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Challenges in Scaling Logistics Start-Up Enterprises in the Niger Delta Region of Nigeria

[*1.] Allagoa, Theophilus and [2.] Sarah I. Daminabo
[1].Niger Delta Development Commission, Plot C5/C6 Eastern By-Pass Marine Base, Port Harcourt Rivers State.

[2.] Centre for Logistics and Transport Studies, Faculty of Social Sciences, University of Port Harcourt, Rivers State.Nigeria

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Abstract: *Logistics start-ups in resource-rich but infrastructure-poor regions must scale on physical and digital networks they do not control. This study examined (i) the infrastructural factors constraining logistics start-ups and (ii) the role of technology adoption in a security-constrained operating environment in the Niger Delta region of Nigeria. A cross-sectional survey was administered through multi-stage sampling in the Port Harcourt, Warri and Uyo logistics hubs; 392 of 400 questionnaires were retrieved from haulage firms, courier start-ups, fleet operators, warehouse and freight handlers and transport workers. Responses to ten four-point Likert items were analysed with descriptive statistics, one-sample t-tests against the scale midpoint (2.50), Spearman rank correlation and rank-based multiple regression. Road-network inadequacy was the most strongly endorsed infrastructural constraint (mean = 3.29; 84.7% agreement), followed by poor sanitation (3.26), insufficient public service centres (3.17) and unreliable power and connectivity (2.91). Theft, vandalism and cargo diversion were rated a significant risk by 82.4% of respondents, while only 43.4% reported that GPS or electronic surveillance is commonly used and 41.8% were confident about regional logistics security. Both composites exceeded the midpoint (infrastructure: mean = 3.02, $t = 20.15$; technology and security: mean = 2.84, $t = 15.51$; both $p < 0.001$). The technology–security composite correlated weakly with infrastructure ($\rho = 0.102$, $p = 0.044$) and with a market-constraint index ($\rho = 0.139$, $p = 0.006$), but infrastructure did not predict the index. The evidence points to an infrastructure–technology–security nexus in which technology is partial, adopted defensively and conditioned by power and connectivity. Policy priorities include ring-fenced corridor maintenance, decentralised energy access, multimodal development and subsidised, security-oriented technology adoption supported by community-based protocols.*

Keywords: Logistics start-ups; infrastructure; technology adoption; cargo security; Niger Delta; Nigeria

INTRODUCTION

The logistics systems available to young firms determine how accessible their target markets are to them at an affordable cost. The World Bank 2023 Logistics Performance Index measures trade logistics in 139

countries and considers infrastructure availability, quality of services and tracking as separate yet interrelated factors affecting performance (Arvis et al., 2023). However, in sub-Saharan Africa, there is unequal access to infrastructure. Research into the World Bank Informal Enterprise Surveys in 12 African countries found a negative relationship between poor infrastructure availability and frequent interruptions to infrastructure availability and enterprise performance (Mbedzi & Kapingura, 2023). A lack of electricity availability causes disproportionate losses to small firms, as they do not have backup capacity and cannot compensate for power cuts. (Osei-Gyebi & Dramani, 2023).

Nigeria provides an example. With freight mostly being transported by road, the Lagos-Kano corridor demonstrates that most operational factors show rail does not perform as well as road, due to shippers' demand for more rapid and faster transport options (Daramola, 2022). However, road networks are often a costly and time-consuming factor. A survey study was conducted within Lagos, which found that infrastructure and related operational factors are key contributing factors to sustainable road freight operations (Odesanya & Olorunfemi, 2025). Haulage costs and productivity have been shown to affect the effectiveness of service delivery for a logistics company within Nigeria (Ogbeide, 2024). Transport services impact the availability of high-quality workers (Aderemi et al., 2024).

Technology is often suggested as a partial alternative to poor physical systems. Adoption of technology has been positively associated with supply chain innovation and performance within SMEs (Jam et al., 2025). A large sample study found that the relationship between adoption of technology and innovation within the Vietnamese logistics industry was dependent on the performance measure used (Nguyen et al., 2024). Reviews of digital adoption within supply chains have highlighted that adoption of technology is context-specific (Jiang et al., 2024). However, within South African SMEs, it was found that logistics information technology did not directly improve product availability. Instead, there were indirect benefits to performance within distribution channels through relationships within the network (Dakora, 2025). Finally, within an environment where cargo theft and kidnapping occur, technology adoption can have an impact on security. Insecure environments have been associated with unstable workforces and decreased industrial competitiveness within Nigeria (Onwuka & Achebe, 2025). Recent evidence suggests that security at a firm level may not be enough; however, there is a strong association between security at a community level and SME performance (Odesola, 2025).

Two theoretical lenses are used to analyse the factors. The resource-based view suggests that infrastructure is a fundamental factor, an external resource that constrains the extent of firms' internal capabilities. The T-O-E framework suggests that there are three factors to consider when making decisions about technology adoption: technology attributes, firm capabilities and environmental factors such as power, connectivity and security (Jam et al., 2025). Therefore, implications for logistics start-ups would be that they should consider infrastructure shortcomings and security risks when deciding whether to adopt technology. They should also decide how to use technology based on these factors. Benefits of technology will depend on the surrounding environment.

