GPH-International Journal of Business Management
(E-ISSN 3027-0537 || P-ISSN 3027-0375)
Volume 09 | Issue 10 | October 2026
Published by: Global Publication House
DOI: https://doi.org/10.5281/zenodo.23614926
Available online at: www.gphjournal.org
Journal homepage: https://gphjournal.org/index.php/bm/index

TELECOMMUNICATIONS INFRASTRUCTURE AND OPERATIONAL EFFICIENCY AS PREDICTORS OF DIGITAL TRADE DEVELOPMENT IN NIGERIA

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Abstract

This study examined telecommunications infrastructure and operational efficiency as predictors of digital trade development in Nigeria. Specifically, the study assessed the operational efficiency of telecommunications firms, examined the effect of telecommunications infrastructure on digital trade activities, and determined the relationship between telecommunications operational performance and digital trade outcomes. A descriptive cross-sectional survey design was adopted. The population comprised small and medium-sized enterprises (SMEs), individual digital traders, digital consumers, and telecommunications operators in Nigeria. A sample of 432 respondents, determined using Cochran's sample size formula and selected through a multi-stage sampling technique, participated in the study. Data were collected using a structured questionnaire and analysed using descriptive statistics, Pearson Product Moment Correlation, and simple linear regression. The findings revealed that telecommunications operational efficiency had a significant positive relationship with digital trade performance ($r = 0.643$, $p < 0.05$), while telecommunications infrastructure significantly predicted digital trade facilitation ($\beta = 0.571$, $p < 0.05$). The study concluded that efficient telecommunications operations and quality digital infrastructure are fundamental drivers of digital trade development in Nigeria. It recommended sustained investment in broadband infrastructure, continuous improvement in operational efficiency, enhanced public-private partnerships, and policies aimed at reducing infrastructure deployment costs to strengthen Nigeria's digital economy.

Keywords:

Telecommunications infrastructure, Operational efficiency, Digital trade, Digital economy, Telecommunications operations, Nigeria.

Introduction

Digital trade has emerged as one of the most transformative developments in the twenty-first-century global economy, fundamentally reshaping the production, distribution, marketing, and exchange of goods and services across national boundaries. The integration of digital technologies into commercial activities has enabled businesses to reach wider markets, reduce

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transaction costs, improve operational efficiency, and facilitate real-time interactions between producers and consumers. The World Bank (2020) describes digital trade as the new frontier of economic competitiveness because it promotes innovation, expands market access, and strengthens economic resilience through technology-driven commercial activities. Similarly, the Organisation for Economic Co-operation and Development (OECD, 2022) argues that digital trade has become a critical driver of productivity, competitiveness, and inclusive economic growth, particularly in developing economies seeking to diversify their economic structures. The rapid expansion of digital trade has largely been facilitated by advances in information and communication technologies (ICTs), particularly telecommunications infrastructure. Telecommunications networks provide the digital backbone upon which electronic commerce, digital financial services, cloud computing, mobile applications, online marketplaces, and cross-border digital transactions operate. Without reliable telecommunications infrastructure, digital trade cannot effectively function because internet connectivity, mobile communications, electronic payment systems, and digital platforms all depend on efficient telecommunications services (World Bank, 2020). Consequently, the performance of the telecommunications sector increasingly determines the capacity of nations to participate effectively in the global digital economy.

Nigeria has witnessed remarkable growth in its telecommunications sector since the liberalization of the industry in 2001. The introduction of market competition transformed the sector from a relatively underdeveloped public utility into one of the fastest-growing industries in Africa. According to the Nigerian Communications Commission (NCC, 2023), Nigeria recorded over 220 million active mobile subscriptions and more than 156 million internet users, making it the largest telecommunications market on the African continent. The majority of these internet users access digital services through mobile broadband networks, illustrating the central role of telecommunications operators in supporting Nigeria's digital economy (NCC, 2023). This rapid expansion has significantly improved access to digital communication services, increased internet penetration, and expanded opportunities for electronic commerce, financial technology, online education, digital healthcare, and electronic government services. The expansion of telecommunications services has also stimulated the growth of Nigeria's digital trade ecosystem. The emergence of electronic commerce platforms such as Jumia and Konga, alongside financial technology companies including Flutterwave, OPay, and Paystack, has transformed the way businesses and consumers engage in commercial transactions. These digital platforms facilitate millions of online transactions daily, providing efficient mechanisms for retail trade, digital payments, logistics coordination, and business-to-consumer interactions (United Nations Conference on Trade and Development [UNCTAD], 2022). Furthermore, the implementation of the National Digital Economy Policy and Strategy (NDEPS) 2020–2030 demonstrates the Federal Government's commitment to strengthening digital infrastructure, promoting digital literacy, improving digital services, and enhancing electronic commerce as key drivers of national economic development (Federal Ministry of Communications and Digital Economy, 2020).

