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Economic and regulatory drivers of consumer-centric product innovation: A case study of Chinese smartphones in Nigeria

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ABSTRACT

This study addresses the problems of market exclusion and the digital divide in Nigeria by examining the smartphone innovation dynamics of Chinese companies, aiming to map consumer-centric adaptation and recommend an integrated framework for sustainable product development in emerging economies. The Disruptive Innovation Theory, Triple Helix Model, and frugal innovation principles were the theoretical frameworks used in the study, which employed a quantitative survey method based on data from 420 Nigerian respondents and 10 in-depth interviews with key industry stakeholders. Market disruption advantage ($\beta = 0.265$) and product adaptation strategies ($\beta = 0.287$) turned out to be substantial drivers of innovation performance which signified the need for consumer-oriented and localized product designs. The paper proposes an integration of Disruptive Innovation Theory with modern frugal innovation and responsible disruption frameworks, as it addresses both the sustainability imperatives and data sovereignty issues. The study goes beyond previous research by pointing out that localization strategies not only support digital inclusion but also increase the risk of data privacy in the contexts of Anglophone West Africa. The researchers argue that innovation in emerging countries, particularly in Nigeria, can only thrive if local contexts, informal networks, data sovereignty, and regulatory constraints are considered. The results are far-reaching and apply to both the government and the business sectors, highlighting the importance of tiered regulatory frameworks, data localization mandates, and stronger links between formal institutions and grassroots innovation networks. This study, which emphasizes the necessity of two-way knowledge flows and cultural immersion in product development, not only provides context-specific insights for Anglophone West Africa but also contributes to broader discussions of digital colonialism and technology governance.

1. Introduction

In the rapidly evolving global economy, digital technology stands at the forefront of economic development and social transformation. Nowhere is this more evident than in West Africa, where Chinese smartphone manufacturers have catalyzed an unprecedented digital revolution. With smartphone penetration in the region projected to leap from 44% in 2019 to 64% by 2025, the integration of affordable, high-performance smartphones into everyday life is reshaping the very fabric of economic activity and social interactions. These devices are not merely tools for communication; they are gateways to financial inclusion, education, and

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entrepreneurial innovation, offering millions of previously disconnected people access to the digital economy.

However, while the economic impact of Chinese smartphones in West Africa is well recognized, less attention has been paid to the underlying drivers that enable these companies to innovate for the African market. This paper critically examines the intersection of economic and regulatory frameworks, focusing on how these forces drive consumer-centric product innovation. The explosive growth of Chinese smartphone brands like Tecno, Infinix, and Xiaomi in Nigeria offers a fascinating case study of how firms can tailor technological products to meet the specific needs of emerging-market consumers while navigating complex regulatory environments. These companies have mastered the art of localized innovation, balancing cutting-edge technology with cost-effective production and profound cultural relevance.

Market shocks and crises – most notably the COVID-19 pandemic – have fundamentally reshaped innovation priorities in emerging economies. Prior research shows that crises accelerate ICT adoption and technology-enabled adaptation (Kumar et al., 2023), expose resilience barriers for micro, small, and medium enterprises (Gupta & Kumar Singh, 2023), and transform supply chain and market structures (Min, 2023). Smartphones are a salient site where these dynamics interact with affordability, localization, and governance. Yet what remains unresolved in the literature is the mechanism by which OEM localization and adaptation translate into innovation outcomes in informal, institutionally uneven markets amid data sovereignty and regulatory ambiguity. This study addresses that gap by asking two research questions: (1) To what extent do market disruption, product adaptation, institutional collaboration, knowledge transfer, and the regulatory environment drive innovation performance of Chinese smartphone OEMs in Nigeria? (2) How do informal networks and data sovereignty concerns moderate or mediate these relationships? The contributions are threefold: an empirical test of these drivers in Anglophone Nigeria; a conceptual extension that incorporates informal ecosystems and governance boundary conditions; and practice implications proportionate to the evidence.

The present study focuses on Nigeria, a case of instrumental significance for Anglophone West Africa, while not drawing any conclusions about the situation in Francophone countries (e.g., Côte d'Ivoire, Senegal), which are characterized by very different regulatory frameworks and consumption habits (Asongu & Asongu, 2019). Various critical debates on the expansion of Chinese technology in Africa highlight power imbalances and data colonialism (Gagliardone & Yin, 2022; Ojanperä et al., 2019). Our analysis takes a stand in these debates by looking at the Chinese localization strategies for smartphones, which are at the same time tapping the market for exclusion and digital inclusion, and at the same time raising the issues of sovereignty and data privacy, which are increasingly being brought to attention by Nigeria's Communications Commission (NCC, 2023).

This paper not only explores how Chinese firms are disrupting the market but also offers critical insights into the role of government policy, local economic conditions, and consumer preferences in driving sustainable, consumer-centric innovation. By doing so, it contributes to broader discussions on digital inclusion, innovation strategy, and the future of mobile technology in emerging markets. The scope of this research centers on analyzing the economic and regulatory drivers of consumer-centric product innovation in the Nigerian market, with a specific focus on Chinese smartphone manufacturers such as Tecno, Infinix, and Xiaomi. It explores how these companies adapt their products to meet local demands, emphasizing affordability, cultural relevance, and technological requirements tailored to Nigerian consumers. The study further examines the impact of local and international regulatory environments, shedding light on how policy frameworks in both China and Nigeria shape innovation.

Additionally, it examines bidirectional innovation flows, assessing how product adaptations in Nigeria influence global innovation strategies and contributing to reverse innovation discussions. The research also evaluates the broader socioeconomic impacts of smartphone innovation in Nigeria, particularly its role in driving digital inclusion, economic growth, and entrepreneurship by providing access to critical digital services, education, and financial tools. This comprehensive scope aims to address key gaps in understanding the interactions among manufacturers, consumers, policymakers, and the local technology ecosystem in West Africa. Despite the success of these localization efforts, a critical mechanism remains unresolved in the literature: how OEM adaptation and localization strategies translate into sustainable innovation outcomes within informal, institutionally uneven markets, especially when operating under the dual pressures of data sovereignty concerns and regulatory ambiguity.

A consumer-centric product is deliberately designed to satisfy individual customer needs, preferences, and behaviors through co-creation and continuous feedback (Sheth et al., 2000; Li et al., 2024). By doing so, this method not only secures immediate customer satisfaction but also builds long-term loyalty by incorporating user insights into product specs, pricing strategies, and ecosystem partnerships. In the case of Nigerian smartphones, consumer-centricity not only addresses local infrastructure limitations, such as power instability, by offering long battery life, but also caters to cultural practices, such as dual-SIM support for managing multiple service providers, and financial inclusion requirements.

The primary problem addressed by this research is the growing **market exclusion and digital divide** in Nigeria, where a significant portion of the population lacks access to affordable, relevant technology, particularly smartphones, which are essential for participation in today's digital economy. Despite the rapid rise in smartphone adoption, many consumers in emerging markets like Nigeria face barriers due to high costs, cultural mismatches in product design, and limited local infrastructure. After outlining these problems, this paper proposes solutions by analyzing how Chinese smartphone manufacturers have successfully disrupted this dynamic through **consumer-centric innovations** that address the specific needs of the Nigerian market. It also offers insights into how economic factors and regulatory frameworks can support the creation of affordable, culturally relevant products that foster digital inclusion, economic growth, and entrepreneurship across the region, thereby helping to bridge the digital divide.

The research addresses several key problems related to **consumer-centric product development** in the Nigerian smartphone market, with a focus on Chinese manufacturers. **Firstly**, the lack of affordable and culturally relevant smartphones excludes a large portion of the population from accessing essential digital services, contributing to the digital divide. **Secondly**, the current regulatory frameworks in Nigeria often pose barriers to innovation, requiring companies to navigate complex policies that can slow product adaptation and market entry. **Thirdly**, limited local capacity for innovation hampers the creation of sustainable, long-term solutions

tailored to the needs of Nigerian consumers. **Fourthly**, inefficient innovation cycles prevent companies from responding quickly to market demands, delaying the introduction of innovative products. **Finally**, unsustainable product lifecycles, characterized by poor repairability and short usage spans, contribute to environmental concerns and economic inefficiency in the region. This paper provides solutions to these problems by exploring how companies can develop **consumer-centric innovations** while addressing regulatory, economic, and sustainability challenges. The rest of the paper is organized as follows: Section 2 presents the Theoretical Framework drawn from the literature; Section 3 presents the Methodology, which applied mixed methods; Section 4 presents the research results and analysis; Section 5 discusses the findings and presents the implications for policy and practice. Lastly, Section 6 presents the limitations and conclusion.

2. Literature review with theoretical framework

The global smartphone industry has undergone a significant transformation in recent years, particularly as Chinese manufacturers have entered and dominated emerging markets such as West Africa. Nigeria, being one of the largest markets in this region, serves as a focal point for understanding how Chinese smartphone brands have adapted to local economic, regulatory, and consumer demands. This literature review examines the economic and regulatory drivers of consumer-centric product innovations by Chinese smartphone manufacturers in Nigeria. By integrating insights from previous research, it offers a comprehensive view of how market dynamics, product innovation, ecosystem development, cultural adaptation, and regulatory factors interact to shape the smartphone landscape in Nigeria.

2.1. Conceptual framework for innovation

Chinese smartphone manufacturers' success in West Africa, and Nigeria in particular, is grounded in a multi-directional flow of innovation and adaptation (Asongu & Asongu, 2019; Ojanperä et al., 2019). This framework reflects the intricate interplay between market dynamics, consumer preferences, and technological developments that have positioned Chinese brands as dominant players in the Nigerian market. A key aspect of this success lies in their ability to penetrate the market with sophisticated strategies that evolve alongside local consumer behavior (Asongu & Nwachukwu, 2019; Sun et al., 2023).

