*Full length article*

# Influence of Digital Leadership and Green Digital Innovation on SMEs in Enugu State, Nigeria

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## ABSTRACT

This study examines the influence of digital leadership and green digital innovation on the performance and sustainability of small and medium enterprises (SMEs) in Enugu State, Nigeria. The specific objectives are to; examine influence of digital leadership on the adoption of green digital innovation among SMEs in Enugu State, Nigeria and to assess the impact of digital leadership and green digital innovation on the performance and sustainability of SMEs in Enugu State, Nigeria. This study adopts quantitative research design, utilizing a structured questionnaire design with a 5-point Likert scale in primary data collection. The target population consists of SMEs across various sectors from the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN). A sample of 313 SMEs was selected from the population of 1,432 SMEs in Enugu State through stratified random sampling. The results demonstrate that digital leadership significantly influenced SME performance and sustainability, with a coefficient of 0.462 (p = 0.000), while green digital innovation (GDI) also had a strong positive effect with a coefficient of 0.347 (p = 0.000). This study concludes that digital leadership has a significant positive influence on SME performance and sustainability. Therefore, it is imperative for SMEs managers to adopt green digital practices and improve their digital leadership skills. The study recommends among others that SME owners and managers should prioritize the development of their digital leadership capabilities by participating in leadership seminars, training programs, and continuous education that emphasize innovation management and digital transformation.

## 1. Introduction

Small and Medium Enterprises (SMEs) are essential to Nigeria's economic framework, making substantial contributions to employment, innovation, and Gross Domestic Product (GDP). In the rapidly evolving digital

economy, it is imperative that Nigerian SMEs embrace digital transformation to maintain competitiveness (Unegbu, Yawas, & Dan-asabe, 2024). Digital leadership has become a pivotal force in directing organizational transformation and utilizing emerging technology to attain sustainable results (Sun, Bhutta, & Sarfraz, 2024). Recent studies on the integration of green digital innovation on how digital practices promote environmental sustainability and offers a dual advantage of enhancing operational effectiveness while addressing global environmental challenges (Quttainah, & Ayadi, 2024; Chen, & Xing, 2025; Cui, 2025). Adoption of these digital practices is essentially crucial in the study context, where infrastructural deficiency and environmental degradation require innovative solutions that are both economically and environmentally viable.   In similar vein, digital technologies, including artificial intelligence, big data, and cloud computing, underpin the digital transformation of SMEs, improving their operational efficiency and competitiveness in a rapidly evolving market landscape. (Teng, Wu, & Yang, 2022; Adu-Ansere, & Lumorvie, 2024; Alkhattali, 2025). Mangifera, Perwithosuci, Aisyah, and Widawati (2024) argues that although SMEs may encounter challenges, it is pivotal that they adopt these technologies to ensure survival. SMEs that possess greater digital capabilities have improved business performance to meet the demanding market expectations. Additionally, digitalization equips SMEs with adaptable skills necessary for resilience in the face of global crisis and the fear of the unknown (Martins, 2022 & Anusi, 2025).

This study concentrates on SMEs specifically in Enugu State, a region in southeastern Nigeria recognized for its growing entrepreneurial landscape. Enugu State is a major commercial hub in Southeastern Nigeria and boasts of diverse range of SMEs that are striving to recognize the important of digital transformation and sustainable practices. Despite the evident issues related to economic and infrastructural underdevelopment, Enugu state serves as an ideal location to examine the impact digital leadership and green digital innovation on its SMEs (Asogwa, Nzewi, & Essell, 2024).

This study will provide crucial insights that will help SMEs in Enugu state to critically understand how digital leadership can drive both business performance and environmental responsibility, inform policy, and contribute to sustainable economic growth in the State. A few studies have been conducted on the potential benefits of digital leadership for SMEs that are underrepresented, and yet in its infancy (Fairlie, 2020; Desai, 2024). Hence, there is paucity of studies examining the influence of digital leadership on SMEs in Enugu State. Therefore, there is a research deficit as a result.   Insights from this study could help inform policy, guide SME development initiatives, and contribute to sustainable economic growth in Enugu State and similar emerging markets.

