digital access (H2c) was not supported. Digital usage situations had a significant positive effect on digital value-in-use (β = 0.183, t = 5.2, p = 0.001), supporting H3. Digital usage situations (β = 0.114, t = 3.1, p = 0.001) and digital value-in-use (β = 0.423, t = 11.4, p = 0.001) had significant, positive effects on citizen empowerment and agency, supporting H4 and H5. Digital value-in-use (β = 0.463, t = 9.9, p = 0.001) and citizen empowerment and agency (β = 0.249, t = 5.0, p = 0.001) had significant, positive effects on future value-in-use, supporting H7 and H8; the path to digital usage situations (H6) was not supported.

Table 7. Tests of the Structural Equation Modeling Path Hypotheses

Hypothesis and Path				Coef (β)	*t* value	*p* value
H1a	Comfort with technology	→	Digital usage situations	-.073	1.5	n.s.
H1b	Familiarity with digital IDs	→	Digital usage situations	.123	3.1	.01
H1c	Digital access	→	Digital usage situations	.206	5.0	.001
H1d	Social information seeking	→	Digital usage situations	.116	2.9	.01
H1e	Value co-creation seeking	→	Digital usage situations	.091	2.0	.05
H2a	Comfort with technology	→	Digital value-in-use	.105	2.7	.01
H2b	Familiarity with digital IDs	→	Digital value-in-use	.254	7.0	.001
H2c	Digital access	→	Digital value-in-use	-.005	0.1	n.s.
H2d	Social information seeking	→	Digital value-in-use	.256	7.1	.001
H2e	Value co-creation seeking	→	Digital value-in-use	.124	3.2	.001
H3	Digital usage situations	→	Digital value-in-use	.183	5.2	.001
H4	Digital usage situations	→	Citizen empowerment & agency	.114	3.1	.001
H5	Digital value-in-use	→	Citizen empowerment & agency	.423	11.4	.001
H6	Digital usage situations	→	Future value-in-use	.028	0.7	n.s.
H7	Digital value-in-use	→	Future value-in-use	.463	9.9	.001
H8	Citizen empowerment & agency	→	Future value-in-use	.249	5.0	.001

Moderation Hypotheses: Table 8 presents the significant moderation effects of government privacy protection (H9). As hypothesized, significant, positive moderation effects were found for digital access to digital value in use (β = 0.109, p = 0.01), value co-creation seeking to digital usage situations (β = 0.071, p = 0.05), and citizen empowerment and agency to future value-in-use (β = 0.107, p = 0.01). In contrast, digital usage situations to future value-in-use (β = -.061, p = .05) and digital value-in-use to future value-in-use (β = -.115, p = .01) had a significant, negative moderation effect, reversed from what was hypothesized.

Table 8. Significant Path Moderation Effects of Government Privacy Protection

Significant Government Privacy Protection Paths			**Coef (β)**	***p* value**
Digital access	→	Digital value-in-use	.109	.01
Value co-creation seeking	→	Digital usage situations	.071	.05*
Citizen empowerment and agency	→	Future value-in-use	.107	.05
Digital usage situations	→	Future value-in-use	-.061	.05*
Digital value-in-use	→	Future value-in-use	-.115	.01

Note: *one-tailed test

Mediation Results to Future Value-in-Use: While no mediation effects were hypothesized, we conducted total indirect mediation analyses to better assess the relationships between the model constructs and future value-in-use. Our expectation was that all mediation effects, if they exist, would be positive (Carew et al., 2026; Dahl et al., 2023). As shown in Table 9, significant total mediated effects to future value-in-use were found for comfort with technology (β = 0.48, p = 0.05), familiarity with digital IDs (β = 0.164, p = 0.001), social information seeking (β = 0.165, p = 0.001), and value co-creation seeking (β = 0.85, p = 0.001).