However, there are still three gaps that have not been addressed. Firstly, the Nigerian evidence is mostly based on Lagos or individual companies. There is little literature regarding the freight and last-mile

demands encountered by logistics start-ups in the Niger Delta. Secondly, infrastructure and technology are often approached separately. Digital technology relies on electricity and connections. Lastly, the relationship between technology and security has rarely been explored from the perspective of the start-up operator. The objective of this research is to (i) identify and prioritise the infrastructure constraints faced by logistics start-ups in the Niger Delta and (ii) assess the influence of technology adoption and security on start-up performance. Two hypotheses were tested: H1: The perceived infrastructure constraints are greater than the neutral point. H2: Perceived technology and security differ from the neutral point and are positively correlated with perceived infrastructure constraints and market constraint index.

THE STUDY AREA

The study was conducted in the Niger Delta region of southern Nigeria, focusing on three metropolitan logistics hubs: Port Harcourt (Rivers State), Warri (Delta State) and Uyo (Akwa Ibom State). These hubs were selected purposively because they combine seaport access, oil and gas service demand, inter-state trade and a high concentration of haulage, courier and fleet enterprises. Within each state, one senatorial district was drawn at random, and five local government areas with significant transport and logistics activity were then selected purposively, giving 15 local government areas in total. The region is characterised by extensive wetlands and creeks, a road network that is heavily used by freight, and a persistent security challenge for cargo movement; these features make it a demanding test case for the scaling of young logistics firms.

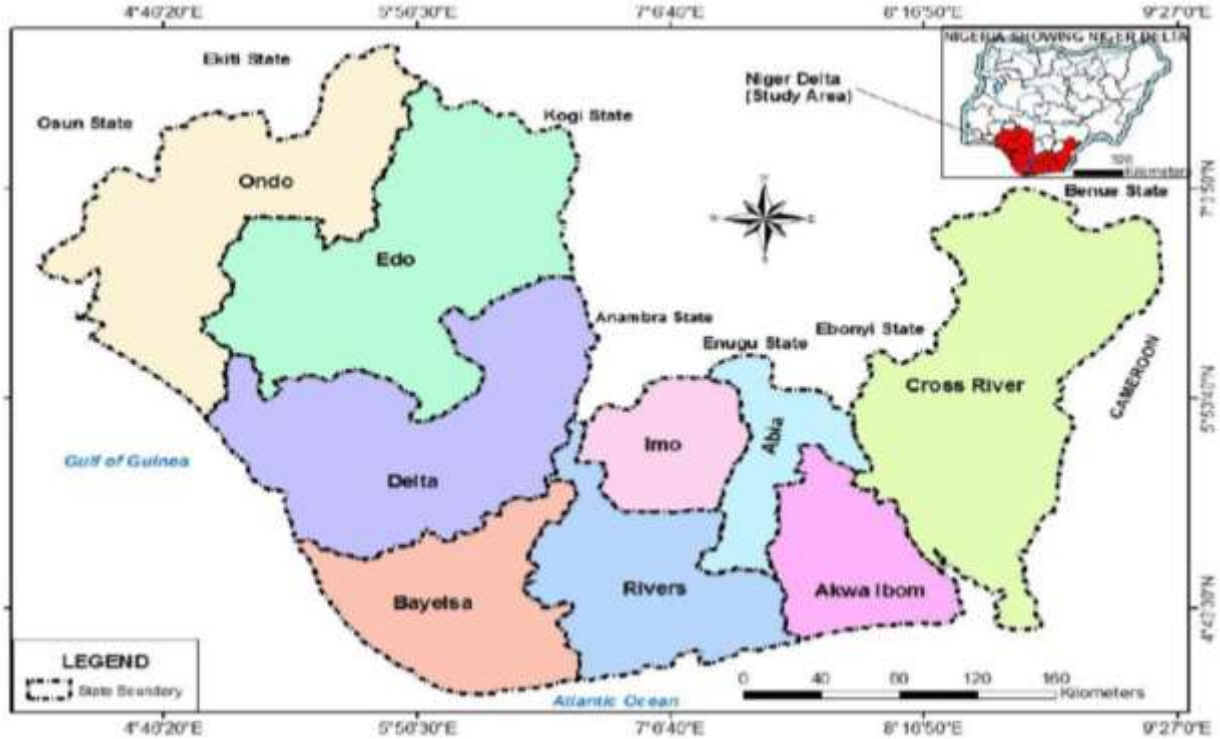


Figure 1: Map Showing the Nine Niger Delta States
Source: ResearchGate http://share.google/zdLzM1fnxOdQaMuv