**Statement of problem**

The rapid advancement of digital technologies and unpredictability in the business environment, particularly in regions such as Enugu State, Nigeria, requires an emphasis on how SMEs can adapt to the challenges presented by digitalization and urgent for sustainable practices. These challenges highlight the essential requirement for effective digital leadership and the integration of green digital innovations into SME operations. Digital leadership is linked to improved employee innovation and resilience, crucial for managing crisis like the COVID-19 pandemic (Putra, Neswardi, Primadona, Jumyetti, & Yuanita, 2023). The significance of digital leadership and sustainable digital innovation for SMEs cannot be overemphasized. Technological developments significantly improve productivity, improve operational efficiency, and bolster business competitiveness (Omeke, 2025). Nevertheless, the implementation and efficient application of digital leadership and green digital innovation among SMEs in Nigeria, especially in Enugu State, is significantly deficient.

In Enugu State, SMEs are crucial to the economy, notably contributing to employment and revenue generation. The National Bureau of Statistics reported in 2020 that SMEs constitute over 90 percent of enterprises in Nigeria, generating around 60 percent of employment opportunities.

Nonetheless, despite their pivotal importance, numerous SMEs in Enugu State encounter obstacles in the adoption and implementation of technological developments. These issues frequently arise from inadequate finances, poor technology infrastructure, and restricted access to training and support. In similar vein, Nwagbala, Kekeocha, and Ihim (2024) contend that numerous SMEs owners are unable to effectively leverage the advantages of digital technology due to inadequate internet connectivity, inconsistent electricity supply, insufficient technical support, and a lack of comprehension regarding the benefits of digital tools. Essentially, this complicates the ability of SMEs to enhance their performance and fostering green digital innovations. Additionally, another striking phenomenon is lack of leadership skills to guide digital transformation and innovation which impedes an organisational ability to respond to technological advancements, Therefore, a deficiency in training will hinder the ability to successful spearhead digital initiatives. Moreso, digital transformation initiatives usually incur significant expenses, particularly the initial investment such as cloud computing, smart manufacturing systems, internet of things, and energy-efficient data centres, and the absence of these funds pose a significant challenge in digital transformation. Addressing these challenges will yield insights into how to enhance digital transformation in the SME sector, by integrating green digital innovation into business models, minimizing environmental impact, and enhancing competitive advantage over time.

Therefore, the main objective of this study is to examine the influence of digital leadership and green digital innovation on the performance and sustainability of small and medium enterprises (SMEs) in Enugu State, Nigeria, and the specific objectives are to:

1. To assess the influence of digital leadership on the adoption of green digital innovation among SMEs in Enugu State, Nigeria
2. To examine the impact of digital leadership and green digital innovation on the performance of SMEs in Enugu State, Nigeria

The remainder of this article is organised as follows: the literature review part provides a comprehensive overview of digital leadership, green digital innovation, SME performance, and the theoretical frameworks that support the study. The research methodology section delineates the research design, data collection methodologies, and analytical techniques utilized. The findings section presents the empirical results obtained from the quantitative data analysis. The discussion section evaluates the findings, emphasizing theoretical and practical contributions, along with limitations for further study exploration. The conclusion section encapsulates the key findings and provides conclusive remarks regarding the study.

## 2 Literature Review

### Digital Leadership

Digital leadership thereafter (DL) is regarded as a vital catalyst for SMEs navigating through navigating the complexities of digital technologies while promoting innovation and adaptability. Sidabutar & Siswanto (2024) asserts that proficient digital leaders empower their employees, cultivates a culture of collaboration, creativity, and resilience. Without doubt, digital leadership enhances employee empowerment, and this empowerment is vital as it fosters increased employee engagement and adaptability, which are needed for the effective implementation of digital transformation Initiatives Lathabhavan and Kuppusamy (2023)

**Green Digital Innovation: A Dual Imperative**

Simultaneously, green digital innovation (GDI) is essential for SMEs aiming to sustain viability in the contemporary environmentally conscious market. Green digital Innovation is the process of integrating sustainable practices with digital technologies to promote economic development and minimize environmental impact, such as reduce energy consumption and resource optimization, and minimise carbon emissions. According to Alajmi (2022), digital leadership plays, as leaders who are skilled and supportive of digital technologies can incorporate these innovations into their business models, strengthening sustainability practices while improving performance.