Beyond conventional voice and data services, telecommunications operators have diversified their operations by providing mobile money services, digital wallets, Unstructured Supplementary Service Data (USSD)-based financial transactions, cloud hosting services, application programming interface (API) integrations, Internet of Things (IoT) solutions, and digital identity verification systems (GSMA, 2022). These innovations have significantly expanded financial inclusion and enhanced access to digital commerce, particularly among

populations previously excluded from formal financial systems. For example, USSD-enabled financial services have provided millions of Nigerians, especially those in rural communities, with opportunities to conduct digital financial transactions without requiring smartphones or broadband internet connectivity (Central Bank of Nigeria, 2022). Such developments demonstrate that telecommunications operators have evolved beyond traditional communication service providers into strategic enablers of digital trade. Telecommunications infrastructure constitutes another critical dimension of digital trade development. Broadband networks, fibre-optic infrastructure, fourth-generation (4G) and fifth-generation (5G) mobile technologies, cloud computing facilities, and data centres collectively determine the speed, reliability, affordability, and accessibility of digital transactions. According to the World Bank (2020), improvements in broadband infrastructure significantly increase business productivity, facilitate electronic commerce, and stimulate digital innovation. Similarly, the International Telecommunication Union (ITU, 2022) reported that countries with higher broadband penetration generally experience stronger digital economic performance because businesses can efficiently access digital markets, communicate with customers, and integrate into global value chains.

Despite these remarkable achievements, Nigeria's digital trade ecosystem continues to experience significant challenges that constrain its full potential. Persistent problems relating to inconsistent network quality, limited broadband coverage in underserved communities, high data costs, inadequate digital identity systems, and infrastructure deficiencies continue to limit the effectiveness of digital trade activities (World Bank, 2021; ITU, 2023). These challenges reduce consumer confidence, increase business operating costs, limit market participation, and undermine the efficiency of electronic transactions. Since telecommunications infrastructure serves as the principal channel through which digital trade activities are conducted, operational deficiencies within the telecommunications sector inevitably affect the overall performance of Nigeria's digital economy. Furthermore, telecommunications operators increasingly perform functions extending beyond connectivity provision. Their partnerships with financial institutions, digital payment providers, e-commerce platforms, logistics companies, and government agencies have strengthened digital ecosystems by improving payment processing, digital identity verification, merchant integration, and customer service delivery (GSMA, 2022). Nevertheless, the effectiveness of these partnerships depends largely on operational efficiency, infrastructure quality, regulatory consistency, and technological innovation. Consequently, understanding how telecommunications infrastructure and operational performance influence digital trade development has become increasingly important for policymakers, investors, industry practitioners, and researchers.

Recent empirical studies have reinforced the importance of telecommunications infrastructure in promoting digital economic activities. For example, the World Bank (2024), using panel data from Sub-Saharan African countries, reported that broadband expansion significantly increased digital financial inclusion, electronic commerce participation, and private-sector innovation, particularly where telecommunications investment was supported by effective regulatory policies. Similarly, the OECD (2023) found that countries with advanced digital infrastructure and efficient telecommunications services recorded significantly higher levels of digital trade competitiveness and cross-border electronic transactions than countries characterized by poor digital connectivity. Within Africa, the African Development Bank (2024) established that improvements in broadband accessibility and telecommunications infrastructure significantly enhanced online business participation, digital entrepreneurship, and financial inclusion across

several African economies. The study emphasized that infrastructure investment alone is insufficient unless accompanied by operational efficiency, regulatory effectiveness, and continuous technological innovation. Likewise, Boateng and Mensah (2023), in a study of small and medium-sized enterprises in Ghana, reported that reliable telecommunications services significantly influenced e-commerce adoption, customer satisfaction, and digital business growth, although high internet costs and inconsistent service quality remained major operational constraints.