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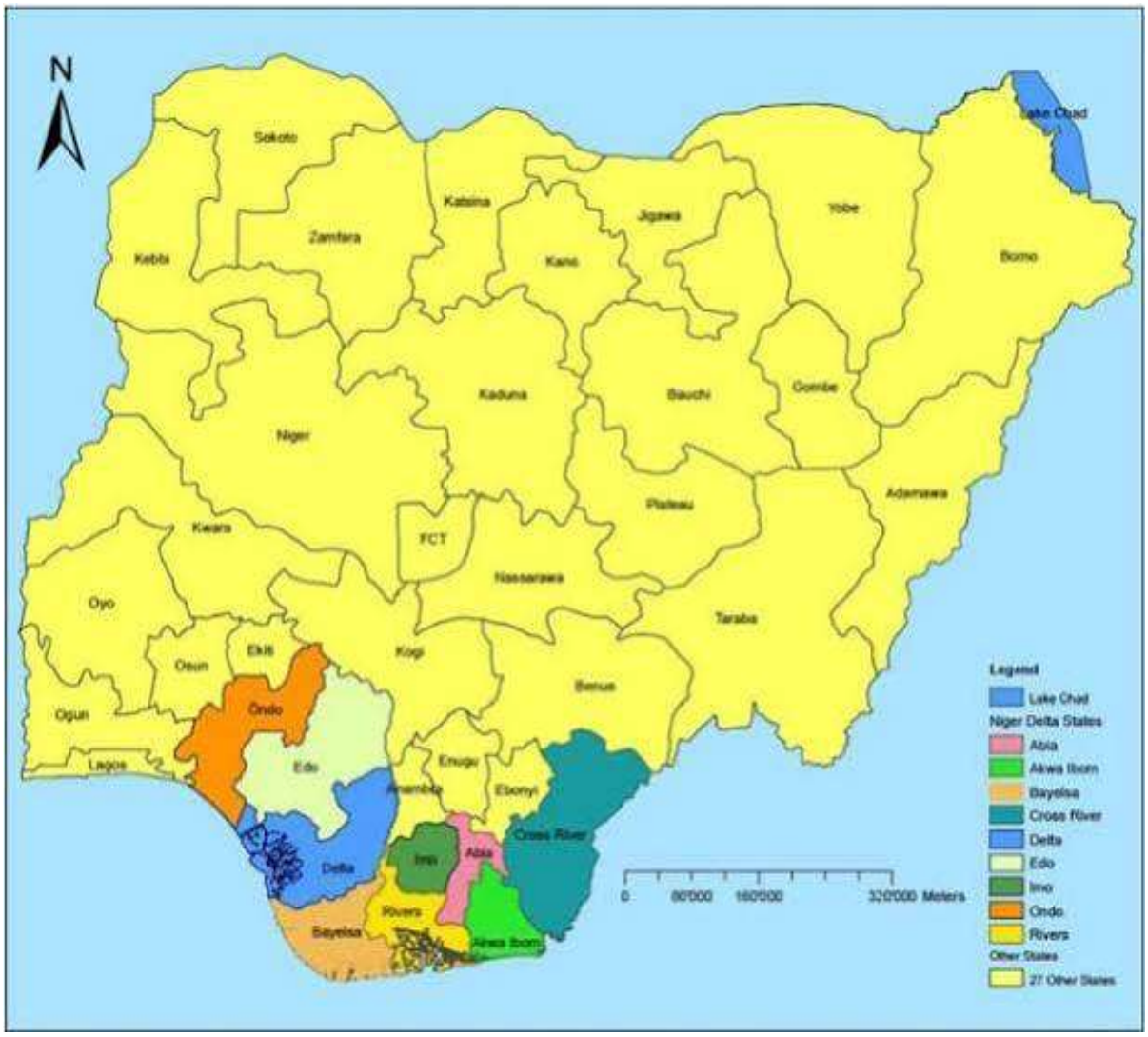


Figure 2: Showing the Strategic Logistical Locations of the Niger Delta States in Nigeria and the Gulf of Guinea.
Source: GIS Lab, Department of Urban & Regional Planning, Rivers State University, 2022

MATERIALS AND METHODS

Design, sampling and respondents

A cross-sectional survey design was adopted. The target population of transport and logistics operators in the three states was estimated at 219,000, obtained by proportional extrapolation from national micro-enterprise statistics because no complete register of operators exists. Applying Yamane's formula at a 5% margin of error gave an indicative sample of about 400. Four hundred questionnaires were administered by the researcher and trained field assistants; 392 were retrieved and usable (98.0%), six having been lost

and two mutilated. Because the sampling frame was estimated rather than enumerated, the sample should be regarded as purposive-stratified rather than statistically representative of all operators.Respondents were drawn from five operator groups (Table 1). Owners and founders accounted for 34.9% of the sample, managers for 25.3% and operations officers for 22.4%; 53.1% had more than five years of sector experience, and 76.8% held at least an HND or first degree.

Table 1: Profile of respondents (*n* = 392)

Characteristic	Frequency	Percentage (%)
Fleet operators	88	22.4
Courier/delivery services	87	22.2
Transport workers	86	21.9
Logistics and haulage firms	76	19.4
Warehouse/freight handlers	55	14.0
Position		
Owner/founder	137	34.9
Manager	99	25.3
Operations officer	88	22.4
Experience		
Less than 2 years	49	12.5
2–5 years	135	34.4
6–10 years	129	32.9
More than 10 years	79	20.2

Note: Sector groups sum to 100%; position and experience are shown selectively (owner/founder, manager, operations officer; four experience bands).
Source: Field survey, 2026

Instrument, reliability and measures

Data were collected with a structured questionnaire of 27 closed items on a four-point scale (1 = strongly disagree to 4 = strongly agree). Face and content validity were established through review by logistics and research-methods experts. Test–retest reliability on a subset of respondents was r = 0.72, and internal consistency was assessed with split-half (Spearman–Brown) and Cronbach's alpha procedures. This article uses ten items: five on infrastructure (B1–B5) and five on technology and security (B14–B18). The wording of each item is given in Tables 2 and 3. Item means and the composite means of each block were computed, and a mean above 2.50 was read as net agreement with the statement.