**The Interplay Between Digital Leadership and Green Innovation**

It's worth noting that there is a symbiotic link between DL and GDI. In Faizurrohman, Baga, and Jahroh (2021) words, digital transformation can facilitate the implementation of green processes and products, thereby fostering sustainability for SMEs. This symbiotic relationship significantly transforms SMEs' market positioning and enhances their resilience against turbulent times. (Sulastri, Mulyadi, Disman, Hendrayati, & Purnomo, 2023).

**Emprical studies**

In Indonesia, Putra, Neswardi, Primadona, Jumyetti, and Yuanita (2023) conducted a quantitative study to investigate the correlation between digital leadership and the resilience of SMEs, mediated by employee creativity.  Based on a sample of 179 SMEs from various sectors in Indonesia, the results reveal the effect mechanism of digital leaders on SMEs resilience and enrich the literature on antecedents of SMEs resilience.  Another study by Cui (2025) investigated the interplay between digital leadership and green digital innovation and the combined influence on corporate digital transformation in Korean corporate industries.  By employing a qualitative research approach, the results of the study indicate that firms with robust digital leadership are more proficient in executing green innovations, leading to improved operational efficiency and competitive advantage.

Niu, Park, and Jung (2022) conducted a study to investigate the effects of digital leadership and environmental, social, and governance (ESG) management on organisational innovation and sustainability on Chinese and Korean companies. Their results demonstrated that digital leadership in both countries had a significant effect on ESGM and organisational innovation. Meanwhile, Imran, Hamid, and Haque (2025) examined the role of digital leadership in the sustainability of SMEs in Malaysia using a quantitative approach. The study findings reveal a positive relationship between digital leadership and SMEs' sustainability.  Furthermore, a study conducted in Pakistan by Begum, Khan, & Muhammad (2024) examined the role of digital leadership in accelerating digital transformation processes while maintaining long-term organizational sustainability in higher education institutions. The findings indicate that organizations led by visionary digital leaders are more effectively equipped to utilize technology for operational efficiency, agility, and competitive advantage.

To condense further to the global south, from the researchers' pertinent searches on relevant key words that align to this study, it is evident that this study has gained more traction in the western countries than Africa, identifying this as a research gap. Notwithstanding the scarcity of literature, it is beginning to gain traction in this recent time. A recent quantitative study conducted by Alonta, Orabueze, and Onyechi (2025) examined the influence of Artificial Intelligence (AI) on enhancing communication and digital literacy skills among SMEs operators in Anambra State, Nigeria. The results of the findings demonstrate that AI plays a vital role in

enhancing communication and digital literacy skills among SME operators in Anambra State, Nigeria. Scholars like Ojobo, Orga, and Okechukwu (2023) evaluated the impact of digital literacy on the performance of small-scale business in Enugu State by employing a descriptive survey design approach. Their results reveal that digital literacy had significant positive impact on the volume of business transactions on small scale business in Enugu State, Z (95, n = 322) = 7.885 < 9.557, p <.05.

## Theoretical Background
### Dynamic Capabilities Theory and the Technology- Organisation Environment

The dynamic capabilities theory (DCT) and the Technology-Organization-Environment (TOE) framework are essential theoretical approaches that clarify how SMEs, can adapt and innovate in diverse contexts. The former was proposed by Teece, Pisano, and Shuen in 1997 and highlights how organisations develop, modify, and enhance internal skills and capabilities to adjust and adapt to a rapidly changing environment. Sidabutar & Siswanto (2024) argues that digital leadership empowers SMEs to identify possibilities in digital and green technologies, capitalize on them through strategic investments, and transform their operations for sustainability. In the context of SMEs, DCT theory are demonstrated through specific organisational behaviors, including the development of adaptive routines and the proactive monitoring of market signals (Li, 2022).

Meanwhile the latter explains how external (technology and market pressure) and internal factors (digital leadership and organisational culture) influence the adoption and implementation of technological innovations in organisations. This theory examines the current technologies used by organisations and the benefits and limitations associating with adopting new technologies. For the SMEs, it is evident the organisational structure, culture, and resource availability significantly impact how they embrace green digital innovation (Kapoor & Aggarwal, 2020). However, the business external environment still shapes and influences their internal capabilities. Although both frameworks differ, however they both emphasize that change is constant, and it is crucial that SMEs become adaptable and responsive. Consequently, the integration of both theories establishes a synergistic framework that addresses how SMEs develop capacities to embrace innovation and the elements influencing the adoption process.