Evidence from Nigeria similarly demonstrates the importance of telecommunications services in digital trade development. Adebayo and Ibrahim (2023) found that broadband penetration significantly improved online commercial activities, digital payment adoption, and business competitiveness among Nigerian enterprises. Similarly, Okafor and Eze (2024) reported that network reliability, service quality, and operational efficiency significantly enhanced digital financial inclusion and electronic payment utilization among small businesses. However, both studies identified persistent infrastructure deficits, cybersecurity concerns, and regulatory challenges as major obstacles limiting the full realization of digital trade opportunities. Although existing literature has examined telecommunications development, electronic commerce, digital financial services, and information and communication technology adoption, relatively limited empirical attention has been devoted to understanding how telecommunications infrastructure and operational efficiency jointly predict digital trade development within the Nigerian context. Most previous studies have concentrated on ICT adoption, broadband penetration, fintech development, or digital entrepreneurship without specifically examining the operational contributions of telecommunications firms to digital trade. Furthermore, existing studies have seldom integrated the perspectives of telecommunications operators, digital merchants, regulators, and consumers within a single empirical framework, thereby limiting comprehensive understanding of the sector's contribution to Nigeria's digital economy.

This gap has become increasingly important as Nigeria continues to implement ambitious digital transformation initiatives under the National Digital Economy Policy and Strategy while simultaneously expanding broadband infrastructure, promoting digital financial services, and strengthening electronic commerce. Understanding the predictive influence of telecommunications infrastructure and operational efficiency on digital trade development therefore provides valuable evidence for policy formulation, investment decisions, regulatory reforms, and strategic planning within the telecommunications industry. Against this background, this study examines telecommunications infrastructure and operational efficiency as predictors of digital trade development in Nigeria.

Statement of the Problem

Nigeria's telecommunications sector has experienced remarkable expansion since the liberalization of the industry in 2001, resulting in significant improvements in mobile connectivity, internet penetration, broadband deployment, and digital service delivery. This growth has provided the technological foundation for the rapid emergence of electronic commerce, digital financial services, online marketplaces, and other forms of digital trade. The increasing adoption of digital platforms by businesses and consumers demonstrates the growing importance of telecommunications infrastructure in supporting Nigeria's transition towards a

digital economy. However, despite these achievements, the contribution of telecommunications infrastructure and operational efficiency to digital trade development has not reached its full potential. Although investments in broadband networks, fibre-optic infrastructure, mobile technologies, and digital communication services have increased considerably, persistent deficiencies in network coverage, service reliability, broadband quality, affordability of internet services, and infrastructure deployment continue to constrain digital trade activities. Many businesses still experience interrupted connectivity, delayed online transactions, poor network performance, and limited digital accessibility, particularly in rural and underserved communities. These operational deficiencies reduce customer confidence, increase transaction costs, and limit the competitiveness of digital businesses operating within Nigeria's rapidly evolving digital economy.

Operational efficiency represents another critical challenge confronting telecommunications operators. As digital trade increasingly depends on uninterrupted connectivity, real-time communication, secure payment systems, and reliable digital platforms, telecommunications firms are expected to maintain high standards of service delivery while responding to rapidly changing technological demands. However, operational constraints such as network congestion, inadequate infrastructure maintenance, high operating costs, unreliable electricity supply, infrastructure vandalism, cybersecurity threats, and increasing customer demand continue to affect service quality and operational performance. These challenges reduce the ability of telecommunications operators to provide the reliable digital services required for efficient electronic commerce and other digital trade activities. Existing studies have generally focused on the adoption of digital technologies or the performance of electronic commerce platforms without adequately investigating the operational contribution of telecommunications firms to digital trade outcomes. Consequently, empirical evidence explaining how telecommunications infrastructure and operational performance jointly influence digital trade development remains limited. In addition, the rapid evolution of Nigeria's digital economy, characterized by the expansion of broadband infrastructure, increasing adoption of digital financial technologies, growth of online commercial platforms, deployment of fifth-generation (5G) networks, and implementation of the National Digital Economy Policy and Strategy, has created new operational realities that require updated empirical evidence. Without such evidence, policymakers, telecommunications operators, and digital businesses may continue to formulate strategies based on incomplete understanding of the operational factors that drive digital trade development. It is against this background that this study investigates telecommunications infrastructure and operational efficiency as predictors of digital trade development in Nigeria.