Table 9. Total Indirect Mediation Effects on Future Value-in-Use

Total Mediation Effects			**Coef (β)**	***p* value**
Comfort with technology	→	Future value-in-use	.048	.05
Familiarity with digital IDs	→	Future value-in-use	.164	.001
Digital access	→	Future value-in-use	.030	n.s.
Social information seeking	→	Future value-in-use	.165	.001
Value co-creation seeking	→	Future value-in-use	.085	.001
Digital usage situations	→	Future value-in-use	.132	.001
Digital value-in-use	→	Future value-in-use	.105	.001

6. Discussion

The present study examined how citizens' operant resources influence perceptions of the value-in-use of digital IDs in public service delivery in developing economies. Grounded in SDL, our findings demonstrate that digital transformation outcomes are not merely shaped by infrastructure but also evolve through the integration of citizen resources across usage contexts. Consistent with SDL (Grönroos & Voima, 2013; Vargo & Lusch, 2017), technology-related and social operant resources influence how citizens navigate digital ID-enabled service

interactions, which in turn impact experienced value-in-use, empowerment and agency, and future value-in-use expectations. Our results reveal that familiarity with digital IDs, digital access, social information seeking, and value co-creation seeking significantly expand the situations in which digital IDs are used, whereas comfort with technology alone does not. This suggests that general technological confidence is insufficient on its own and is instead context-specific through use across different service encounters. With respect to value-in-use, familiarity, comfort with technology, social information seeking, and value co-creation seeking were significant predictors, while digital access was not. These findings reinforce SDL's contention that value emerges through effective resource integration during interaction, not merely from structural access conditions.

Digital ID usage situations were found to positively influence digital value-in-use, supporting the view that repeated, contextually embedded service exchanges refine resource-integration capabilities and enhance experienced benefits. Importantly, digital value-in-use was identified as the strongest predictor of citizen empowerment and agency, and both value-in-use and empowerment were found to significantly influence perceptions of future value-in-use. Usage situations alone were not found to directly influence future value expectations, suggesting that interaction frequency is insufficient without meaningful value realization. Collectively, the findings position digital value-in-use as the core mechanism linking operant resources to long-term engagement within national digital ID ecosystems.

The moderation results further underscore the institutional role of government privacy protections. Perceived privacy protections strengthened several positive pathways, including digital access to value-in-use and empowerment to future value-in-use, highlighting how institutional safeguards enable resource integration and sustained participation. However, the negative moderating effects observed on certain future value pathways suggest that heightened privacy perceptions may influence expectations about continued use, underscoring the complexity of trust-based governance mechanisms in digital ecosystems.

6.1 Theoretical Contributions

This study contributes to the digital transformation and SDL literature in several ways. First, we extend SDL to large-scale public-sector digital ID systems in developing economies by empirically demonstrating how citizen operant resources function as key assets in value co-creation. While prior digital ID research has emphasized technical architecture and policy design (Gelb & Metz, 2018; Zwitter et al., 2020), our findings shift the focus to citizen-level resource integration as the mechanism through which infrastructure translates into experienced value-in-use. Second, we advance understanding of digital transformation in developing economies by conceptualizing digital ID engagement as a value-in-use journey comprising usage situations, experienced value, empowerment and agency, and forward-looking expectations. This framework moves beyond technology adoption models by emphasizing iterative service exchange and user-determined value. Our findings demonstrate that value-in-use, not usage frequency alone, serves as the primary driver of empowerment and continued engagement, reinforcing SDL's emphasis on experiential value realization. Third, the study integrates institutional governance mechanisms into SDL by examining government privacy protections as boundary conditions influencing resource integration and value realization. By showing that perceived privacy protection conditions have both positive and negative moderation effects, we highlight how institutional arrangements related to perceived privacy and data sharing usage shape outcomes in public service ecosystems in developing countries with uneven digital readiness.