To unpack the objective of this study, the following hypotheses will be hypothesized:

$H_1$: Digital leadership has no significant influence on performance and sustainability of SMEs in Enugu State, Nigeria.

$H_2$: Green digital innovation has no significant impact on the performance and sustainability of SMEs in Enugu State, Nigeria.

## 3 Research Methodology Summary

This study employs a quantitative research design to investigate the influence of digital leadership and green digital innovation on SMEs in Enugu State, Nigeria. The target population consists of SMEs across various sectors, the population of SMEs in Enugu state according to the small and medium enterprise development agency (SMEDAN) is 1432 as at 2023. Using Yamane's (1967) formula at a 5% margin of error as seen below.

$$N = \frac{N}{1 + N(0.05)^2}$$

$n$ = Sample size
$N$ = Population size is 1432
$e$ = Margin of error (5%)

$$n = \frac{1432}{1 + 1432(0.05)^2} = 313$$

A sample of 313 SMEs was selected from the population of 1,432 SMEs in Enugu State through stratified random sampling. Sample of staff = Number of SMEs × Number of staff per SME. We select 2 staff per SME. Staff Sample Size (n) is 313×2 = 626. Subsequently, two employees were selected per SME, resulting in a total staff sample size of 626 respondents. A structured questionnaire was utilized to gather data, featuring Likert-scale items that assess the practices of digital leadership, green innovation strategies, and performance indicators of the SMEs. Data analysis involved descriptive statistics to summarize the findings and inferential statistics, specifically multiple regression analysis, explored the relationships between the independent variables (digital leadership and green innovation) and the dependent variable (SME performance).

The regression equation is $Y = a + b_1 x_1 + b_1 x_1 + \mu_i$ applied were $Y$ represents SME performance, $x_1$ and $x_2$ denote digital leadership and green innovation, respectively, $a$ is the constant $b_1$ and $b_2$ are the coefficients of the predictor's variables and $\mu_i$ is the error term. To ensure the validity and reliability of the questionnaire, a pilot study was conducted with 30 SMEs, with adjustments made based on feedback. Reliability and validity were assessed using Cronbach's alpha and Average variance extracted, aiming for a value above 0.70 and 0.5 respectively to confirm internal consistency and validity. Ethical considerations included obtaining informed consent and ensuring participant confidentiality.

## 4 Results

This section presents the results of data analysis, and the discussion of findings based on the objectives of the study. Specifically, this section covers the demographic characteristics of the respondents, descriptive statistics of the variables, reliability analysis, hypothesis testing, and discussions of the findings about existing literature.

*Demographic characteristics of the Respondents*
The demographic information of the respondents includes gender, age, educational qualification, and years of work experience. These characteristics provide context to better understand the perspectives of the respondents.
Table 1: Demographic Profile of the respondent (n=626)

| Variable | Frequency | Percentage (%) |
|---|---|---|
| Gender | | |
| Male | 472 | 75.4 |
| Female | 154 | 24.6 |
| Age | | |
| 18-30 years | 182 | 29.1 |
| 31-40 years | 306 | 48.9 |
| 41-50 years | 87 | 13.9 |

| | | |
|---|---|---|
| Above 50 years | 51 | 8.1 |
| **Educational Qualification** | | |
| Diploma | 74 | 11.8 |
| Bachelor's Degree | 340 | 54.3 |
| Master's Degree | 168 | 26.8 |
| Others | 44 | 7.0 |
| **Marital Status** | | |
| Single | 371 | 59.3 |
| Married | 182 | 29.1 |
| Divorced/Widowed | 75 | 11.9 |

Table 1 is the demographic profile of the respondents; The result shows that the majority were male (75.4%), while females constituted 24.6% of the sample. In terms of age distribution, most respondents (48.9%) were within the 31–40 years age bracket, followed by those aged 18–30 years (29.1%), indicating that the workforce is largely youthful. A smaller proportion of the respondents were between 41–50 years (13.9%) and above 50 years (8.1%). Regarding educational qualifications, more than half of the respondents (54.3%) held a bachelor's degree, while 26.8% had a master's degree. Those with a Diploma accounted for 11.8%, and 7.0% reported other types of qualifications. This shows that the SME workforce in Enugu State is fairly well-educated, with a strong representation of individuals possessing higher education degrees. In terms of marital status, most respondents (59.3%) were single, while 29.1% were married, and 11.9% were either divorced or widowed. Overall, the demographic data suggests that the SME workforce in Enugu State is predominantly young, educated, and largely unmarried, characteristics that may have implications for how digital leadership and green digital innovation are perceived and implemented within the sector.