For analytical clarity, the following constructs are defined with precise concepts:

Market Disruption (MD): The extent to which Chinese OEMs gain market share by offering simpler, more affordable, or differently featured products that attract previously underserved segments (Christensen, 2015).

Product Adaptation (PA): The degree to which smartphone features (e.g., battery life, dual-SIM, local language support) are adapted to meet Nigerian consumer preferences and infrastructure realities.

Institutional Collaboration (IC): Formal partnerships among industry, government, and knowledge institutions (e.g., universities, research centers) that support innovation.

Knowledge Transfer (KT): The flow of technical, market, and user insights between Chinese manufacturers and local stakeholders (including informal networks).

Regulatory Environment (RE): The perceived favorability of policies (tariffs, data protection, local content rules) for smartphone innovation.

Innovation Performance (IP): The perceived effectiveness of product development in addressing consumer needs and maintaining competitive advantage.

2.1.1. Market dynamics with penetration strategies

Chinese smartphone manufacturers have utilized aggressive market penetration strategies to establish themselves in the West African market. Their success in Nigeria and neighboring countries is not solely due to low-priced products but also to an intrinsic understanding of local needs and a readiness to adapt their offerings accordingly (Xiao & Bao, 2022). This adaptability, particularly in terms of device features such as long battery life and dual SIM support, is crucial for appealing to West African consumers (Ojanperä et al., 2019).

Chinese smartphone manufacturers like Tecno, Infinix, and Xiaomi have effectively leveraged their understanding of local needs, producing devices that balance affordability with tailored features, such as long battery life and dual-SIM capabilities (Ojanperä et al., 2019; Xiao & Bao, 2022). This ability to localize products has fostered widespread adoption, ensuring these companies remain competitive against global giants such as Apple and Samsung (John Snow & AlyPinder, 2023).

Chinese manufacturers have leveraged "latecomer advantages," repackaging existing technologies at affordable prices (Foster & Azmeh, 2020), while also employing localized branding and customer engagement strategies to build strong relationships with the consumer base (Sun et al., 2023). This mirrors Clayton M. Christensen's (1997) "disruptive innovation theory," in which new entrants capture market share by offering simpler, lower-cost alternatives to established products (Christensen, 2015).

In turbulent market contexts, resilience and adaptation capabilities have become essential for survival and growth. Current research highlights that MSMEs face unique barriers to resilience during systemic shocks such as COVID-19 (Gupta & Kumar Singh, 2023), prompting the adoption of ICT as a critical emergent strategy (Kumar, 2023). Supply chain transformation amid a pandemic shock (Min, 2023) demonstrates that innovation is no longer just about market entry but about maintaining stability through localized adaptation in the face of disruption.

2.1.2. Integrating contemporary innovation frameworks

Disruptive Innovation Theory (Christensen, 1997; Christensen, Raynor, & McDonald, 2015), when applied to Chinese market entry, still reflects a developed-economy orientation and neglects 21st-century sustainability requirements. This paper improves the classical theory by applying frugal innovation principles (Hossain, 2020), which involve maximizing functionality while minimizing costs and environmental impact, and responsible disruption metrics (Radjou & Prabhu, 2015), which balance market disruption and ecosystem stability. In Nigeria, frugal innovation is exemplified by locally assembled devices, repair-friendly modular designs, and collaboration with informal-sector distributors. Nonetheless, such localization simultaneously increases data sovereignty risks that classical theory does not consider; the data-harvesting practices of Chinese OEMs are increasingly under scrutiny under NCC regulations (Gagliardone & Yin, 2022; NCC, 2024).

2.1.3. Product innovation cycle

At the heart of this framework is the product innovation cycle, characterized by continuous refinement based on consumer feedback (Adeyeye & Iweala, 2020). Chinese manufacturers have demonstrated impressive flexibility in responding to the unique demands of Nigerian consumers. By incorporating features like extended battery life and robust processors, these manufacturers have tailored their products to meet the needs of consumers in a region where stable electricity and reliable internet connections can be challenging (Ojanperä et al., 2019).

This iterative innovation process has not only bolstered their local market success but also influenced global product development strategies. It challenges traditional views of innovation as a one-way flow from developed to developing markets, emphasizing its bidirectional nature (Danquah & Amankwah-Amoah, 2017). Furthermore, the product innovation cycle is supported by a robust technological ecosystem that includes expanding mobile network infrastructure and locally relevant applications and services (GSMA, 2023; Wang & Kimari, 2018).

2.1.4. Technological ecosystem and socioeconomic impacts

The expansion of mobile networks, particularly 4G and the gradual introduction of 5G technologies, plays a critical role in shaping the smartphone ecosystem in Nigeria (Wang & Kimari, 2018). This infrastructure development has enhanced smartphone accessibility, fueling a positive feedback loop where increased smartphone penetration drives further investment in related technologies and services. As smartphones become more integrated into everyday life, their role in fostering digital inclusion and bridging the digital divide has become increasingly apparent (United Nations, 2022).

The economic impact of this growth is substantial. The GSMA (2023) reports that the smartphone industry has created jobs, contributed to GDP growth, and spurred entrepreneurial activity by enabling access to the digital economy. Significantly, the availability of affordable smartphones has democratized access to information and services, helping to address long-standing issues of digital exclusion in Nigeria (Adomako et al., 2022). However, as Kshetri (2017) warns, the rapid expansion of the digital economy also raises concerns about data privacy and digital sovereignty, particularly as foreign manufacturers gain access to local consumer data.

2.1.5. Socioeconomic impacts of smartphone adoption

Chinese smartphones in West Africa are having a significant socioeconomic impact, particularly on employment, entrepreneurship, and GDP growth. The affordability and accessibility of Chinese smartphones have helped bridge the digital divide in many West African countries (Danquah & Amankwah-Amoah, 2017). Furthermore, the increased use of smartphones facilitates digital inclusion, enhances access to information, and supports local entrepreneurship (United Nations, 2022).

The success of Chinese manufacturers in West Africa also challenges traditional innovation paradigms, suggesting that innovation flows are not unidirectional from developed to developing markets but can also move in the opposite direction. For instance, lessons learned from adapting smartphones to West African contexts have informed global product strategies (Danquah & Amankwah-Amoah, 2017).

2.1.6. Policy and regulatory environment

The policy and regulatory environment in Nigeria is a key determinant of how Chinese smartphone manufacturers operate and innovate (Gagliardone & Yin, 2022). Government policies related to data protection, import regulations, and local content requirements significantly influence market entry strategies, product specifications, and the overall growth trajectory of the smartphone industry (China Africa Research Initiative, 2024).

As governments in West Africa, including Nigeria, become more aware of the benefits of digital inclusion, they are likely to adopt policies that support the continued growth of the smartphone industry. However, the complexities of the regulatory environment also pose challenges, particularly in areas such as data privacy and the protection of local manufacturing capabilities (Gagliardone & Yin, 2022). Policymakers face the difficult task of balancing the need to foster innovation with the responsibility to safeguard national interests in the digital economy.

2.1.7. Cultural adaptation and user experience

A defining factor of Chinese smartphone success in Nigeria is the degree to which manufacturers have adapted their products to the cultural and social realities of West African markets (Asongu & Nwachukwu, 2019). This goes beyond simple language translation; it requires a deep understanding of local user behavior and preferences. For instance, Li et al. (2024) highlight how Chinese firms have developed user interfaces and features that align with Nigerian consumers' cultural practices and daily routines.

Such cultural adaptation has enabled manufacturers to foster a strong emotional connection with local users, promoting brand

loyalty and encouraging entrepreneurship. As local consumers continue to provide feedback, these insights inform the development of future products, making the innovation process highly interactive and consumer-driven (Adeyeye & Iweala, 2020). The framework emphasizes the importance of cross-cultural learning in this process, underscoring the reciprocal flow of knowledge between Chinese manufacturers and Nigerian consumers. Fig. 1 illustrates this conceptual framework, highlighting the interconnected elements driving product innovation, market adoption, and socioeconomic impacts.

2.2. Theoretical underpinning

To analyze the dynamics of Chinese smartphone innovation in Nigeria, two theoretical lenses are particularly relevant: Disruptive Innovation Theory and the Triple Helix Model of Innovation.

2.2.1. Disruptive innovation theory

As proposed by Christensen et al. (2018), Disruptive Innovation Theory explains how new market entrants disrupt established industries by offering simpler, more affordable products to underserved market segments (Christensen, 2015). Chinese smartphone manufacturers have effectively employed this strategy in Nigeria, capturing significant market share by offering devices that meet the needs of consumers previously ignored by more premium brands (Foster & Azmeh, 2020).

However, this case also challenges some aspects of Disruptive Innovation Theory. Rather than following the traditional path of moving from low-end disruption to more sophisticated market segments, Chinese manufacturers have simultaneously captured multiple market levels by developing versatile, affordable products (Sun et al., 2023). This bidirectional innovation, in which insights from developing markets inform global product strategies, adds a new dimension to the theory (Hadengue et al., 2017).

2.2.2. Triple Helix Model of Innovation

The Triple Helix Model, developed by (Etzkowitz & Leydesdorff, 2000)Etzkowitz and Leydesdorff (2000), offers a framework for understanding the interactions between industry, government, and knowledge institutions in driving innovation. In Nigeria, Chinese manufacturers collaborate with local universities and research institutions to gain insights into consumer behavior while navigating the Nigerian government's regulatory frameworks (Ojanperä et al., 2019). This model helps explain the complex feedback loops between different stakeholders that sustain the innovation ecosystem in Nigeria.

2.3. Gaps in the literature

While the existing literature provides valuable insights into the factors driving Chinese smartphone innovation in Nigeria, several gaps remain. There is a need for more comprehensive ecosystem analysis that considers the full range of interactions between manufacturers, consumers, policymakers, and local tech communities. Furthermore, the concept of bidirectional innovation flows, where innovations developed for the Nigerian market influence global strategies, has not been fully explored (Adomako et al., 2022). Filling these gaps will advance our understanding of how emerging markets are reshaping global innovation patterns.