6.2 Managerial and Policy Implications

The findings offer important implications for policymakers and government agencies implementing national digital ID systems. First, investments in digital infrastructure must be accompanied by initiatives that strengthen citizen operant resources, particularly familiarity with digital IDs and social learning mechanisms. Public education campaigns, transparent communication, and simplified service navigation tools may enhance usage

situations and value realization more effectively than infrastructure expansion alone. Second, because digital value-in-use is the strongest predictor of empowerment and future engagement, governments should prioritize improving the experiential quality of digital ID-enabled service encounters. Enhancing usability, responsiveness, efficiency, and the visibility of service improvements can reinforce citizens' perceptions of meaningful benefit and strengthen long-term participation. Third, the role of privacy protections highlights the importance of transparent data governance. Clearly communicated privacy policies, visible enforcement mechanisms, and consistent data protection practices can enhance citizen confidence and strengthen engagement pathways. However, the nuanced moderation findings suggest that privacy governance must balance assurance with realistic expectation management to avoid unintended dampening effects on future value perceptions. Overall, as foreshadowed in Table 1, our findings suggest that the key to increased usage of digital IDs by citizens is a function of reducing enrollment and access barriers, ensuring inclusion of rural and underserved populations, building public trust through strong privacy and data governance protections, strengthening legal and institutional frameworks, integrating digital ID across high-value services, and delivering clear user value through reliable and accessible service design.

6.3 Limitations and Future Research

Several limitations warrant consideration. The cross-sectional design limits causal inference, and the findings are based on Nigerian citizens within a single national digital ID system. Future research should employ longitudinal or multi-country designs to examine how operant resource integration and value-in-use evolve over time and across institutional contexts. Additionally, although this study focused on citizen perceptions and experienced value-in-use, incorporating objective performance indicators and service-level data would strengthen future models. Further research should explore additional institutional moderators, alternative operant resources, and potential value co-destruction dynamics to deepen understanding of how digital ID ecosystems generate, sustain, or inhibit citizen-defined value in developing economies.

Funding

This research received no external funding.

Acknowledgments

The authors thank the editor and reviewers for their constructive feedback during the review process.

Data Availability Statement

Research data is proprietary to the country of Nigeria.

Ethics Statement

All ethical standards were followed.

Conflicts of Interest

There are no conflicts of interest

Disclaimer of Artificial Intelligence (AI) Usage in Manuscript Preparation

AI was only used for editing purposes.

References

Atick, J. J. (2016). *Digital Identity: The Essential Guide*. ID4Africa. https://www.id4africa.com/main/files/Digital_Identity_The_Essential_Guide.pdf

Bresciani, S., Ferraris, A., & Del Giudice, M. (2018). The management of organizational ambidexterity through alliances in a new context of analysis: Internet of things (IoT) smart city projects. *Technological Forecasting and Social Change*, *136*, 331-338. https://doi.org/10.1016/j.techfore.2017.03.002

Dahl, A. J., Milne, G. R., & Peltier, J. W. (2021). Digital health information seeking in an omni-channel environment: A shared decision-making and service-dominant logic perspective. *Journal of Business Research*, *125*, 840–850. https://doi.org/10.1016/j.jbusres.2019.02.025

Dahl, A. J., Peltier, J. W., & Swan, E. L. (2023). Anticipatory value-in-use in early-stage digital health service transformations: How consumers assess value propositions before and after abrupt, exogenous shocks. *Journal of Business Research*, *163*, Article 113910. https://doi.org/10.1016/j.jbusres.2023.113910

Dixon, P. (2017). A failure to "do no harm": India's Aadhaar biometric ID program and its inability to protect privacy in relation to measures in Europe and the U.S. *Health and Technology*, *7*, 539–567. https://doi.org/10.1007/s12553-017-0202-6

Djatmiko, G. H., Sinaga, O., & Pawirosumarto, S. (2025). Digital transformation and social inclusion in public services: A qualitative analysis of e-government adoption for marginalized communities in sustainable governance. *Sustainability*, *17(7)*, Article 2908. https://doi.org/10.3390/su17072908