Data analysis

Descriptive statistics (mean, standard deviation, percentage agreement) were computed for each item. H1 and H2 were tested with one-sample *t*-tests of each composite against the scale midpoint of 2.50, reported with Cohen's *d* and 95% confidence intervals. Although Likert items are ordinal, simulation evidence indicates that the *t*-test performs comparably to rank-based tests when samples are large, around 200 or more (Şimşek, 2023); the relational analysis nevertheless used Spearman's rank correlation and an

ordinary least squares regression on rank-transformed variables, with the market-constraint index (MCI, the mean of items B24–B26, higher values indicating stronger constraint) as the outcome. Significance was judged at $p < 0.05$, two-tailed. An important interpretive point is that the technology–security block mixes one risk statement (B14) with four protective or adoption statements (B15–B18). Composite results for that block are therefore interpreted together with item-level results and a valence-aligned protection score (mean of B15–B18).

Ethical considerations

The survey followed guidelines set by the Ethical Committee on Research of the University of Port Harcourt. Ethical approval was obtained prior to data collection, and participants were allowed to withdraw at any time. Informed consent was obtained, and no personal data is presented in the data. The data were collected following guidelines given by the Nigeria Data Protection Regulation.

RESULTS AND DISCUSSION

Infrastructural constraints

Table 2 shows that four out of the five infrastructure statements were positively endorsed. The statement regarding the lack of a good road network had the highest mean and standard deviation (Mean 3.29, SD 0.88). 84.7% of respondents agreed or strongly agreed that poor road networks increase delivery times and costs. It was also highly endorsed that poor sanitation infrastructure exists (82.7%), there are not enough public service centres (78.6%), and that inadequate electricity, power and internet connections hinder processes (65.1%). The only statement that was negatively endorsed was the extent to which the government have made efforts to repair the road networks (Mean 2.46). 42.1% agreed that there are not enough efforts being made compared to 57.9% who disagreed. Overall, the infrastructure score was fairly positive (Mean 3.02, SD 0.51) with 70.6% agreeing.

Table 2: Descriptive statistics for infrastructural constraints (n = 392)

Item	Mean	SD	Disagree (%)	Agree (%)
B1: Poor road networks significantly increase my delivery time and costs	3.29	0.88	15.3	84.7
B2: Poor sanitation infrastructure disrupts logistics service delivery	3.25	0.92	17.4	82.6
B3: Inadequate electricity, power supply and internet connectivity hinder my operations	2.91	1.02	35.0	65.1
B4: Insufficient public service centres impede my access to essential logistics services	3.17	0.89	21.4	78.6
B5: Government road repair efforts are inadequate for my logistics needs	2.46	0.92	57.9	42.1
Composite (INFRA)	**3.02**	**0.51**	**—**	**70.6**

Note: Disagree = strongly disagree + disagree; Agree = agree + strongly agree. Scale midpoint = 2.50.
Source: Field survey,2026

The ranking is consistent with evidence that infrastructure deficiency and supply disruption depress the performance of small and informal African firms (Mbedzi & Kapingura, 2023) and that power-related disruption is especially costly for small firms (Osei-Gyebi & Dramani, 2023). It also resonates with Lagos-based findings that infrastructure-related barriers shape sustainable road freight operations (Odesanya & Olorunfemi, 2025). Two features of the Niger Delta pattern deserve emphasis. First, the dominance of road quality reflects the region's dependence on road haulage: because rail does not offer comparable speed, operators have limited modal alternatives (Daramola, 2022), so road deterioration translates directly into higher delivery time and cost, the two operating variables that most affect haulage service delivery (Ogbeide, 2024). Second, the strong endorsement of sanitation and public service centres shows that start-ups experience infrastructure as an urban service bundle rather than as roads alone; the quality of surrounding public services conditions access to workers and facilities, as suggested by evidence linking transport services to workforce quality (Aderemi et al., 2024).

The impact of this constraint will vary depending on the size of the business. Large businesses will have their own infrastructure, including depots, backup generation and security to reduce any risk created by infrastructure. Start-ups will have to rely on publicly available infrastructure. As seen within sub-Saharan Africa, small businesses are suffering from high losses due to outages (Osei-Gyebi & Dramani, 2023), as well as informal and small businesses suffering the most from poor supply (Mbedzi & Kapingura, 2023). This shows that infrastructure is creating a regressive tax on new businesses. Within the logistics industry, infrastructure is not only an input requirement but also an output requirement. Delays on roads create costs, quality issues and damage reputation, which is why the quality of roads received the highest level of agreement.

The low agreement on road-repair inadequacy should be read carefully. It does not indicate that roads are adequate, since B1 shows near-consensus on poor networks. A more plausible reading is that operators distinguish between the condition of the network and the visibility of repair effort, and that some respondents operate on corridors where intermittent rehabilitation has occurred. The result therefore suggests that the binding constraint is the cost and unreliability of the network rather than a complete absence of maintenance activity, which has implications for how maintenance should be financed and prioritised (see Section 6).