*Descriptive Statistics*
Descriptive statistics were used to summarize the responses to each variable which include collaborative goal setting, employee empowerment, and organizational development.
Table 2: Descriptive Statistics

| Variable | Mean | Standard Deviation |
|---|---|---|
| Performance and sustainability of SMEs | 3.304 | 1.46 |
| Digital Leadership | 3.290 | 1.38 |
| Green Digital Innovation | 3.771 | 1.08 |

Table 2 The mean scores for performance and sustainability of SMEs (3.304), DL (3.290), and GDI (3.771) indicate generally positive perceptions across all three variables. The standard deviations show varying levels of response consistency, with performance and sustainability of SMEs (SD = 1.46) and DL (SD = 1.38). In contrast, GDI (SD = 1.08) shows the lowest variability, reflecting less diverse opinions among respondents for this construct.

*Reliability and Validity Test*
The reliability of the questionnaire was assessed using Cronbach's Alpha to ensure internal consistency.
Table 3: Reliability and Validity Test

| Variable | Cronbach's Alpha | AVE |
|---|---|---|
| Performance and sustainability of SMEs | 0.72 | 0.57 |
| Digital Leadership | 0.83 | 0.61 |
| Green Digital Innovation | 0.77 | 0.53 |

Table 3 is the Cronbach's Alpha values for performance and sustainability of SMEs (0.72), DL (0.83), and GDI (0.77) indicate that the questionnaire items for these constructs exhibit acceptable to good reliability. DL shows strong internal consistency. Generally, the scales are reliable for measuring their respective constructs. The average variance extracted (AVE) suggests the discriminant validity is >0.5 above the acceptance threshold.

*Regression Results*
Regression analysis, which is an Inferential statistics approach, was employed to test the study's hypotheses. Multiple linear regression analysis was used to assess the effect of collaborative goal setting and employee empowerment on organizational development.

Table 4: Regression Output

| Model 1 | Coefficient | F-statistic | R-Square | Adjusted R-Square | Durban-Watson |
|---|---|---|---|---|---|
| DL | .462 [.000] | 99.381 [.000] | .698 | .691 | .400 |
| GDI | .347 [.000] | | | | |
| Constant | 3.41 [.002] | | | | |

DL= Digital leadership; GDI=Green Digital Innovation; [ ] represents p-value

The regression result in table 4 revealed that both DL and GDI have a positive and statistically significant impact on the performance and sustainability of SMEs. Specifically, Digital Leadership had a coefficient of 0.462 (p = 0.000), while Green Digital Innovation had a coefficient of 0.347 (p = 0.000), indicating that improvements in these areas are associated with higher SME performance. The constant term was also significant, suggesting a

strong baseline performance level even in the absence of the predictors. The model showed a strong overall fit, with an R-square value of 0.698 and an adjusted R-square of 0.691, meaning that approximately 69.8% of the variability in SME performance and sustainability is explained by the combined effects of Digital Leadership and Green Digital Innovation. The F-statistic was 99.381 (p = 0.000), further confirming that the model is statistically significant overall.

*Hypothesis Testing*

$H_{01}$: Digital leadership has no significant influence on performance and sustainability of SMEs in Enugu State, Nigeria.

$H_{02}$: Green digital innovation has no significant impact on the performance and sustainability of SMEs in Enugu State, Nigeria.

Decision rule

For $H_{01}$: If the p-value for digital leadership is ≤ 0.05, reject $H_{01}$ and conclude that digital leadership has a significant effect on performance and sustainability of SMEs in Enugu State, Nigeria. Otherwise, do not reject $H_{01}$.

For $H_{02}$: If the p-value for green digital innovation is ≤ 0.05, reject $H_{02}$ and conclude that digital leadership has a significant effect on performance and sustainability of SMEs in Enugu State, Nigeria. Otherwise, do not reject $H_{02}$.