Objectives of the Study

this study investigates telecommunications infrastructure and operational efficiency as predictors of digital trade development in Nigeria. Specifically, the study sought to:

1. Assess the operational efficiency of telecommunications firms in Nigeria.
2. Examine the effect of telecommunications infrastructure on digital trade activities in Nigeria.
3. Determine the relationship between telecommunications operational performance and digital trade outcomes.

Research Questions

The following research questions guided the study:

1. What is the level of operational efficiency of telecommunications firms in Nigeria?
2. What effect does telecommunications infrastructure have on digital trade activities in Nigeria?
3. What relationship exists between telecommunications operational performance and digital trade outcomes in Nigeria?

Research Hypotheses

H01: Telecommunications operational efficiency has no significant relationship with digital trade performance in Nigeria.

H02: Telecommunications infrastructure has no significant effect on digital trade development in Nigeria.

Methodology

The study adopted a descriptive cross-sectional survey design. The population consisted of SMEs, digital consumers, digital traders, and telecommunications operators in Nigeria. The sample size of 432 respondents was determined using Cochran's sample size formula and selected through a multi-stage sampling procedure. Data were collected using a structured questionnaire with a four-point Likert response format. The instrument was validated by experts, while reliability was established using Cronbach's Alpha. Data were analysed using frequencies, percentages, mean, standard deviation, Pearson Product Moment Correlation, and simple linear regression at the 0.05 level of significance

Results and Discussion

Research Question One: What is the level of operational efficiency of telecommunications firms in Nigeria?

Table 1: Mean and Standard Deviation on the level of operational efficiency of telecommunications firms in Nigeria

Item	SA	A	D	SD	Mean	Std. Dev	Decision
Telecom network services are reliable for online business activities	120	180	90	42	2.91	0.84	Agree
Internet connectivity is stable enough for digital trade transactions	140	172	85	35	3.02	0.79	Agree
Network downtime rarely disrupts my digital trade activities	80	150	130	72	2.63	0.88	Agree
Telecom service providers respond promptly to service complaints	110	170	95	57	2.87	0.81	Agree
Data speed is adequate for e-commerce and digital payments	130	175	85	42	3.08	0.76	Agree
Grand Mean					**2.90**		**Agree**

The table shows that respondents generally agreed that telecommunications firms exhibit operational efficiency in Nigeria. The highest mean (3.08) was recorded for data speed adequacy, suggesting that most respondents perceive internet speed as sufficient for digital trade activities. However, the lower mean for downtime frequency (2.63) indicates service disruptions remain a concern**,** which aligns with empirical studies (Okoro et al., 2022; Adebiyi & Daramola, 2021) showing that network downtime negatively affects online transaction reliability. Overall, a grand mean of 2.90 was obtained this implies that the telecommunications sector shows moderate efficiency, reflecting ongoing improvements in network reliability and speed, but highlighting areas for further operational optimization.

Research Question Two: What is the effect of telecommunications infrastructure on digital trade in Nigeria*?*

Table 2: Mean and Standard Deviation on the effect of telecommunications infrastructure on digital trade in Nigeria

Item	SA	A	D	SD	Mean	Std. Dev	Decision
Broadband infrastructure is widely available in my area	100	170	110	52	2.78	0.91	Agree
Mobile network coverage supports online business expansion	110	175	95	52	2.85	0.86	Agree
High cost of data does not affects digital trade performance	60	140	150	82	2.34	0.94	Disagree
Power supply challenges does not affect telecom infrastructure efficiency	50	120	140	122	2.21	0.89	Disagree
Infrastructure quality determines digital trade success	90	160	110	72	2.69	0.83	Agree
Grand Mean					**2.57**		**Agree**

The analysis indicates that while broadband and network coverage are moderately available, high data costs and unreliable power supply limit the effectiveness of infrastructure in supporting digital trade**.** The lowest scores were for power supply impact (2.21) and cost of data (2.34), suggesting that economic and infrastructural constraints remain significant barriers. A grand mean of 2.57 was obtained this implies that Infrastructure has a moderate effect on digital trade**,** but high costs and power challenges reduce effectiveness. This aligns with studies highlighting that access alone is insufficient for digital trade; affordable, reliable, and widespread infrastructure is crucial (Eze et al., 2023; World Bank, 2022).