Technology adoption and security conditions

The technology and security block is shown in Table 3. Operators felt that cargo theft, vandalism and cargo diversion were a significant risk (mean 3.25, 82.4% agreement). However, there was low agreement that regional logistics security was secure (mean 2.49, 41.8% agreement), with only 43.4% agreeing that GPS and electronic monitoring systems were widely used by firms within the region. There was good agreement that security devices used provided adequate protection for their cargo and assets (77.3%, mean 3.13). In addition, 63.5% of operators had no significant losses from kidnap or cargo diversion (mean

2.81). This gave a total score of 2.84 (SD 0.43). Figure 1 shows all ten statements plotted against the centre of the scale. Figure 2 shows the complete distribution of responses for each statement.

Table 3: Descriptive statistics for technology and security items (n = 392)

Item	Mean	SD	Disagree (%)	Agree (%)
B14: Theft, vandalism and cargo diversion constitute a significant risk to my logistics operations	3.25	0.89	17.6	82.4
B15: I am confident about the level of logistics security in the Niger Delta region	2.49	0.85	58.2	41.9
B16: GPS and electronic surveillance tools are commonly used by logistics firms in this region	2.50	0.91	56.7	43.4
B17: Security devices adequately protect my cargo and logistics assets	3.13	0.98	22.7	77.3
B18: My logistics operations proceed without significant losses due to kidnapping or cargo diversion	2.81	1.08	36.5	63.5
Composite (TECH)	**2.84**	**0.43**	**—**	**61.7**

Note: B14 is a risk statement; B15–B18 are protective or adoption statements. Scale midpoint = 2.50.
Source: Field survey.

Because B14 is a risk statement and B15–B18 are protective statements, the composite conceals an important structure. The mean of the four protective items is 2.73, only modestly above the midpoint, while the risk item stands at 3.25. In substance, operators face a high and widely acknowledged threat, rely on devices that most believe are effective, but do not believe that the broader regional environment is secure or that surveillance technology is yet the norm. This pattern is consistent with the view that digital tools produce uneven benefits and that adoption outcomes depend on the surrounding ecosystem (Jiang et al., 2024; Nguyen et al., 2024). It is also consistent with evidence that the gains from digital adoption in SME supply chains are mediated by innovation capability rather than being automatic (Jam et al., 2025), and with South African evidence that logistics information technology improves distribution performance mainly through network relationships and not through direct effects on product availability (Dakora, 2025).

Table 4 makes the valence structure explicit by reporting each item in two ways: as originally scored and in a vulnerability-oriented form in which protective statements are reverse-scored (5 − mean), so that higher values always indicate greater vulnerability. On this basis, the average vulnerability orientation is 2.47, essentially at the midpoint, because strong perceived risk (B14) is offset by relatively high perceived device effectiveness (B17). The result clarifies that the technology–security block does not describe a uniformly adverse position; it describes a divided one.

Table 4: Valence-aligned scores for the technology and security block (*n* = 392)

Item	Valence	Original mean	Vulnerability-oriented mean
B14: Theft, vandalism, and cargo diversion are a significant risk	Risk	3.25	3.25
B15: Confident about regional logistics security	Protective	2.49	2.51
B16: GPS/surveillance commonly used in the region	Adoption	2.50	2.51
B17: Security devices adequately protect cargo and assets	Protective	3.13	1.87
B18: Operations proceed without major losses	Protective	2.81	2.19
Mean of block	—	**2.84**	**2.47**

Note: Vulnerability-oriented mean = original mean for B14 and 5 − original mean for B15–B18. Calculated from item means; standard deviations of aligned composites cannot be derived without item covariances.
Source: Field survey, 2026; author's calculation.

Security considerations further increase the second layer of the analysis. With over 4 in 5 operators identifying theft, vandalism and cargo hijacking as a significant threat, implementation of technology is largely used as a security measure. This explains the high perceived effectiveness of using technology to secure assets (B17) and low perception of an effective external environment (B15). This aligns with evidence from Nigeria showing that lack of security impacts staff stability and competitiveness (Onwuka & Achebe, 2025); however, firm-level security measures do not provide enough protection, and there is a strong correlation between community-based security and SME performance (Odesola, 2025). Start-up businesses will only have limited private security due to a lack of self-funding, and so technology alone is only partially addressing the issue.