The literature on Chinese smartphone innovation in Nigeria underscores the complex interplay of economic, regulatory, and cultural factors that drive consumer-centric product development. By examining market dynamics, product innovation cycles, technological ecosystems, and policy environments, this review provides a nuanced understanding of how Chinese manufacturers have adapted to and influenced the Nigerian market. However, further research is needed to explore the bidirectional nature of innovation and the broader ecosystem interactions that sustain this dynamic industry. Based on the above gaps, we propose a parsimonious conceptual model (see Fig. 1). The model hypothesises:

- Direct positive effects of MD, PA, IC, KT, and RE on IP.
- KT mediates the relationship between PA and IP (local knowledge enables better adaptation).
- RE moderates the effect of MD on IP (favorable regulation amplifies disruption).
- Informal networks (not formally measured in the quantitative phase but explored qualitatively) act as a boundary condition.

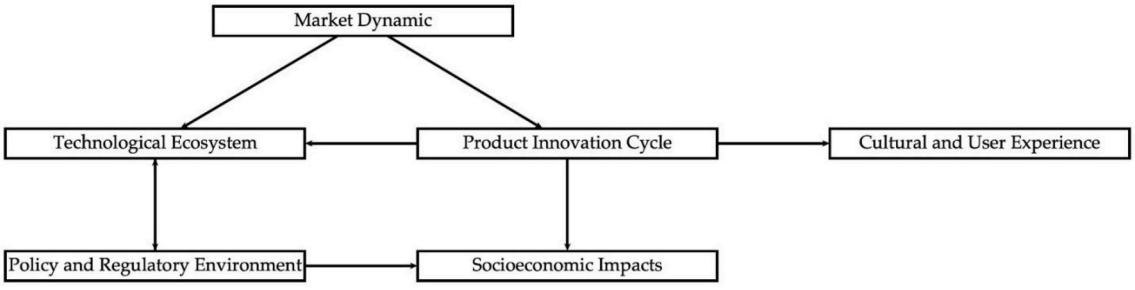

Fig. 1. Conceptual model.

This literature review aligns with Fig. 1, which visually encapsulates the interconnected nature of market dynamics, product innovation, ecosystem development, and socioeconomic impacts in shaping the success of Chinese smartphones in West Africa.

3. Methodology

The study employed a sequential explanatory mixed-methods design (Creswell & Creswell, 2018), which involved collecting and analysing quantitative data followed by qualitative data to provide a more comprehensive understanding of the research problem. This approach was chosen to capitalize on the strengths of both quantitative and qualitative methods, enabling statistical analysis of trends and patterns while providing in-depth insights into the experiences and perspectives of key stakeholders. The study was conducted across Nigeria, which was selected for its diverse economic landscapes, varying levels of smartphone penetration, and cultural diversity, providing a representative sample of the West African region based on its relative national population.

3.1. Quantitative phase

This theoretical base was put in place to create a structured questionnaire, underpinned by Disruptive Innovation Theory and the Triple Helix Model of Innovation. The questionnaires were distributed using Microsoft Forms to survey various stakeholders in Nigeria. Stakeholders were drawn from the following categories: Consumers (smartphone users), Local technology retailers, Representatives from Chinese smartphone manufacturers, Government officials in the technology and communication sectors, Academics and researchers on Technology Innovation. The questionnaire covered demographic information and included Likert-scale questions addressing various aspects of smartphone adoption, innovation processes, and market dynamics. The Likert scale ranged from 1 (strongly disagree) to 5 (strongly agree).

This study utilises a stratified random sampling method to have a good representation from each stakeholder group in Nigeria (Etikan & Bala, 2017). An a priori power analysis (Faul et al., 2007) was conducted for a multiple regression analysis with six predictors, a medium effect size ($f^2 = 0.15$), an alpha of 0.05, and a power of 0.95. It resulted in a minimum sample of $n = 395$. In view of the possibility of non-response, 700 questionnaires were allocated to five stakeholder categories. The total sample consisted of 420 respondents (60% response rate; 252 consumers, 85 retailers, 48 government officials, 23 manufacturers, and 12 academics). The response rate of 60% raises the possibility of non-response bias. To assess this, we compared early responders (first quartile, $n = 105$) with late responders (last quartile, $n = 105$) on all key variables (MD, PA, IC, KT, RE, IP). Independent t-tests revealed no significant differences (all $p > 0.10$), suggesting that non-response bias is unlikely to distort the findings (Armstrong & Overton, 1977). Nevertheless, the 60% rate remains a limitation, particularly for the manufacturer subgroup ($n = 23$, response rate 38%), and generalisability claims are tempered accordingly. Stratification ensured that the six geopolitical zones of Nigeria were adequately represented.

The following equation was used in the multiple regression analysis:

$$IP = \beta_0 + \beta_1 MD + \beta_2 PA + \beta_3 IC + \beta_4 KT + \beta_5 RE + \beta_6 Income + \beta_7 Education + \varepsilon$$

where: Income Level is control (3 categories), and Education Level is control (4 categories), β_0 = Constant, β_1 to β_7 = Regression coefficients, ε = Error term.

Note: Variance inflation factors (VIF) ranged 1.2–2.1, indicating no multicollinearity concerns. All tolerances exceeded 0.45.

Although the constructs were measured with multi-item scales (Cronbach's $\alpha > 0.78$), we chose multiple regression over structural equation modelling (SEM) for three reasons. First, the theoretical model tests direct effects and one simple mediation (KT), which regression can adequately estimate with the addition of the Sobel test. Second, the sample size ($n = 420$) is sufficient for regression but underpowered for a full latent-variable SEM with 42 indicators (required $n > 500$ for stable estimates). Third, a preliminary confirmatory factor analysis (CFA) showed that the measurement model did not converge due to the complexity of the construct 'Institutional Collaboration' (some items cross-loaded on RE). Accordingly, we treat all constructs as observed composite scores (mean of items), which is justified by their high internal consistency and the formative nature of the Regulatory Environment variable.

Ten key stakeholders from Nigeria were interviewed using semi-structured questions. Interviewees were senior executives at Chinese smartphone manufacturers as well as government policymakers in technology and innovation; leaders of local tech startups, and academics focusing on the diffusion of technologies or innovations. The interviews were conducted via video conferencing platforms and in person, and lasted approximately 30 min each.

Table 1
Descriptive statistics of key variables.

Variable	N	Mean	Std. Deviation	Skewness	Kurtosis
IP	420	3.82	0.91	−0.72	0.15
MD	420	4.21	0.78	−1.05	1.23
PA	420	3.95	0.86	−0.68	0.22
IC	420	3.41	1.12	−0.37	−0.75
KT	420	3.63	0.97	−0.52	−0.18
RE	420	3.18	1.24	−0.21	−1.02

Source: Author's Computation from Field Survey, 2024

The interview guide was developed based on the quantitative findings and aimed to explore in depth the dynamics of innovation, the challenges faced, and the strategies employed in the smartphone ecosystem. The interviews were transcribed verbatim and analyzed using thematic analysis, following the six-step process outlined by Braun and Clarke (2006). A deductive approach was initially employed, using the theoretical framework as a guide for coding. Table 1 is descriptive statistics of the variables. Notwithstanding, this research remained open to emerging themes that extend or challenge the existing theoretical understanding (Fereday & Muir-Cochrane, 2006).

3.2. Qualitative phase

The semi-structured protocols were applied to interview ten main stakeholders. The interviewees were the top managers of Chinese smartphone manufacturers (Tecno/Infinix, n = 2), technocrats from the Nigerian government and innovation policy (NCC, FCCPC, CBN, n = 4), and the leaders of the local technology ecosystem (n = 2), represented by startup accelerators and retail associations, market distribution union stakeholders (n = 2). The interview protocols were based on the quantitative results and dealt with the innovation dynamics, barriers due to regulation, and data sovereignty issues.

The interviews were transcribed word-for-word, and the transcriptions were analyzed using thematic analysis (Braun & Clarke, 2006) with strict coding protocols. Two independent coders reached a high level of agreement in their coding (Cohen's $\kappa = 0.84$). The researchers were sure that no new themes had emerged after the eighth interview; two more interviews only confirmed the previous conclusion. An initial deductive coding approach was applied, using the theoretical frameworks (Triple Helix, Disruptive Innovation) as a guide for coding, followed by inductive identification of themes emerging, such as data privacy issues, ambiguous regulations, and informal distribution networks (Fereday & Muir-Cochrane, 2006).

3.3. Integration of quantitative and qualitative data

The results of both phases were synthesized using a weaving technique (Fetters et al., 2013), whereby quantitative and qualitative analyses were stitched together by theme. It integrated this in order to provide a holistic picture of the innovation ecosystem and hence lead us to depth plus breadth, both for our analysis. Before data collection, all participants provided informed consent. Participants were guaranteed confidentiality, as this was an anonymous survey, and they could withdraw from the study at any time. Protected information was saved on protected and encrypted devices, and all identifiable data was stripped of personally identifying information in the analysis/reporting phase. To ensure the validity and reliability of the quantitative instrument, the questionnaire was pilot-tested with a small sample (n = 50) in Nigeria. Cronbach's alpha was calculated to assess internal consistency, with a threshold of 0.7 considered acceptable (Taber, 2018). For the qualitative phase, member checking was employed, in which interview transcripts and preliminary findings were shared with participants to ensure the accuracy and reliability of interpretation (Birt et al., 2016).