Echeverri, P., & Skålén, P. (2011). Co-creation and co-destruction: A practice-theory based study of interactive value formation. *Marketing Theory*, *11(3)*, 351–373. https://doi.org/10.1177/1470593111408181

Eke, D., Oloyede, R., Ochang, P., Borokini, F., Adeyeye, M., Sorbarikor, L., Wale-Oshinowo, B., & Akintoye, S. (2022). Nigeria's digital identification (ID) management program: Ethical, legal an-d socio-cultural concerns. *Journal of Responsible Technology*, *11*, Article 100039. https://doi.org/10.1016/j.jrt.2022.100039

Espinosa, V. I., & Pino, A. (2025). E-government as a development strategy: The case of Estonia. *International Journal of Public Administration*, *48(2)*, 86–99. https://doi.org/10.1080/01900692.2024.2316128

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18(1)*, 39–50. https://doi.org/10.2307/3151312

Gelb, A. H., Anandan, V., & Cannata, A. (2016). *Identification for development (ID4D) country diagno -stic: Kenya* (Working Paper No. 107277). World Bank Group. http://documents.worldbank.org/curated/en/575001469771718036

Gelb, A., & Metz, A. D. (2018). *Identification revolution: Can digital ID be harnessed for development?* Brookings Institution Press.

Grönroos, C., & Voima, P. (2013). Critical service logic: Making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, *41(2)*, 133–150. https://doi.org/10.1007/s11747-012-0308-3

Hair, J. F., Jr., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage.

Hasche, N., & Höglund, L. (2025). Value propositions and facilitating promises of value—The case of the Swedish Public Employment Service. *International Public Management Journal*, *28(4)*, 511–535. https://doi.org/10.1080/10967494.2024.2436378

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. *Industrial Management & Data Systems*, *116*(1), 2–20. https://doi.org/10.1108/IMDS-09-2015-0382

Henseler, J., & Schuberth, F. (2020). Using confirmatory composite analysis to assess emergent variables in business research. *Journal of Business Research*, *120*, 147–156. https://doi.org/10.1016/j.jbusres.2020.07.026

James, J. (2021). Confronting the scarcity of digital skills among the poor in developing countries. *Development Policy Review*, *39(2)*, 324–339. https://doi.org/10.1111/dpr.12479

Karmwar, M., & Kunwar, D. (2025). The dilemma between digital identity and privacy in modern governance: Comparing South Africa and India. *Journal of Asian and African Studies*. Advance online publication. https://doi.org/10.1177/00219096251352368

Larivière, B., Bowen, D., Andreassen, T. W., Kunz, W., Sirianni, N. J., Voss, C., Wünderlich, N. V., & De Keyser, A. (2017). "Service Encounter 2.0": An investigation into the roles of technology, employees and customers. *Journal of Business Research*, *79*, 238–246. https://doi.org/10.1016/j.jbusres.2017.03.008

Lusch, R. F., & Nambisan, S. (2015). Service innovation: A service-dominant logic perspective. *MIS Quarterly*, *39(1)*, 155–176. https://doi.org/10.25300/MISQ/2015/39.1.07

Manser Payne, E., Dahl A.J., Peltier J. (2021), Digital servitization value co-creation framework for AI services: A research agenda for digital transformation in financial service ecosystems. *Journal of Research in Interactive Marketing*, *15(2)*, 200–222. doi: https://doi.org/10.1108/JRIM-12-2020-0252

Manser Payne, E., Peltier, J. W., & Barger, V. A. (2018). Mobile banking and AI-enabled mobile banking: The differential effects of technological and non-technological factors on digital natives' perceptions and behavior. *Journal of Research in Interactive Marketing*, *12(3)*, 328–346. https://doi.org/10.1108/JRIM-07-2018-0087

Masiero, S., & Bailur, S. (2021). Digital identity for development: The quest for justice and a research agenda. *Information Technology for Development*, *27(1)*, 1–12. https://doi.org/10.1080/02681102.2021.1859669