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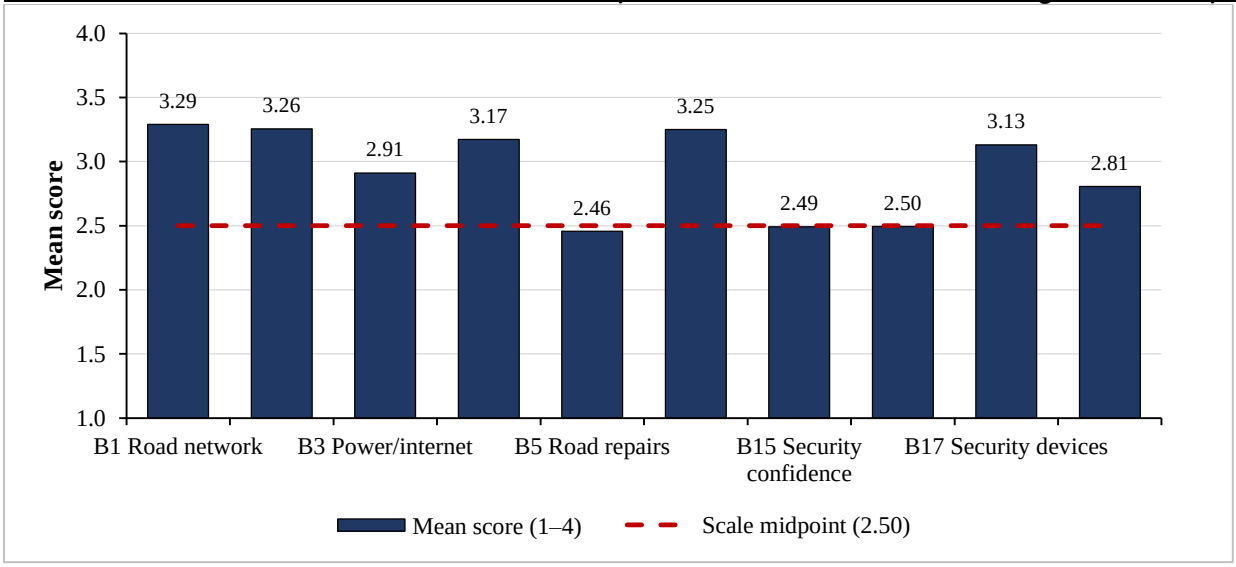


Fig. 3: Mean agreement scores for infrastructure (B1–B5) and technology/security (B14–B18) items relative to the scale midpoint (2.50)

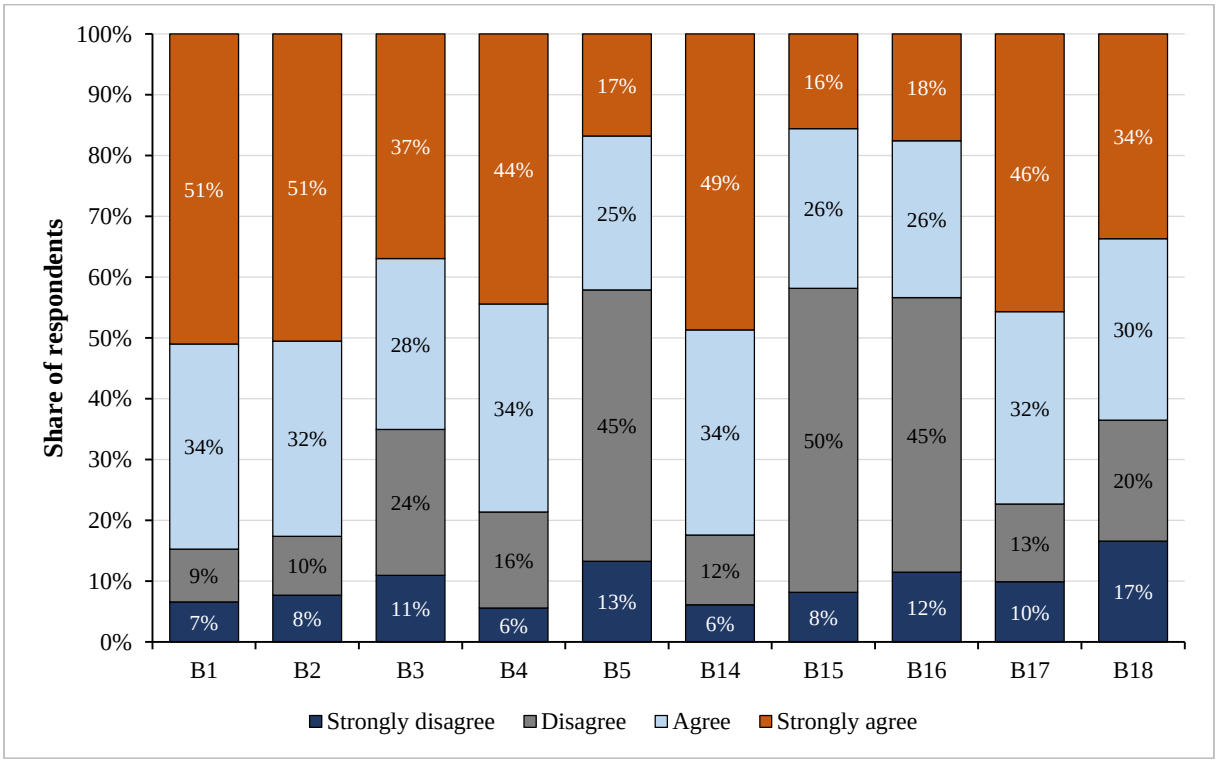


Fig. 4: Response distribution for infrastructure (B1–B5) and technology/security (B14–B18) items (*n* = 392)

The distribution of responses in Fig. 3 reinforces these interpretations. For road networks (B1), sanitation (B2) and theft risk (B14), half or nearly half of respondents chose "strongly agree", a degree of consensus that is unusual in perception data and suggests that these constraints are experienced as structural facts rather than as matters of opinion. By contrast, the security-confidence and surveillance items (B15, B16) are concentrated in the "disagree" category, which indicates widespread but moderate scepticism and leaves room for improvement through programme design. The relatively flat distribution for B18, with substantial shares at both extremes, shows that exposure to kidnapping and cargo diversion is uneven across operators, which is a plausible explanation for the heterogeneity captured in the standard deviation (1.08), the highest in the block.