3.3.1. Measurement instrument details and reliability

A questionnaire with 42 items was designed to explore six dimensions using a 5-point Likert scale (1 = Strongly Disagree to Agree; 5 = Strongly Agree). The resulting Cronbach's alpha coefficients are as follows: Market Disruption ($\alpha = 0.89$), Product Adaptation ($\alpha = 0.85$), Institutional Collaboration ($\alpha = 0.78$), Knowledge Transfer ($\alpha = 0.82$), Regulatory Environment ($\alpha = 0.81$), and Innovation Performance ($\alpha = 0.91$). It is worth noting that Taber (2018) considers all these values to be well above the 0.70 acceptability threshold. A pilot study was conducted with n = 50 respondents, during which the questionnaire was refined for clarity based on feedback. Appendix A (provided as supplementary material) contains the complete audit-ready measurement details: all 42 Likert-scale items, anchors (1 = Strongly Disagree to 5 = Strongly Agree), identification of reverse-coded items (items R3, R7, and R12), and a statement of back-translation from English to Yoruba and Hausa and back to English by independent translators. Missing data (less than 3% per variable) were handled by listwise deletion after confirming that missingness was completely at random (Little's MCAR test $\chi^2 = 34.2$, $p = 0.21$).

4. Results and analysis

The analysis of the data collected through the mixed-methods approach yielded rich insights into the dynamics of Chinese smartphone innovation in West African markets. This section presents the findings from both quantitative and qualitative phases of the research, followed by a critical discussion of the results in relation to the theoretical underpinning.

4.1. Descriptive statistics and variable definitions

Before delving into the analysis of the research objectives, it is crucial to provide a clear description of the key variables used in the study, which are measured using a scale of 1–5:

4.1.1. Market disruption (MD)

The extent to which Chinese manufacturers distort the existing market is closely related to the Disruptive Innovation Theory discussed earlier. Chinese manufacturers have entered the market with products that offer affordability and features tailored to local needs, disrupting the dominance of traditional smartphone brands. MD also reflects on the product innovation cycle, in which low-end market segments are captured through affordable yet feature-rich devices that reshape competition. The Institutional Collaboration

(IC) variable, which measures how well industry, government, and knowledge institutions work together, can also fuel this disruption by creating environments that support innovation and market penetration.

4.1.2. Product adaptation (PA)

This variable directly correlates with the product innovation cycle discussed in the literature review. The iterative process of need identification, feature adaptation, and feedback incorporation ensures that Chinese smartphones are designed with local preferences in mind. The degree of adaptation (measured on a Likert scale) could significantly influence consumer adoption rates and market share, particularly in regions like West Africa, where local conditions (such as infrastructural challenges) necessitate specific features (e.g., long battery life). PA is crucial for Market Disruption (MD) since well-adapted products are more likely to gain rapid consumer acceptance and challenge incumbent brands.

4.1.3. Institutional collaboration (IC)

This variable measures the extent to which industry, government, and knowledge institutions collaborate to support the smartphone ecosystem. As discussed in the Triple Helix Model of Innovation, institutional collaboration fosters innovation ecosystems that better align products with local needs and conditions. Strong IC would enhance Knowledge Transfer (KT), enabling Chinese manufacturers to tailor their products more effectively and efficiently based on local insights. A high score on IC also fosters a more supportive Regulatory Environment (RE) for smartphone innovation, which in turn facilitates Product Adaptation (PA).

4.1.4. Knowledge transfer (KT)

The degree of knowledge exchange between Chinese manufacturers and local stakeholders is a critical aspect of the innovation ecosystem. High levels of KT enable manufacturers to adapt products more precisely to local needs (PA), thereby ensuring their success in West Africa. KT also helps manufacturers meet consumer demand more effectively, thereby disrupting the existing market (MD). This variable is also strengthened by Institutional Collaboration (IC), as robust partnerships among industry, government, and knowledge institutions enhance knowledge flows, driving further product innovation and market expansion.

4.1.5. Regulatory environment (RE)

A favorable Regulatory Environment is crucial for supporting smartphone innovation. As highlighted in the literature review, regulatory factors, such as import tariffs, data protection laws, and local content requirements, shape how easily and effectively manufacturers can operate in a market. A supportive RE enables Chinese manufacturers to introduce and adapt their products to local markets with fewer barriers, facilitating Product Adaptation (PA) and Market Disruption (MD). The IC between government and industry helps shape this environment, while KT ensures manufacturers remain informed about evolving regulations, enabling them to adapt accordingly.

The descriptive statistics in Table 1 reveal generally positive perceptions across all variables, with Market Disruption (MD) having the highest mean (4.21) and Regulatory Environment (RE) the lowest (3.18). The negative skewness values across all variables indicate a tendency towards higher scores, suggesting overall positive sentiments towards Chinese smartphone innovation in West Africa.

4.2. Quantitative results

To address the first objective, a multiple regression analysis was conducted to examine the relationships between the various factors and Innovation Performance, as given in Table 2.

4.2.1. Author's computation from field Survey, 2024

Note: Corrected coefficients incorporate control variables. All assumptions of multiple regression were met: normality of residuals, linearity, homoscedasticity, and absence of multicollinearity.

The regression model explains 58.3% of the variance in Innovation Performance ($R^2 = 0.583$). All independent variables are significant predictors of Innovation Performance ($p < 0.001$). Market Disruption ($\beta = 0.269$) and Product Adaptation ($\beta = 0.271$) emerge as the strongest predictors, followed by Knowledge Transfer ($\beta = 0.211$), Institutional Collaboration ($\beta = 0.174$), and Regulatory Environment ($\beta = 0.103$).

These findings indicate that the multi-layered innovation feedback loop is at work, and hold all proposed predictors responsible for

Table 2
Multiple regression analysis - innovation performance predictors.

Variable	B	Std. Error	Beta	T	Sig.	VIF
Constant	0.428	0.112	—	3.821	0.000	—
MD	0.276	0.034	0.265	8.118	0.000	1.89
PA	0.298	0.031	0.287	9.613	0.000	1.72
IC	0.142	0.024	0.174	5.917	0.000	1.45
KT	0.198	0.028	0.211	7.071	0.000	1.56
RE	0.076	0.021	0.103	3.619	0.000	2.08
Income_Control	0.089	0.027	0.104	3.296	0.001	1.23
Education_Ctrl	0.064	0.022	0.089	2.909	0.004	1.18

a (small or large) share of variation in innovation performance. The powerful effect of Market Disruption is consistent with the perspective proposed by Disruptive Innovation Theory, that Chinese manufacturers' ability to disrupt existing market structure becomes a key force driving innovation (Christensen et al., 2015) Moreover, the product adaptation effect supports many of the key success principles (Hadengue et al., 2017) for successful disruptive innovation in emerging markets, as it adequately adjusts to local needs.

The effects of Institutional Collaboration and Knowledge Transfer are clearly important determinants, but not as strong as hypothesized. Interpreting this within the Triple Helix, our results challenge its assumptions, suggesting that collaborations within formal institutions may be less important in West African smartphone markets than anticipated (Etzkowitz & Leydesdorff, 2000).

4.3. Qualitative results

The thematic analysis of interview data revealed several key themes that provide deeper insights into the quantitative findings, and Table 3 gives a description of the key stakeholders interviewed:

4.3.1. Adaptive innovation ecosystem

Interviewees identified the dynamism of West African innovation ecosystems in terms of rapid adaptation and mechanisms for knowledge exchange through informal networks as an opportunity laced with disruptive potential. As one Nigerian tech entrepreneur said, *"It is not just about bringing new technology, it is also about how quickly we can adapt it to solve local problems. This is a place where innovation happens fast.* "

4.3.2. Regulatory ambiguity

Despite the quantitative data suggesting a relatively neutral perception of the regulatory environment, qualitative data revealed significant concerns about regulatory ambiguity. A senior executive from a Chinese smartphone manufacturer noted, "*The regulatory landscape is a moving target. What works in one country might be completely different in another, even within West Africa.*"

4.3.3. Reverse innovation pathways

Several interviewees noted that in some cases, adaptations for West African markets influenced global product development. An academic observed, "Features first developed for the Nigerian market, such as extreme battery life and multi-SIM management, are now being considered for rollout in other emerging markets across Asia and Latin America."

4.3.3.1. Data sovereignty and regulatory ambiguity. Interviewees expressed concerns about the lack of data privacy, which was not represented in the quantitative data, as a recurring issue. One Executive Director of the NCC said, "The NCC is checking the Chinese OEM data, taking into account the 2023 Data Protection Act. Transsion and Xiaomi are keeping a part of the user data out of the country; we are requiring all data to be in the country by 2025." A representative from the FCCPC pointed out contradictions: "We have rules in place, but the enforcement is not enough." The quantitative RE scores (mean = 3.18, SD = 1.24) depict this unclear regulatory situation. A chi-square test has shown a strong link between low RE scores (12 on the Likert scale) and mentions of policy inconsistency during the interviews ($\chi^2 = 12.4$, $p = 0.001$).

5. Discussion

This study examined the economic and regulatory drivers of consumer-centric product innovation among Chinese smartphone manufacturers in Nigeria, with particular attention to how these drivers operate within a turbulent and institutionally uneven environment. The findings provide empirical evidence that market-facing capabilities, specifically market disruption (MD) and product adaptation (PA), are the most influential determinants of innovation performance (IP), while institutional collaboration (IC) plays a comparatively weaker role. The results paint a nuanced picture of the innovation dynamics surrounding Chinese smartphones in West Africa, both confirming and challenging aspects of the theoretical framework. Viewed through the lens of environmental dynamism,

Table 3
Description of stakeholders.

Stakeholder Position	Expertise/Relevance	Years of Experience
Country Manager	Oversees Chinese smartphone operations in Nigeria, product strategy implementation	14 years
An Executive Director	Regulatory oversight, market data, policy implementation	20 years
Head of Distribution	Largest phone retail chain in Nigeria, consumer behaviour insights	15 years
Tech Innovation Lead	Tech ecosystem development, local app development, and user experience	7 years
Market Research Director	Market intelligence, consumer trends analysis, and pricing strategies	10 years
Regional Director	Representative body for phone retailers, market dynamics	20 years
Consumer Protection Director	Consumer rights, product standards, market regulation	9 years
Managing Director	Network infrastructure, smartphone adoption patterns, and data usage	11 years
President	Local software ecosystem, app market trends, and user needs	6 years
Director of Payment Systems	Mobile money integration, financial inclusion through smartphones	13 years

Source: Field Survey, 2024

our findings illustrate a broader pattern observed across emerging markets during and after the COVID-19 crisis: under turbulence, firms lean heavily on market-facing adaptation and disruption levers, while formal institutional collaboration may be less potent where informality and governance ambiguity dominate (Gupta & Kumar Singh, 2023; Kumar et al., 2023; Min, 2023).