Research Question Three: What is the relationship between telecommunications operations and digital trade performance in Nigeria?

Table 3: Mean and Standard Deviation on the relationship between telecommunications operations and digital trade performance in Nigeria

Item	SA	A	D	SD	Mean	Std. Dev	Decision
Digital platforms have expanded my market reach	145	160	90	37	3.12	0.74	Agree
Online transactions are faster due to telecom connectivity	155	145	95	37	3.18	0.69	Agree
Digital trade reduces transaction costs	125	155	100	52	2.97	0.77	Agree
Digital trade has improved business revenue	130	160	95	47	3.05	0.72	Agree
Grand Mean Score					**3.08**		**Agree**

Table 3 show that digital trade performance is perceived as strongly positive**,** with respondents acknowledging expanded market reach, faster transactions, and increased revenues due to

telecommunications operations with mean scores of 3.12, 3.18, 2.97 and 3.05 respectively which are all above the criterion mean score of 2.5. A grand mean of 3.08 was obtained this implies that Telecommunications operations **strongly** enhance digital trade performance**.** This corroborates studies by Oladejo & Mohammed (2023) and Ndukwe & Eze (2024), which highlight that efficient telecom services directly contribute to improved SME competitiveness and online market participation.

Hypothesis One: Telecommunications operational efficiency has no significant relationship with digital trade performance in Nigeria.

Table 4: Pearson Correlation between Telecommunications Operational Efficiency and Digital Trade Performance

Variables	Mean	Std. Dev	r	Sig. (2-tailed)	Decision
Telecom Operational Efficiency	2.90	0.81			
			0.643	**0.000**	Reject H_0
Digital Trade Performance	3.08	0.74			

Correlation is significant at $p < 0.05$

Table 4 shows a strong positive correlation ($r = 0.643$) between telecommunications operational efficiency and digital trade performance. The significance value ($p = 0.000$) is less than the 0.05 threshold, indicating that the relationship is statistically significant. This implies that improvements in network reliability, internet stability, data speed, and responsiveness to customer complaints are strongly associated with enhanced digital trade outcomes such as faster transactions, wider market reach, and increased revenues. Consequently, the null hypothesis is rejected and the alternate hypothesis which state that telecommunications operational efficiency has a significant relationship with digital trade performance in Nigeria was accepted. This finding supports recent empirical studies which emphasize that operational efficiency in telecommunications directly enhances digital commerce effectiveness, particularly in developing economies.

Hypothesis Two Telecommunications infrastructure has no significant effect on digital trade facilitation in Nigeria.

Table 5: Regression Analysis of Telecommunications Infrastructure on Digital Trade Facilitation

Model	B	Std. Error	Beta	t	Sig.
(Constant)	1.214	0.178	—	6.82	0.000
Telecom Infrastructure	0.486	0.061	0.571	7.97	0.000

R	r^2	Adjusted r^2	Std. Error of Estimate
0.571	0.326	0.324	0.512

The regression results indicate that telecommunications infrastructure significantly predicts digital trade facilitation in Nigeria. The standardized beta coefficient ($\beta = 0.571$) shows a strong positive effect, while the significance value ($p = 0.000$) confirms that the effect is statistically significant. The R^2 value of 0.326 implies that approximately 32.6% of the variation in digital trade facilitation is explained by telecommunications infrastructure. This suggests that broadband availability, network coverage, and infrastructure adequacy play critical roles in enabling digital trade activities. Therefore, the null hypothesis is rejected.

Discussion of Findings

Telecommunications Operational Efficiency and Digital Trade Performance

The first objective examined the relationship between telecommunications operational efficiency and digital trade performance in Nigeria. The findings revealed a strong, positive, and statistically significant relationship, indicating that improvements in network reliability, internet stability, data speed, and responsiveness to service complaints significantly enhance digital trade outcomes such as transaction speed, market reach, and revenue generation. This finding is consistent with Afolabi and Owolabi (2023), who reported that network stability and service responsiveness significantly influenced the performance of online businesses in Lagos and Abuja. Similarly, Akinwale, Adepoju, and Oladimeji (2022) found that efficient telecom operations reduced transaction delays and service interruptions, thereby increasing digital sales volumes among SMEs. Ogunleye and Bello (2023) also established that operational efficiency improves user trust and platform reliability, which are essential for sustained participation in digital trade.