Hypothesis tests

Both composites differed significantly from the midpoint (Table 5). The infrastructure composite produced a large standardised difference (d = 1.02), and the technology–security composite a moderate-to-large difference (d = 0.79). H1 is therefore supported: net agreement that infrastructure constrains operations is high and consistent across respondents, as the narrow standard deviation (0.51) indicates. H2's first component is also supported, but the substantive reading depends on item valence. The valence-aligned protection score (2.73) is much closer to the midpoint than the composite suggests, and the t-test should be understood as evidence of salience and net perception, not of a causal effect of technology on performance.

Table 5: One-sample t-tests of composite scores against the scale midpoint (2.50), n = 392

Composite	Mean	SD	95% CI	$t(391)$	p	Cohen's d
Infrastructure (INFRA)	3.017	0.508	[2.97, 3.07]	20.14	< 0.001	1.02
Technology and security (TECH)	2.835	0.427	[2.79, 2.88]	15.51	< 0.001	0.78

Note: Cohen's d = (mean − 2.50)/SD; 95% CI computed from the reported mean and SD. Decision: H1 supported; H2 (first component) supported.
Source: Field survey.

Relationships among infrastructure, technology/security and market constraint

Table 6 shows the rank-order associations. Infrastructure and technology/security were weakly but significantly correlated (ρ = 0.102, p = 0.044), and technology/security was significantly correlated with the market-constraint index (ρ = 0.139, p = 0.006). Infrastructure was not associated with the index (ρ = 0.044, p = 0.380). In the rank-based regression of the index on all five dimensions, technology/security was the only significant predictor (β = 0.140, t = 2.78, p = 0.006), whereas infrastructure was not (β = 0.033, p = 0.516). The overall model was only marginally significant ($F(5, 386)$ = 2.18, p = 0.056) and explained 2.7% of the variance (adjusted R^2 = 0.015); the largest variance inflation factor was 1.02, so multicollinearity is not a concern.

Table 6: Spearman correlations and rank-based regression results (n = 392)

Pair	Spearman ρ	p	Regression β on MCI	p (β)
INFRA ↔ TECH	0.102	0.044	—	—
INFRA ↔ MCI	0.044	0.380	0.033	0.516
TECH ↔ MCI	0.139	0.006	0.140	0.006

Note: MCI = market-constraint index (mean of B24–B26; higher = stronger constraint). Regression includes five predictors; only the INFRA and TECH coefficients are shown. Model: $R^2 = 0.027$, adjusted $R^2 = 0.015$, $F(5, 386) = 2.18$, $p = 0.056$.
Source: Field survey.

The implications of these associations should be viewed in the direction of the scores. High scores for infrastructure indicate a high level of consensus that infrastructure is lacking, whilst high index scores indicate a high level of consensus that brand visibility, expanding routes and concerns about survival are constraining growth. The positive coefficients indicate that operators who perceive infrastructure to be lacking are likely to have higher scores for the technology-security composite. Similarly, operators with high technology-security scores are likely to have a high perception of market constraints. However, these associations are very weak (ρ^2 indicates that ≤2% of variance in joint ranks can be explained) and cannot be interpreted as technology being detrimental to the market. It is more plausible to interpret these results as indicating that insecurity and lack of infrastructure are causing operators to perceive more risk (B14). Operators in harsher environments are likely to have more devices to protect them (B17) and will also perceive more constraints on growth. This is consistent with findings that individual protective actions aren't sufficient unless there is collective action (Odesola, 2025) and that technology has contextual effects (Nguyen et al., 2024). Future work could investigate this further by analysing item-level responses and using valence-aligned scoring.

A further point concerns effect size. The correlations in Table 6 are statistically detectable only because the sample is moderately large; shared rank variance between technology–security and market constraint is under 2%, and the regression model explains 2.7% of variance. These figures show that the market constraints reported by start-ups are overwhelmingly determined by factors outside the dimensions measured here, including regulatory and financial conditions, competition and firm-specific capabilities. This is itself a substantive finding. It cautions against interpreting infrastructure or technology as sufficient explanations of scaling difficulty and supports the integrated, multi-dimensional policy approach set out in Section 6.

Integrated discussion: the infrastructure–technology–security nexus

The results highlight an overarching theme of constraints. Physical infrastructure was seen as the greatest constraint by the greatest number of people. A key point of intersection between the physical and digital dimensions was electricity and connectivity (B3; 65.1% agreement). To use digital tracking, dispatch and payment systems requires steady electricity and connectivity. Therefore, poor infrastructure increases the costs associated with using the technology, which aims to mitigate it. Additionally, there is a high level of agreement about the high level of security risk. This means the focus when adopting technology will be on mitigating loss. Finally, the weak correlations between the variables indicate that the start-ups see

these constraints as being largely separate issues. As such, solving only one issue like road quality or device distribution will not help scale.

These results offer a counter-narrative to any overly optimistic claims regarding tech leapfrogging. Firstly, the evidence that digital tech improves supply chain performance through innovation (Jam et al., 2025) and that logistics tech is delivered via network relationships (Dakora, 2025) means start-ups require complementary technologies and relationships. Secondly, the results show infrastructure and security policies should be delivered together. Collective security, dependable electricity and common digital infrastructure can all create positive feedback loops. This is supported by the evidence that community-level interventions perform better than individual efforts (Odesola, 2025). The results therefore suggest that corridor-level interventions should be designed.