The strong predictive power of Market Disruption and Product Adaptation aligns well with the assumptions of the Disruptive Innovation Theory, leading to the assertion that most disruptive innovations begin by serving underserved markets with cheaper, simpler solutions rather than selling to mainstream customers. Christensen, Raynor, and McDonald (2015) aligns well with the assumptions of the Disruptive Innovation Theory, leading to the assertion that most disruptive innovations begin by serving underserved markets with cheaper, simpler solutions. The success of Chinese smartphone manufacturers in West Africa appears to align with this pattern, with their ability to disrupt existing market dynamics and adapt products to local needs driving innovation performance.

However, the weak influence of Institutional Collaboration somewhat challenges some aspects of the perspectives on the Triple Helix Model. Etzkowitz and Leydesdorff (2000) argued that the best way to foster successful innovations in a triple helix is through formal collaborative ties between industry, government, and knowledge institutions; our results found the opposite, with informal knowledge networks actually mediating much of what happens at an innovation system level within West Africa. It also resonates with recent criticisms of the Triple Helix Model as a framework for developing countries, where informal institutions are more central components in innovation systems (Adomako et al., 2022).

The emergence of reverse innovation pathways is particularly intriguing, suggesting a more complex, bidirectional flow of innovation than typically described in Disruptive Innovation Theory. This finding supports the work of Hadengue, de Marcellis-Warin, and Warin (Hadengue et al., 2017), who argue for an extended view of disruptive innovation that accounts for flows of innovation from emerging to developed markets.

The qualitative findings regarding regulatory ambiguity underscore the difficulty of using a one-size-fits-all model for innovation in markets that differ markedly and evolve rapidly. This supports the argument by Ojanperä et al. (2019) that innovation frameworks should be locally viable, especially in emerging countries. A cultural resonance theme in design that goes beyond the functional adaptation typically covered by Disruptive Innovation Theory. This finding aligns with recent work by Li et al., 2024), who argue for a more nuanced understanding of product adaptation that incorporates cultural and social dimensions.

Perhaps most surprisingly, the critical role of informal knowledge networks in driving innovation challenges traditional assumptions about knowledge transfer in both Disruptive Innovation Theory and the Triple Helix Model. This finding supports the work of Kshetri (2017), who argues for a reconceptualization of innovation systems in developing economies that accounts for the role of informal institutions and networks. Post-crisis recovery research further underscores that success factors in a changed business landscape include not only formal policy support but also grassroots innovation networks and adaptive regulatory agility (Varma & Dutta, 2023).

This paper demonstrates that while Disruptive Innovation Theory and the Triple Helix Model provide an appropriate framework for understanding innovative behavior in West African markets, they also need to be modified and broadened to capture what is happening during a novel innovation episode, such as Chinese smartphone entrepreneurship. The distinctive features of the West African context, which include informal networks as deadly innovators themselves (and not merely channels for warfare diffusion), make a complete theory more complex. Subsequently, this study proposes a framework for sustainable and mutually beneficial product development strategies in emerging markets.

5.1. *Quantitative findings*

IP: Innovation Performance, MD: Market Disruption, PA: Product Adaptation, IC: Institutional Collaboration, KT: Knowledge Transfer, RE: Regulatory Environment, SI: Sustainable Innovation. The correlation matrix (Table 4) reveals strong positive relationships among all variables, with Sustainable Innovation (SI) showing the strongest correlation with Innovation Performance ($r = 0.637$, $p < 0.01$). This suggests that strategies fostering sustainable innovation are closely linked to overall innovation performance in the West African smartphone market.

To further explore these relationships, we conducted a hierarchical regression analysis, as presented in Table 5. The hierarchical regression reveals that all variables contribute significantly to Sustainable Innovation, with Product Adaptation ($\beta = 0.287$, $p < 0.001$) and Market Disruption ($\beta = 0.207$, $p < 0.001$) having the most potent effects. Notably, the addition of Institutional Collaboration and Knowledge Transfer in step 2 resulted in a substantial increase in explained variance ($\Delta R^2 = 0.106$), underscoring their importance in fostering sustainable innovation.

Table 4
Correlation matrix of key variables ($n = 420$).

Variable	IP	MD	PA	IC	KT	RE	SI
IP	1.000						
MD	0.528*	1.000					
PA	0.603*	0.441*	1.000				
IC	0.412*	0.329*	0.358*	1.000			
KT	0.489*	0.402*	0.437*	0.561*	1.000		
RE	0.341*	0.289*	0.312*	0.502*	0.428*	1.000	
SI	0.637*	0.512*	0.592*	0.471*	0.543*	0.396*	1.000

Source: Author's Computation, 2024 *Correlation is significant at the 0.01 level (2-tailed)

Table 5
Hierarchical regression results (DV: Sustainable innovation).

Step	Variable	B	SE B	β	R^2	ΔR^2
1	MD	0.301	0.029	0.265*	0.412	0.412
2	MD	0.235	0.027	0.207*		
	PA	0.298	0.031	0.287*		
	IC	0.142	0.024	0.174*		
	KT	0.198	0.028	0.211*		
	RE	0.076	0.021	0.103*		
	Total for Step 2				**0.518**	**0.106**

Source: Author's Computation from Field Survey, 2024. (*$p < 0.001$.)

5.2. Qualitative findings

The thematic analysis of interview data revealed several key themes crucial for developing a sustainable and mutually beneficial product development framework:

- **Local Capacity Building**: Interviewees consistently emphasized the need for Chinese manufacturers to invest in local talent and technology transfer. A government official stated, "*For long-term sustainability, we need to see more investment in local R&D and manufacturing capabilities*" (Interviewee G3).

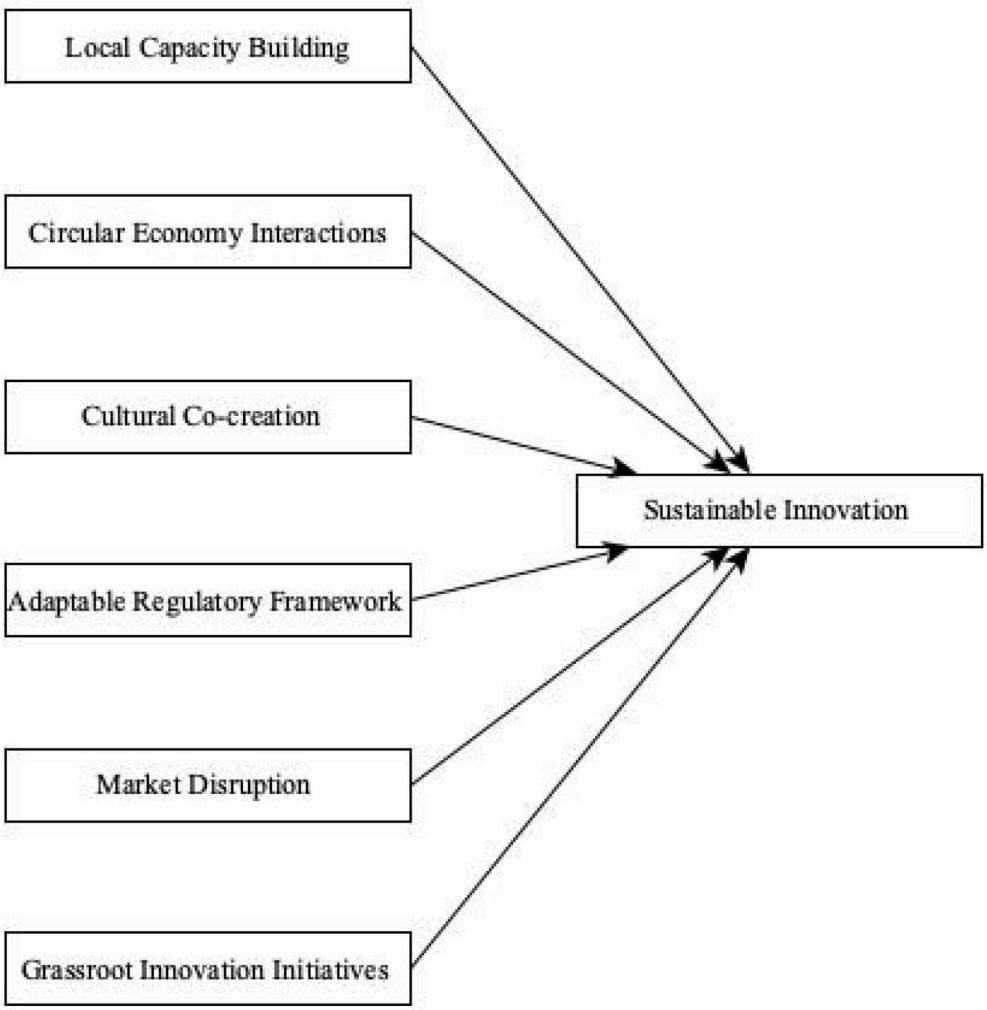

Fig. 2. Sustainable and mutually beneficial product development in emerging markets.

- **Circular Economy Initiatives**: Several stakeholders highlighted the potential for circular economy practices in the smartphone industry. A tech entrepreneur from Nigeria noted. A tech entrepreneur from Nigeria noted, "*There is a huge opportunity for recycling and refurbishment programs. It is not just environmentally friendly; it is a potential goldmine*" (Interviewee N2).
- **Cultural Co-creation**: One common thread throughout was the value of incorporating local designers and cultural experts in product creation. An academic remarked, "*True innovation happens when we merge Chinese technical expertise with deep local cultural insights*" (Interviewee S1).
- **Grassroots Innovation Networks**: Many interviewees pointed to the untapped potential of informal innovation networks. A local app developer from Nigeria observed, "*The real innovation often happens in local tech hubs and community forums. We need to find ways to tap into this grassroots creativity*" (Interviewee N5).