Table 5: Diagnostic Test

| Diagnostic Test | Method Used | Test Statistic | P-value |
|---|---|---|---|
| Normality Test | Shapiro-Wilk Test | .819 | .077 |
| | Kolmogorov -Smirnov Test | .182 | .054 |
| Multicollinearity Test | Variance Inflation factor (VIF) | $X_1$=2.15; $X_2$=1.98 | === |
| Heteroscedasticity Test | Breusch-Pagan Test | $\chi^2 = 4.21$ | 0.352 |

$X_1$=Digital leadership; $X_2$=Green Digital Innovation. Outcome variable: Performance and sustainability of SMEs.

The diagnostic tests conducted for the multiple regression analysis as shown in table 5 indicate that the model satisfies important assumptions, ensuring its validity for interpretation. The normality tests, including the Shapiro-Wilk and Kolmogorov-Smirnov tests, yielded p-values greater than 0.05, confirming that the residuals are normally distributed. The Variance Inflation Factor (VIF) values for all independent variables were below 10, indicating no serious multicollinearity issues. The Breusch-Pagan test for heteroscedasticity resulted in a p-value of 0.352, suggesting that the variance of residuals is constant. Lastly, the Durbin-Watson statistic of 1.42 indicates no significant autocorrelation in the residuals. Therefore, these results confirm that the regression model meets the necessary assumptions, satisfying the appropriateness of the analysis and interpretations above.

**Discussion of findings**

The demographic profile of the respondents revealed important characteristics about the workforce of SMEs in Enugu State, Nigeria. Out of 626 respondents, the majority were male (75.4%), while females represented 24.6%. This gender distribution suggests that the SME sector in the region remains male-dominated. Age distribution

showed that 48.9% of respondents were between 31–40 years, followed by 29.1% aged 18–30 years, indicating that the workforce is relatively young and likely to be receptive to digital and innovative initiatives. Educational qualifications further supported this observation, with 54.3% of respondents holding a bachelor's degree, 26.8% possessing a master's degree, and 11.8% having a diploma. Only 7.0% had other types of qualifications. This relatively high educational attainment suggests that the workforce is well-positioned to understand and implement digital leadership and green innovation strategies. Furthermore, marital status data showed that 59.3% of respondents were single, 29.1% were married, and 11.9% were divorced or widowed, reinforcing the notion of a young, dynamic, and flexible workforce.

The regression analysis examined the influence of DL and Green Digital Innovation (GDI) on the performance and sustainability of SMEs. The results indicated that both predictors significantly and positively affected the dependent variable. Digital Leadership had a coefficient of 0.462 (p = 0.000), implying that a one-unit increase in Digital Leadership would lead to a 0.462 unit increase in SME performance and sustainability. Similarly, Green Digital Innovation had a coefficient of 0.347 (p = 0.000), suggesting that a one-unit improvement in green digital practices would correspondingly enhance performance by 0.347 units. The constant value was 3.41 (p = 0.002), indicating a strong baseline level of performance even without considering the predictors. These findings suggest that both digital leadership capabilities and eco-friendly technological innovations are critical drivers of SME success and long-term viability. The strength of the model was further confirmed by an R-square value of 0.698 and an adjusted R-square of 0.691, indicating that approximately 69.8% of the variability in SME performance and sustainability was explained by digital Leadership and Green Digital Innovation. The F-statistic of 99.381 (p = 0.000) demonstrated that the model was statistically significant. However, the Durbin-Watson statistic of 1.400 pointed no presence of positive autocorrelation among the residuals, suggesting a non-violation of the regression assumption of error independence. Moreover, these findings align with previous studies that investigated the impact of DL on SMEs. For instance, Putra et al. (2023) study in Indonesia highlights that DL linked to improved employee innovation and resilience. Their study confirms that DL is a leadership style that can develop a positive impact on output and it is consistent with this study that there exists a positive correlation between DL and GDI.

Similarly, Cui's (2025) study investigated how DL enables corporate organisations to effectively implement GDI, consequently enhancing corporate digital transformation and improving operational efficiency and competitive advantage in Korean industries. Cui highlighted that organisations possessing strong digital leadership competencies were more successful in implementing sustainable, eco-friendly innovations resulting in improved organisation performance and long-term success. While our findings corroborate Cui (2025) on the beneficial impact of digital leadership on sustainability, however, the contextual disparities, particularly the weaker infrastructure and policy support in Enugu relative to Korean organisations, indicate that internal leadership competencies may play a more critical role in resource-constrained environment.