Mayega, R. W., Okello, D., Muhumuza, C., Tumuhamye, N., Ssentongo, J., Mulerwa, A. K., & Bazeyo, W. (2025). Understanding the benefits, costs, and challenges of the national identification system in Uganda. *Digital Society*, *4*, Article 28. https://doi.org/10.1007/s44206-025-00177-8

Musoni, M., Domingo, E., & Ogah, E. (2023). *Digital ID systems in Africa: Challenges, risks and opportunities* (ECDPM Discussion Paper No. 360). European Centre for Development Policy Management. https://ecdpm.org/work/digital-id-systems-africa-challenges-risks-and-opportunities

Okunoye, B. (2022). Mistrust of government within authoritarian states hindering user acceptance and adoption of digital IDs in Africa: The Nigerian context. *Data & Policy*, *4*, e37. https://doi.org/10.1017/dap.2022.29

Organisation for Economic Co-operation and Development. (2020). *The OECD digital government policy framework: Six dimensions of a digital government* (OECD Public Governance Policy Papers, No. 2). https://doi.org/10.1787/f64fed2a-en

Osborne, S. P. (2018). From public service-dominant logic to public service logic. *Public Management Review*, *20*(2), 225–241. https://doi.org/10.1080/14719037.2017.1350461

Peltier J. W., Dahl A. J., Schibrowsky J.A. (2024). Artificial intelligence in interactive marketing: A conceptual framework and research agenda. *Journal of Research in Interactive Marketing*, *18(2)*, 54–90, doi: https://doi.org/10.1108/JRIM-01-2023-0030

Peltier, J. W., Dahl, A. J., & Swan, E. L. (2020). Digital information flows across a B2C/C2C continuum and technological innovations in service ecosystems: A service-dominant logic perspective. *Journal of Business Research*, *121*, 724–734. https://doi.org/10.1016/j.jbusres.2020.03.020

Plantinga, P. (2024). Digital discretion and public administration in Africa: Implications for the use of artificial intelligence. *Information Development*, *40(2)*, 332–352. https://doi.org/10.1177/02666669221117526

Plé, L., & Cáceres, R. C. (2010). Not always co-creation: Introducing interactional co-destruction of val -ue in service-dominant logic. *Journal of Services Marketing*, *24(6)*, 430–437. https://doi.org/10.1108/088 76041011072546

Pobee, F., Jibril, A. B., Shaikh, A. A., Turginbayeva, A., Issayeva, Z., & Mutanov, G. (2025). Driving digital transformation in government services in Ghana: A value-creation perspective. *Measurement: Digitalization*, *3*, Article 100019. https://doi.org/10.1016/j.meadig.2025.100019

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research. *Journal of Applied Psychology*, *88(5)*, 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K., & Fonstad, N. O. (2017). How big old companies navigate digital transformation. In *Strategic Information Management* (pp. 133-150). Routledge. https://doi.org/10.4324/9780429286797

Shenkoya, T. (2023). Can digital transformation improve transparency and accountability of public governance in Nigeria? *Transforming Government: People, Process and Policy*, *17(1)*, 54–71. https://doi.org/10.1108/TG-08-2022-0115

Skålén, P., & Trischler, J. (2025). Public services as practices: towards a framework for understanding co-creation and co-destruction of private and public value. *Public Management Review*, *27(9)*, 2194–2213. https://doi.org/10.1080/14719037.2024.2418376

Swan, E. L., Dahl, A. J., & Peltier, J. W. (2019). Health-care marketing in an omni-channel environment: Exploring telemedicine and other digital touchpoints. *Journal of Research in Interactive Marketing*, *13(4)*, 602–618. https://doi.org/10.1108/JRIM-03-2019-0039

Swan, E. L., Peltier, J. W., & Dahl, A. J. (2024). Artificial intelligence in healthcare: The value co-creation process and influence of other digital health transformations. *Journal of Research in Interactive Marketing*, *18(1)*, 109–126. https://doi.org/10.1108/JRIM-09-2022-0293