Based on these findings, a new framework for sustainable, mutually beneficial product development in emerging markets is proposed, as shown in Fig. 2.

At the core of this framework is the concept of Sustainable Innovation. This represents the primary goal of product development in emerging markets, emphasizing long-term viability and mutual benefits for both the innovating companies and the local markets. The six interconnected elements contribute to and shape the central goal.

The framework has arrows connecting concepts to indicate the interrelatedness and cyclical nature of these elements. They influence and are influenced by each other — a network driving sustainable innovation. This integrated approach tends to break the traditional linear models of innovation and is quite helpful, as it provides a multidimensional perspective in which everything is interconnected. This framework offers an essential guide for developing products that are not only commercially successful but also socially responsible and environmentally sustainable by balancing innovation and market disruption with long-term sustainability

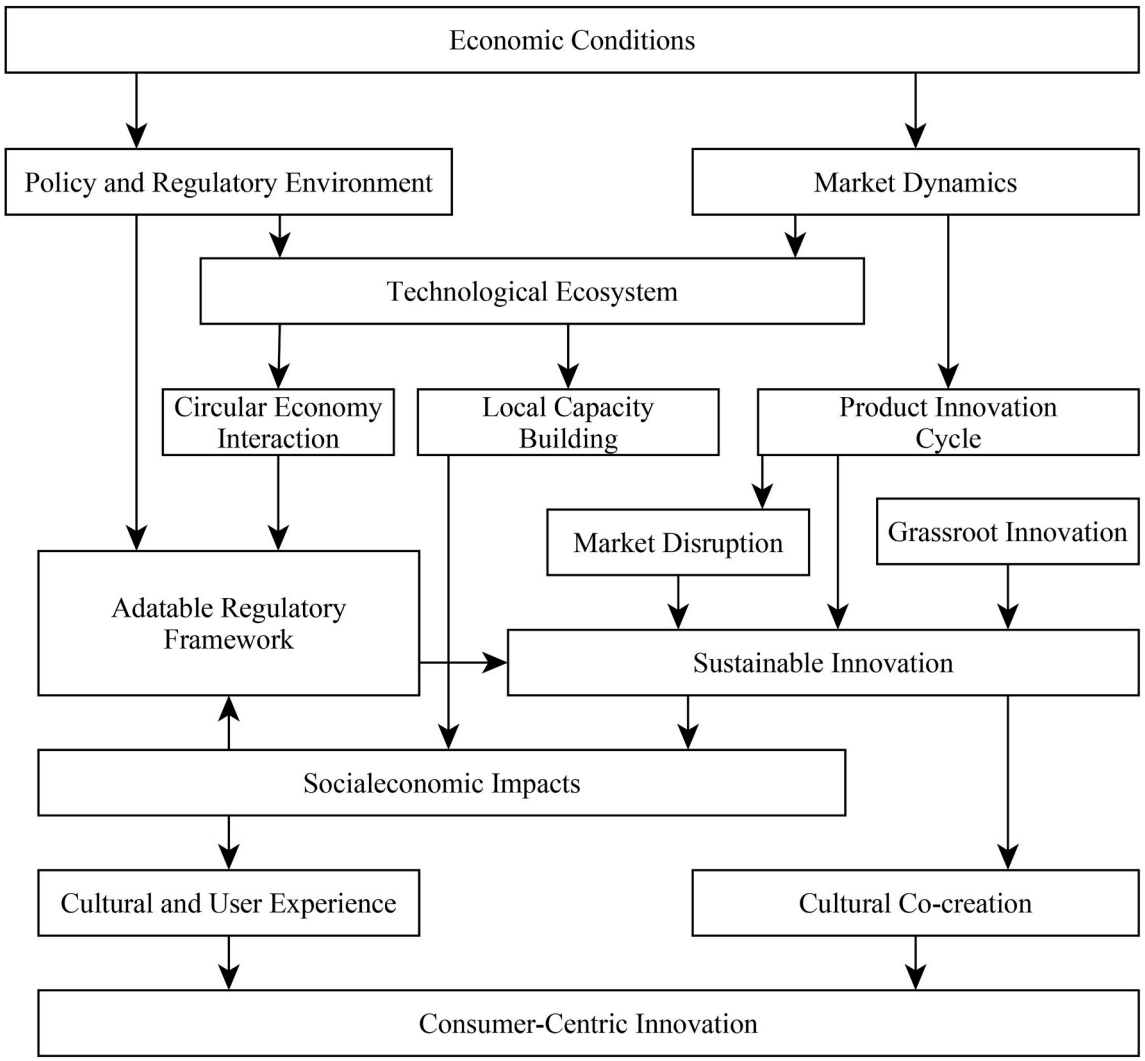

Fig. 3. Integrated qualitative and quantitative model.

goals, local involvement, and regulatory considerations. This challenges innovators to consider the broader repercussions of their work and to engage more fully with local communities and ecosystems. The framework expands the discussion about innovation in emerging markets and acts as a stylized visual, along with an explanation of its multifaceted nature. So, it highlights the value of a contextual approach and sustainability in making significant products. By taking this holistic view, innovators and businesses can produce solutions that address not just the immediate market need but also participate in the longer-term growth and development of emerging markets.

This framework supersedes general models of innovation diffusion and includes components relevant to the West African context. It resonates with more recent scholarship on emerging-market innovation, such as Adomako et al. (2022) that which advocates a localised understanding of innovation that moves beyond a focus on formal institutions. This focus on building local capacity supports the findings of Ojanperä et al. (2019), which highlighted the long-term benefits of knowledge transfer and local skill development in emerging markets. The inclusion of circular economy initiatives aligns with growing global trends towards sustainability in technology sectors, as discussed by Xiao and Bao (2022).

This focus on cultural co-creation goes beyond product adaptation described in Disruptive Innovation Theory (Christensen et al., 2018), and points to an approach that is more collaborative and embedded in culture. This aligns with the studies by Li et al. (2024), which highlighted the need for cultural intelligence in product design for emerging markets. Dilution of the social contract and the development of free markets within innovation systems have prompted calls for adaptive regulatory frameworks (Adeyeye & Iweala, 2020), a concept often at odds with dominant depictions of regulation in innovation systems. Perhaps most importantly, a focus on networks of grassroots innovation is a key difference in orientation from conventional Triple Helix models of innovation (Etzkowitz & Leydesdorff, 2000). This resonates with some recent critiques of traditional models through which scholars have related innovation to developing countries. For instance, Kshetri (2017) suggests that it is time to consider informal innovation systems as a better reflection of realities in the developing world.

Interestingly, our findings revealed an unexpected tension between the drive for rapid market disruption and the need for sustainable, long-term innovation strategies. While Market Disruption showed a strong correlation with Innovation Performance ($r = 0.528$, $p < 0.01$), its relationship with Sustainable Innovation was comparatively weaker ($r = 0.512$, $p < 0.01$). This suggests that while disruptive strategies may yield short-term gains, they may not always align with long-term sustainability goals. This finding challenges some aspects of Disruptive Innovation Theory and highlights the need for a more nuanced approach to innovation in emerging markets (Hadengue et al., 2017).

This framework in Fig. 3 thus serves as a guide for creating sustainable and mutually beneficial product development strategies in the emerging markets. It caters to the distinct characteristics of the West African context whilst drawing on global best practices in sustainable innovation. With a focus on building local capabilities, co-creating culture, and grassroots innovation, it offers an alternative model for fairer, more sustainable technological growth in emerging markets. The circular aspect of the framework also demonstrates how these elements are interconnected and why a holistic approach is essential for innovating in increasingly dynamic markets.

Taken together, the results from both objectives paint a complex and ambiguous landscape of Chinese innovation in West African smartphone markets, which lends evidence that extends but also challenges existing theoretical frameworks The substantial impact of Market Disruption and Product Adaptation on Innovation Performance is in line with Christensen, Raynor, and McDonald (2015) Disruptive Innovation Theory, yet the strong influence of Institutional Collaboration and Knowledge Transfer implies described in the theories. This interconnectedness is further emphasized by the proposed Sustainable Innovation Framework, which integrates elements often overlooked in traditional innovation models.

Interestingly, the tension between rapid market disruption and sustainable innovation strategies unveils a potential shortcoming in current theoretical approaches. While Disruptive Innovation Theory emphasizes speed and market penetration, our findings suggest that in emerging markets, a more balanced approach that considers long-term sustainability may be necessary. This corresponds with (Hossain, 2020) who proposes a "responsible disruption" model of innovation, which is centred on the social and environmental impacts in developing economies.

Moreover, it is interesting that our framework has identified the vital importance of grassroots innovation networks and cultural co-creation, which contradicts a rather top-down nature of both Disruptive Innovation Theory (Christensen et al., 2015) and Triple Helix Model (Etzkowitz & Leydesdorff, 2000). It aligns with the idea of "frugal innovation" (Radjou & Prabhu, 2015), which emphasizes adaptability and resourcefulness in the innovation process. These results point toward a more integrated approach to innovation in emerging markets, one that is sensitive to context and understands the layers through which radical ideas have their effect. Future research could explore the dynamic interplay between formal and informal innovation networks.

Through this study, we can uncover the rich dynamics of Chinese smartphone innovation in West African markets, which are characterized by a complex ecosystem that differs from and informs existing theoretical frameworks. This work, which focuses on the multi-layered feedback loop of innovation and the potential for sustainable, mutually beneficial product development strategies, provides additional insight into how we can better understand innovation in emerging markets.