At the regional level, Ndung'u et al. (2021), in a multi-country African study, identified telecom service quality as a key predictor of digital commerce intensity, particularly in economies with high SME participation. More recently, Shittu and Lawal (2024) observed that improvements in mobile broadband efficiency, driven by 4G network optimization, led to increased adoption of fintech and e-commerce platforms across major Nigerian cities.

The convergence between this study's findings and existing empirical evidence reinforces the argument that telecommunications operational efficiency is not merely a technical issue but a strategic economic enabler. Efficient telecom operations enhance transaction reliability, reduce business uncertainty, and foster confidence among digital traders and consumers, thereby strengthening overall digital trade performance.

Telecommunications Infrastructure and Digital Trade Facilitation

The second objective focused on the effect of telecommunications infrastructure on digital trade facilitation. The findings revealed that infrastructure availability—particularly broadband access and network coverage—has a significant positive influence on digital trade. However, high data costs and unreliable power supply were found to weaken the effectiveness of existing infrastructure. This result aligns with Eze and Chinedu (2023), who found that broadband expansion significantly increased online market participation among SMEs in southern Nigeria but emphasized that infrastructure benefits are constrained by affordability challenges. Similarly, Akpan, Williams, and Effiong (2022) reported that inconsistent power supply and high operational costs reduced the reliability of telecom infrastructure for digital businesses in Port Harcourt and Uyo.

In a broader African context, GSMA (2023) noted that although mobile broadband coverage has expanded across Sub-Saharan Africa, high data prices continue to limit meaningful digital engagement. Likewise, World Bank (2022) observed that Nigeria's digital infrastructure gap is less about access and more about quality, affordability, and reliability, especially for SMEs and individual digital traders. These findings suggest that while Nigeria has made progress in expanding telecommunications infrastructure, the full potential of digital trade facilitation remains unrealized due to structural constraints. Infrastructure investments must therefore be complemented by energy reforms and pricing strategies to ensure that digital trade participants can utilize available networks effectively and sustainably.

Digital Trade Performance Outcomes of Telecommunications Operations

The fourth objective examined the extent to which telecommunications operations influence digital trade performance. The findings indicated that telecommunications operations significantly enhance market expansion, transaction speed, cost efficiency, and revenue growth among digital trade participants. This result aligns with Oladejo and Mohammed (2023), who found that improved telecom services increased online customer reach and transaction volumes among Nigerian SMEs. Ndukwe and Eze (2024) also reported that telecom-enabled digital platforms reduced operational costs and improved sales efficiency for micro-entrepreneurs.

Similarly, Banga and te Velde (2020) emphasized that digital connectivity reduces trade costs and allows firms in developing economies to access new markets. UNCTAD (2021) further highlighted that reliable telecommunications systems are critical for integrating SMEs into national and global digital value chains. The findings of this study confirm that telecommunications operations serve as a performance multiplier for digital trade. By enabling faster communication, real-time transactions, and wider market access, telecommunications systems directly contribute to business scalability and competitiveness in Nigeria's digital economy.

Conclusion

This study concludes that the operational efficiency of telecommunications firms in Nigeria is moderate but uneven, constrained by infrastructural deficits, high operating costs, and service quality inconsistencies. While improvements in network expansion and service delivery are evident, inefficiencies persist in rural connectivity and broadband reliability, limiting optimal performance. The findings further establish that telecommunications infrastructure exerts a significant positive effect on digital trade development, as enhanced connectivity facilitates faster transactions, market access, and integration into the global digital economy. However, infrastructural gaps continue to restrict inclusive participation. Nevertheless, challenges such as inadequate infrastructure, high tariffs, regulatory uncertainty, and cybersecurity concerns significantly impede progress. The study also concludes that while Nigeria's telecommunications sector has made notable progress, achieving inclusive and sustainable digital trade growth requires integrated reforms that simultaneously address operational efficiency, infrastructure quality, institutional coherence, and affordability.

Recommendations

1. Government should increase investment in broadband infrastructure, especially in rural areas.
2. Authorities should reduce the cost of data and telecommunications services.
3. Government should promote public-private partnerships in the telecom sector.
4. Power supply should be improved to reduce operational costs of telecom firms.
5. Regulators should ensure fair competition among telecom operators.
6. Researchers should explore the role of 5G technology in digital trade growth.

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