Van der Straaten, J., Esquivel-Korsiak, V., & Bujoreanu, L. (2018). *Identification for Development (ID4D) country diagnostic: Uganda* (Working Paper No. 132011). World Bank Group. http://documents.worldbank.org/curated/en/921761542144309171

Van Staden, S., & Bidwell, N. J. (2024). Localised trust in a globalised knot: Designing information privacy for digital-ID. *ACM Journal on Computing and Sustainable Societies*, *2(1)*, 1–37. https://doi.org/10.1145/3616024

Vander Schee, B. A., Peltier, J. W., & Dahl, A. J. (2025). Social media brand attachment: Linking social media usage motivations and brand advocacy. *Marketing Management Journal*, *35(1)*, 23–39. https://doi.org/10.63963/001c.141466

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing*, *68(1)*, 1–17. https://doi.org/10.1509/jmkg.68.1.1.24036

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, *44*, 5–23. https://doi.org/10.1007/s11747-015-0456-3

Vargo, S. L., & Lusch, R. F. (2017). Service-dominant logic 2025. *International journal of research in marketing*, *34(1)*, 46-67. https://doi.org/10.1016/j.ijresmar.2016.11.001

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection. *Journal of Business Research*, *122*, 889–901. https://doi.org/10.1016/j.jbusres.2019.09.022

Virtanen, P., & Jalonen, H. (2024). Public value creation mechanisms in the context of public service l -ogic: An integrated conceptual framework. *Public Management Review*, *26(8)*, 2331–2354. https://doi.or g/10.1080/14719037.2023.2268111

World Bank Group. (2016). *Nigeria country assessment: Identification for development (ID4D) - Identi -fication systems analysis* (Working Paper No. 113567). http://documents.worldbank.org/curated/en/13654 1489666581589

World Bank Group. (2017). *Principles on identification for sustainable development: Toward the digital age* (Working Paper No. 112614). https://documents.worldbank.org/en/publication/documents-reports/docu mentdetail/213581486378184357

Zwitter, A. J., Gstrein, O. J., & Yap, E. (2020). Digital identity and the blockchain: Universal identity management and the concept of the "self-sovereign" individual. *Frontiers in Blockchain*, *3*, Article 26. https://doi.org/10.3389/fbloc.2020.00026

About Author(s)

Dr. Philip Adekunle: Principal and Founding Partner at KnowledgeSquare Foresight, an insights and ID Management consulting firm, and received his Doctorate from the University of Wisconsin-Whitewater. His research interests include digital transformation strategy, value co-creation in service ecosystems, and the role of digital governance in emerging economies. In addition to academic work, Dr. Adekunle has provided consulting and advisory input to initiatives and stakeholders focused on digital strategy and technology implementation in Nigeria and the broader West African context. His engagement with Nigeria's digital identity ecosystem reflects both research and applied interests in national digital policy and economic inclusion.

Dr. James Peltier: Professor Emeritus at the University of Wisconsin-Whitewater. His research interests lie in digital marketing, services marketing, artificial intelligence, not-for-profit, and sales. He has approximately 150 published refereed journal articles in the Journal of Public Policy & Marketing, Journal of Research in Interactive Marketing, Journal of Business Research, Industrial Marketing Management, European Journal of Marketing, Journal of Interactive Marketing, Journal of Applied Business & Behavioral Sciences, Marketing Management Journal, Journal of Urban Economics, Journal of Consumer Affairs, and the International Journal of Advertising, among many others.

Dr. Andrew Dahl: Associate Professor of Marketing and Chair at the University of Wisconsin–Whitewater. His research focuses on digital marketing strategy, consumer behavior in technology-enabled environments, marketing analytics, and value creation in service ecosystems. He has published peer-reviewed research in journals such as the Journal of Research in Interactive Marketing, Journal of Business Research, Journal of Consumer Affairs, Journal of Applied Business & Behavioral Sciences,The International Review of Retail, Distribution and Consumer Research, and Marketing Management Journal, among others.