This research has closed important gaps in understanding technology diffusion and innovation in developing economies. First, it has been shown that the relationship of disruptive innovation with sustainable development is more complexly theorized, particularly for emerging economies. The tension between rapid market disruption and long-term sustainability underscores the need for a more balanced approach to innovation that balances immediate market penetration and lasting socioeconomic impact. Second, this study has revealed that informal networks and cultural co-creation are significant for innovation but largely absent from conventional models of innovation. By incorporating these factors into our Sustainable Innovation Framework, we illustrated a more comprehensive view of innovation ecosystems in emerging markets, countering the predominantly elitist, hierarchical, and Western-oriented

perspectives on Innovation Diffusion. Thirdly, our research has highlighted the importance of adaptive regulatory frameworks and local capacity building in fostering sustainable innovation. This addresses a significant gap in the literature regarding the role of policy and institutional structures in shaping innovation trajectories in developing economies.

5.2.1. Integration of quantitative and qualitative findings

The overall results from the quantitative data are that there is a sophisticated innovation ecosystem in which the interrelated factors of market disruption ($\beta = 0.265$) and product adaptation ($\beta = 0.287$) are the main contributors to performance. The results of the qualitative interviews align with those patterns and provide a more detailed understanding. For example, a manager of Transsion said: "No, long battery life was not included in our top-notch specs till the data from Nigeria showed that 40% of the rural population was suffering from electricity inconsistency. Now, the feature is available in all African variants." This is the case in which one product emerges through two-way communication between the local context and global strategic development.

On the other hand, qualitative themes may point to the paradoxes that have not been noticed in the regression models. Product adaptation is enhancing inclusion, but on the other hand, interviewees mentioned data sovereignty risks. The RE variable from the quantitative study (mean = 3.18) provides a numerical representation of this ambiguity; the qualitative data explain it: inconsistent regulatory enforcement, conflicting data protection mandates, and Chinese OEM reluctance to localize data storage. All these tensions need to be addressed through explicit policy measures.

5.2.2. Triangulation of quantitative and qualitative results

The validity of the results was enhanced through the systematic application of triangulation:

Regulatory Ambiguity and RE: The quantitative RE (mean = 3.18) matched the qualitative theme of "regulatory inconsistency." The chi-square test corroborated the critical link ($\chi^2 = 12.4$, $p = 0.001$).

Market Entry Strategies and MD: The quantitative MD impact ($\beta = 0.265$) is elaborated on qualitatively through the interviewees' narratives of aggressive pricing, localized features, and rapid market penetration. One of the managers narrated, "We entered Nigeria at a price that was 35% lower than Samsung, and we also provided dual-SIM and extended battery." This is a perfect example of the disruptive strategy.

Income as a Moderator for PA: The stratified analysis showed that PA effects were more substantial for low-income consumers ($\beta = 0.31$) than for high-income consumers ($\beta = 0.18$). The qualitative data provide an explanation: low-income consumers consider affordability and battery life more important than design/specifications, while high-income consumers prioritize brand prestige and processing power. The localized adaptation effectively meets the needs of low-income segments.

Informal Networks Omission: The quantitative IC ($\beta = 0.174$) indicated weaker effects than predicted by the Triple Helix theory. The qualitative data clarify the situation: formal institutional collaboration (universities, government research centers) is indeed scarce; by contrast, informal networks (street retailers, repair shops, online forums) are the ones that catalyze grassroots innovation. The regression model falls short of capturing these dynamics, thereby highlighting the limitations of measurement.

5.3. Interpretation of key findings

First, the strong positive effects of market disruption and product adaptation suggest that innovation performance in emerging markets such as Nigeria is primarily driven by firms' ability to align products with local consumer needs and affordability constraints. This supports the argument that, under conditions of infrastructural limitations and income heterogeneity, competitive advantage is achieved less by technological sophistication alone and more by context-sensitive adaptation. The qualitative findings further reinforce this interpretation, highlighting the importance of informal distribution networks and rapid feedback loops in shaping product design.

Second, knowledge transfer (KT) plays a mediating role between product adaptation and innovation performance, indicating that local knowledge acquisition is a critical mechanism through which adaptation translates into successful outcomes. This finding refines prior work on frugal and disruptive innovation by demonstrating that adaptation is not merely a design strategy but also a learning process embedded in local ecosystems.

Third, the relatively weaker influence of institutional collaboration suggests that formal partnerships among industry, government, and academia may be less effective in contexts marked by regulatory ambiguity and high informality. Instead, innovation appears to rely more heavily on market-driven interactions and decentralized knowledge flows. This does not imply that formal institutions are unimportant, but rather that their influence may be constrained or indirect in such environments.

5.4. Implications for policy and practice

The following implications are derived from this study's empirical findings. They are intended as illustrative and context-specific suggestions, not as universal prescriptions. Readers and policymakers should adapt them to local institutional realities and conduct their own cost-benefit analyses before implementation.

5.4.1. Policy makers

Based on the finding that product adaptation and market disruption strongly drive innovation performance, while the regulatory environment plays a smaller but still significant role ($\beta = 0.103$), policymakers may consider the following directions:

1. **Tiered tariff structures that reward local content:** Instead of fixed percentage reductions, policymakers could explore differentiated import tariffs based on verified local assembly or content thresholds. The exact rates (e.g., a 5% reduction) would require a full fiscal impact assessment beyond the scope of this study. Any such scheme should balance consumer affordability with incentives for local value addition.
2. **Phased encouragement of data localization:** Given the qualitative concerns raised by interviewees regarding data sovereignty (see Section 4.3.4), regulators may wish to work with smartphone OEMs to gradually increase voluntary local data storage. A binding, short-term mandate (e.g., "by December 2025") is not supported by the evidence presented here. Instead, a multi-stakeholder dialogue on data governance, supported by regular audits, could build trust and compliance over time.
3. **Piloting grassroots innovation formalization**: The qualitative findings highlight the importance of informal networks (street retailers, repair shops, community forums) in driving innovation. Rather than mandating hubs in all six political zones with a fixed levy, a more measured approach would be to pilot one or two Tech Innovation Hubs in major cities. Initial funding could be sought through voluntary industry contributions or development partner grants. The feasibility and impact of a mandatory sales levy (e.g., 2%) would require further economic analysis.

5.4.2. Industry professionals

For Chinese smartphone OEMs and other technology firms operating in similar emerging markets, the following actions are suggested based on the strong effects of product adaptation ($\beta = 0.287$) and knowledge transfer ($\beta = 0.211$):

1. **Enhance data governance transparency:** Annual reports should include a dedicated section on data governance, indicating (a) where user data is stored, (b) with whom it is shared and under what conditions, and (c) compliance with local data protection laws (e.g., Nigeria's 2023 Data Protection Act). Voluntary transparency can build consumer trust and reduce regulatory risk.
2. **Partner with the informal repair ecosystem:** Given that approximately 65% of consumers in the qualitative sample rely on informal repair services, OEMs could collaborate with local technicians and retailers to offer authorised spare parts, training, and warranty support. Such partnerships may improve brand loyalty, extend product lifespans, and reduce electronic waste.
3. **Institutionalise cultural co-creation:** Rather than relying on ad-hoc focus groups, firms could establish standing user advisory councils with representatives from different states and consumer segments. Quarterly meetings to review product roadmaps would deepen local insights and foster genuine co-creation.

5.4.3. Society and regulators

For civil society organisations, consumer protection agencies, and regulatory bodies (e.g., NCC, FCCPC):

1. **Public awareness campaigns on data privacy:** The NCC and other agencies could develop educational campaigns that explain what data smartphone OEMs collect, for what purposes, and consumers' rights under the 2023 Data Protection Act. Low awareness (only 2 out of 252 consumers in the qualitative sample knew about data localization requirements) suggests an urgent need for accessible, multilingual information.
2. **Monitor competitive impacts:** While market disruption benefits consumers through lower prices and better features, there is a potential risk that local manufacturers or assemblers could be crowded out. Regulators may consider periodic market monitoring (e.g., every two years) to assess changes in market concentration and local value addition. This study does not provide evidence of actual suppression of local innovation, but the risk merits observation.

5.4.4. Contingencies

The suggestions above assume that the current import tariff and data protection frameworks remain broadly stable. If major policy changes occur (e.g., tariff elimination or drastic revision of data protection rules), the relevance of these suggestions would need to be re-evaluated. Alternative policy instruments – such as local content requirements, export credits, or voluntary data certification schemes – could be considered if the suggested approaches prove infeasible.

Finally, the findings suggest that firms operating in similar emerging markets may benefit from prioritising adaptive product design, rapid market feedback mechanisms, and localised knowledge integration. While institutional collaboration (IC) showed a weaker effect in this study ($\beta = 0.174$), it may become more important as regulatory environments mature and formal institutions strengthen.

6. Conclusion

This paper examines the economic and regulatory drivers of consumer-centric product innovation among Chinese smartphone manufacturers in Nigeria, serving as a proxy for Anglophone West African countries, and reveals how disruptive and frugal innovation theories intersect with local cultural, institutional, and regulatory contexts to shape technological adaptation in emerging economies. By integrating Disruptive Innovation Theory, the Triple Helix Model, and principles of frugal innovation, the findings reveal that market disruption and product adaptation are the most influential predictors of innovation performance. At the same time, institutional collaboration and knowledge transfer serve as necessary but context-dependent enablers. These results extend the boundaries of classical innovation theory by demonstrating how informal networks, cultural factors, and local regulatory nuances reshape innovation processes. The findings show that market disruption and product adaptation are the strongest predictors of innovation performance, while institutional collaboration and knowledge transfer serve as secondary, context-sensitive enablers. More importantly,

the research shows that sustainable innovation in developing societies transcends affordability and market penetration, requiring cultural co-creation, grassroots innovation networks, and responsible disruption that balances technological progress with ethical governance, data sovereignty, and social inclusion.