Implications for theory and practice

The findings provide theoretical support for infrastructure being considered as an external boundary. Resource-based theory would imply firms with high capabilities will grow. The technology-organisation-environment framework would predict environmental factors will impact adoption outcomes (Jam et al., 2025). The evidence from the Niger Delta supports these predictions, as adoption has occurred and is partial and risk-driven. It also shows that adoption is not linked to market outcomes. In terms of practical implications, operators need to invest in providing reliable power and basic monitoring technologies before investing in advanced analytics. They should also take part in shared security. As far as policy implications, it implies that multi-agency interventions at corridor level are more likely to provide effective outcomes, as the limitations found are experienced by the same firms.

Beyond its empirical contribution, the study offers three practical lessons for researchers working in similar settings. First, perception-based instruments should specify item valence from the outset and, where blocks mix risk and protection statements, report valence-aligned indices alongside raw composites. Second, associations between technology and outcome measures in cross-sectional data should be interpreted with attention to defensive adoption and reverse causality, since firms facing greater risk adopt more protection. Third, studies of logistics start-ups should treat the operating corridor, rather than the individual firm, as a unit of analysis, because infrastructure and security conditions are shared among firms that use the same routes.

CONCLUSION

The key infrastructural challenges faced by logistics startups in the Niger Delta were identified in this study as poor road infrastructure, insufficient sanitation/public services and inconsistent power/connectivity. Technology adoption was also found to be limited, with a defensive motivation and high perceived risk of theft. Both composites had scores well above the midpoint. Technology-security was only loosely correlated with infrastructure and market constraint. The amount of variance explained by the relationship model was low. This indicates that there is an interlink between infrastructure, technology and security, meaning that implementing one strategy alone will most likely not be enough.

There are limitations to this study. It is a cross-sectional and subjective study; therefore, it is not possible to establish causality. The sample size was also an estimate. The technology-security composite included reverse-scored items; however, the original scale was not back-coded. This was overcome by scoring each item individually and in line with its valence; however, this should be rectified in future instruments. Future studies should aim to collect objective performance data and implement panel/quasi experimental designs. Technology adoption and security should also be measured separately. Comparative studies should be conducted between different states in the Niger Delta to determine if the inter-link changes depending on the level of infrastructure and security risk.

RECOMMENDATIONS

Infrastructural constraints.

1. **Ring-fenced corridor maintenance.** The Niger Delta Development Commission (NDDC) and the Federal Ministry of Works should establish a dedicated logistics corridor maintenance fund, prioritising the arterial routes that connect the Port Harcourt, Warri and Uyo hubs, with performance-based maintenance contracts that report road condition publicly.
2. **Decentralised energy access.** The Rural Electrification Agency and state governments should provide solar-powered charging and connectivity infrastructure at logistics clusters in secondary cities and peri-urban corridors, given the weak power and internet conditions endorsed by 65.1% of respondents.
3. **Multimodal alternatives.** The National Inland Waterways Authority should pilot commercially viable inland-waterway freight services through public–private partnerships, reducing single-mode dependence on a deteriorating road network.
4. **Service-centre decentralisation.** State governments should extend public service centres, including licensing, inspection and sanitation services, to logistics clusters to reduce time lost accessing essential services.

Technology adoption and security.

1. **Subsidised, security-oriented adoption.** The National Information Technology Development Agency and the NDDC should operate a technology adoption programme that subsidises GPS tracking, digital dispatch and monitoring for qualifying start-ups, with first-year subscription support and training, since only 43.4% report that such tools are commonly used.
2. **Community-based security protocols.** Industry associations, the Nigeria Police Force and community organisations should adopt standard incident-reporting, early-warning and rapid-response protocols for cargo security, because collective arrangements complement firm-level devices (Odesola, 2025).
3. **Integrated infrastructure–technology planning.** Power and connectivity upgrades should be planned jointly with technology programmes so that devices are deployable and sustainable at the corridor level.
4. **Capability building.** Training programmes should build start-ups' capacity to use tracking data for route planning and customer service, not only for loss prevention, to convert defensive adoption into performance gains (Jam et al., 2025).

Table 7 summarises the recommendations by objective, lead agency, time horizon and priority.

Table 7: Objective-based policy matrix

Obj.	Recommendation	Lead agency	Horizon	Priority
1	Corridor maintenance fund	NDDC / Federal Ministry of Works	Short term	Critical
1	Solar-powered energy and connectivity at clusters	Rural Electrification Agency	Medium term	High
1	Inland-waterway freight pilots	NIWA / private partners	Long term	High
1	Decentralised public service centres	State governments	Medium term	Medium
2	Subsidised tracking and dispatch adoption	NITDA / NDDC	Medium term	High
2	Community-based cargo security protocol	Police/industry associations/communities	Short term	Critical
2	Joint infrastructure–technology planning	NDDC / state governments	Medium term	High
2	Analytics and capability training	Industry associations/polytechnics	Medium term	Medium

Note: Priority reflects the strength of respondent endorsement and the dependence of other interventions on the item.
Source: Author's synthesis from the survey findings.

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