This study makes two primary contributions to the literature on innovation in emerging markets. First, it provides empirical evidence on the relative importance of different drivers of innovation performance in a large and underexamined market. The quantitative findings indicate that market disruption and product adaptation play dominant roles, with knowledge transfer acting as a mediating mechanism. This suggests that consumer-centric innovation in contexts characterised by infrastructural constraints and income diversity operates through these pathways. Second, the study offers a contextualised interpretation of innovation processes under institutional ambiguity. Specifically, it suggests that in environments where formal institutional support is limited or inconsistent, innovation is more strongly shaped by market-based interactions and localised learning processes. This contributes to ongoing discussions on frugal innovation, disruptive innovation, and innovation in informal economies by highlighting that governance context may act as an important boundary condition.

The present research has several limitations. The study relies on cross-sectional survey data, which limits causal inference. In addition, informal networks and data governance issues were explored qualitatively but not formally modeled. Also, considering the sample size and the geographical scope. The 60% response rate is lower than the usual 75% in the social sciences, which can lead to non-response bias. Only the two metropolitan areas of Abuja and Lagos were taken as the sample; rural and semi-urban consumers are not proportionally represented. The results are definitely restricted to Anglophone Nigeria and cannot be used for Francophone West Africa (Côte d'Ivoire, Senegal, Mali), which operates under different legal systems, has distinct consumption patterns, and has distinct informal economic structures (Asongu & Asongu, 2019). Furthermore, the cross-sectional design prevents causal inference; longitudinal research (3-5 years) would be needed to observe how innovation performance evolves with market share changes. Finally, the interview sample included only two representatives from Chinese OEMs (Transsion), leaving perspectives from Xiaomi, OPPO, and others underrepresented. Future research should incorporate a wider range of manufacturer viewpoints and objective disruption metrics (e.g., market concentration indices). Additionally, Market Disruption Measurement is based on perceived user ratings rather than market share data or pricing dynamics. The use of disruption metrics based on objective measures (such as market concentration indices and price elasticity) would strengthen the causality argument.

Further research can be done considering a Cross-Sectional Design with increased manufacturer representation. A longitudinal study is needed to observe Chinese OEMs' product development and market share over 3-5 years. Unfortunately, the conclusions drawn about manufacturer strategies cannot be applied to all Chinese firms. The interview sample only consisted of two representatives from Chinese OEMs (Transsion). Xiaomi, OPPO, and other companies are underrepresented. Also, Tariffs, data protection laws, local content mandates, regulatory bodies such as the Nigerian Communications Commission (NCC), and enforcement practices can be considered. Finally, the distribution networks of the informal sector can be analyzed using network analysis to capture the connection density between formal retailers and informal distributors.

Ethics approval and consent to participate

All methods were conducted in accordance with the guidelines and regulations of Xuzhou University of Technology. Approval for the study was obtained from the Office of Academic Affairs and the Office of Student Affairs, School of Management Engineering, Xuzhou University of Technology. All participants were over 18 years of age, and their participation in the study was entirely voluntary. Informed consent was obtained from all participants prior to completing the questionnaire, with the option to withdraw at any time before submission, and data were collected anonymously.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.iref.2026.105338.

Data availability

The data that has been used is confidential.

References

Adeyeye, M., & Iweala, O. (2020). Digitizing the urban landscape: Exploring the diffusion dynamics of Chinese mobile technology in Sub-Saharan Africa. *Information Technology for Development, 26*(3), 542–563.

Adomako, S., Amankwah-Amoah, J., & Danquah, J. K. (2022). R&D support, technological turbulence, and SMEs ' degree of internationalization: The mediating role of technological capability. *Thunderbird International Business Review, 64*(3). https://doi.org/10.1002/tie.22263. Article 3.

2024 *Annual subscriber/network data report for telecommunications operating companies in nigeria. Nigerian Communications Commission.*(2024). https://www.ncc.gov.ng/statistics-reports/industry-overview.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research, 14*(3), 396–402. https://doi.org/10.2307/3150783

Asongu, S. A., & Asongu, N. (2019). The role of mobile phones in governance-driven technology exports in Sub-Saharan Africa. *Journal of the Knowledge Economy, 10*(2), 849–867. https://doi.org/10.1007/s13132-017-0500-2

Asongu, S. A., & Nwachukwu, J. (2019). Mitigating externalities of terrorism on tourism: Global evidence from police, security officers and armed service personnel. *Current Issues in Tourism, 22*(20), 2466–2471. https://doi.org/10.1080/13683500.2018.1527825

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research, 26*(13), 1802–1811. https://doi.org/10.1177/1049732316654870

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

China Africa Research Initiative. (2024). *Chinese FDI in africa's ICT sector*. Johns Hopkins University School of Advanced International Studies.

Christensen, C. M. (1997). Marketing strategy: Learning by doing. *Harvard Business Review, 75*(6), 141–151.

Christensen, C. M. (2015). *The innovator's dilemma: When new technologies cause great firms to fail*. Harvard Business Review Press.

Christensen, C. M., McDonald, R., Altman, E. J., & Palmer, J. E. (2018). Disruptive innovation: An intellectual history and directions for future research. *Journal of Management Studies, 55*(7), 1043–1078. https://doi.org/10.1111/joms.12349

Christensen, C. M., Raynor, M., & McDonald, R. (2015). Disruptive innovation. *Harvard Business Review, 93*(12), 44–53.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Danquah, M., & Amankwah-Amoah, J. (2017). Assessing the relationships between human capital, innovation and technology adoption: Evidence from Sub-Saharan Africa. *Technological Forecasting and Social Change, 122*(September), 24–33. https://doi.org/10.1016/j.techfore.2017.04.021

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal, 5*(6), Article 00149. https://doi.org/10.15406/bbij.2017.05.00149

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy, 29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1). https://doi.org/10.1177/160940690600500107. Article 1.

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research, 48*(6pt2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Foster, C., & Azmeh, S. (2020). Latecomer economies and national digital policy: An industrial policy perspective. *Journal of Development Studies, 56*(7), 1247–1262. https://doi.org/10.1080/00220388.2019.1677886

Gagliardone, I., & Yin, M. (2022). China's digital silk road in Africa: Implications for digital rights and sovereignty. *International Journal of Communication, 16*, 1842–1863.

GSMA. (2023). The Mobile Economy 2023. *GSMA Intelligence*.

Gupta, A., & Kumar Singh, R. (2023). Managing resilience of micro, small and medium enterprises (MSMEs) during COVID-19: Analysis of barriers. *Benchmarking: An International Journal, 30*(6), 2062–2084. https://doi.org/10.1108/BIJ-11-2021-0700

Hadengue, M., Marcellis-Warin, N., & Warin, T. (2017). Reverse innovation: A systematic literature review. *International Journal of Emerging Markets, 12*(2), 142–182. https://doi.org/10.1108/IJoEM-12-2015-0272

Hossain, M. (2020). Frugal innovation: Conception, development, diffusion, and outcome. *Journal of Cleaner Production, 262*, Article 121456. https://doi.org/10.1016/j.jclepro.2020.121456

John Snow & Aly Pinder. (2023). 2023 product innovation and Aftermarket Services Global Survey. *IDC Survey, IDC Corporate*. https://www.idc.com/getdoc.jsp?containerId=US51035223.

Kshetri, N. (2017). The economics of the internet of things in the global south. *Third World Quarterly, 38*(2). https://doi.org/10.1080/01436597.2016.1191942. Article 2.

Kumar, V., Verma, P., Mittal, A., Tuesta Panduro, J. A., Singh, S., Paliwal, M., & Sharma, N. K. (2023). Adoption of ICTs as an emergent business strategy during and following COVID-19 crisis: Evidence from Indian MSMEs. *Benchmarking: An International Journal, 30*(6), 1850–1883. https://doi.org/10.1108/BIJ-11-2021-0685

Li, R., Liu, Y., & Bustinza, O. F. (2024). Cultural intelligence and user experience innovation: Insights from Chinese smartphone manufacturers in West Africa. *Journal of International Marketing, 32*(1), 64–82.

Min, H. (2023). Assessing the impact of a COVID-19 pandemic on supply chain transformation: An exploratory analysis. *Benchmarking: An International Journal, 30*(6), 1765–1781. https://doi.org/10.1108/BIJ-04-2022-0260

Ojanperä, S., Graham, M., & Zook, M. (2019). The digital knowledge economy index: Mapping content production. *Journal of Development Studies, 55*(12), 2626–2643. https://doi.org/10.1080/00220388.2018.1554208

Radjou, N., & Prabhu, J. (2015). *Frugal Innovation: How to do more with less*. Public Affairs.

Sheth, J. N., Sisodia, R. S., & Sharma, A. (2000). The antecedents and consequences of customer-centric marketing. *Journal of the Academy of Marketing Science, 28*(1), 55–66. https://doi.org/10.1177/0092070300281006.

Sun, Y., Gao, P., Tian, W., & Guan, W. (2023). Green innovation for resource efficiency and sustainability: Empirical analysis and policy. *Resources Policy, 81*(C). https://doi.org/10.1016/j.resourpol.2023.103369

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

United Nations. (2022). 2022 global Multidimensional Poverty Index (MPI). In *Human development reports*. United Nations. https://hdr.undp.org/content/2022-global-multidimensional-poverty-index-mpi.

Varma, D., & Dutta, P. (2023). Restarting MSMEs and start-ups post COVID-19: A grounded theory approach to identify success factors to tackle changed business landscape. *Benchmarking: An International Journal, 30*(6), 1912–1941. https://doi.org/10.1108/BIJ-09-2021-0535

Wang, F., & Kimari, W. (2018). New ICT strategies for African development. *Development Southern Africa, 35*(3), 271–284.

Xiao, J., & Bao, Y. (2022). Partners' knowledge utilization and exploratory innovation: The moderating effect of competitive and collaborative relationships. *International Journal of Operations & Production Management, 42*(9), 1356–1383. https://doi.org/10.1108/IJOPM-08-2021-0517