Consequently, both studies illustrate that DL is an essential enabler that not only expedites the implementation of green digital innovations but also directly enhances organisational performance and sustainable growth.
Imran et al. (2025) further contribute to this discourse by discussing    the role of DL in the sustainability of SMEs in Malaysia. They showed that digital leaders help SMEs adopt tech, minimise expenses, and stay ahead of the competition. This highlights that DL encompasses not only the adoption of technology but also the integration of sustainability into business strategies through effective leadership. In this sense, this finding is

consistent with the current study indicating that digital leadership is a significant catalyst for SME sustainability, irrespective of geographic or economic setting. On the other hand, the current study demonstrates a strong positive influence of DL on the performance and sustainability of SMEs in Enugu State.

On the contrary, Nwagbala et al. (2024) contend that inadequate technological infrastructure, erratic electrical supply, limited internet access, and insufficient technical support are the principal factors hindering SMEs in Nigeria, irrespective of leadership quality. Although cost restrictions may apply in technology adoption, this study presents a more optimistic perspective on SMEs' capacity for digital transformation despite constrained resources, challenging more pessimistic views. For example, SMEs may seek for soft loans, grants, and funding from international bodies like bank of industry, united nations development agency (UNDP), and world bank. Another way to navigate financial constraints is to utilize cost-effective, scalable solutions such as cloud-based services (Google workspace, Microsoft 365) rather than investing in costly, intricate information technology infrastructure. Additionally, subscribing to pay-as-you-go models for cloud computing (SaaS, IaaS) enables SMEs to avoid substantial initial expenses. In other words, SMEs with proactive visionary leaders may still manage to navigate financial barriers, enhance innovation and maintain performance.

Therefore, Lathabhavan and Kuppusamy (2023) reinforce the notion that both new and experienced leaders may successfully implement digital transformation without risks, provided they possess digital leadership skills. In essence, SMEs locally and internationally must cultivate strong DL to effectively incorporate GDI into their business models, hence enhancing sustainability and competitive advantage. The findings in Enugu State present a strong positive influence of DL on performance but did not assess how organisational culture and employee attitudes may mediate the relationship between DL, GDI, and performance. Lastly, this study investigated SMEs as a single group, neglecting to differentiate between sectors that may experience DL and GDI impacts variably, which was not analysed. This sectoral discrepancy may indicate that the findings are not generally applicable to various types of SMEs.

## 5 Conclusion

This study explored the performance and sustainability of small and medium-sized enterprises (SMEs) in Enugu State, interest is on the roles of digital leadership and green digital innovation which served as the predictors variables. The findings suggest that these two variables significantly impact performance and sustainability of SME, explaining around 70% of the differences in sustainability and performance. Furthermore, the analysis results confirmed the significance of the findings. While affirming the correlation between DL and SME sustainability, this study adds contextual novelty by investigating this relationship in a region (Enugu State, Nigeria) where deficiencies and resource limitations are notably severe, thereby enhancing the literature on digital transformation in emerging economies. Lastly, the research showed the necessity for SMEs in Enugu State, Nigeria to adopt green digital practices and improve their digital leadership skills. In doing so, these SMEs can increase their performance and better present the challenges of a digital and environmentally conscious marketplace.

## Recommendations

Based on the study's result, SMEs should invest in continuous training for their managers and employees to develop essential digital skills. Also, individuals who make policy are advised to encourage green innovations

through incentives that promote sustainable practices. Future research could further investigate sector-specific impacts and regional variations across Nigeria.

## Practical/managerial implications

This research is significant to both theoretical and practical applications. The study emphasizes the essential function of digital leadership in promoting the implementation of green digital innovations. This underscores that SME managers and owners ought to invest in the development of digital leadership skills through structured training, seminars, and continuous educational programs. Furthermore, the findings indicate that digital leadership acts as a catalyst for SMEs to incorporate sustainable practices into their business models, leading to enhanced overall performance. Lastly, another crucial practical aspect is the established necessity for policy and institutional support. The study recommends that stakeholders, including governmental agencies, policy makers and industry associations, provide access to leadership and innovation training programs customized for the specific requirements of SMEs. The strategic implementation of green digital technologies may enhance the performance of individual SMEs while also advancing overarching economic sustainability objectives in emerging economies.

## Limitations of the study

This study did not categorize SMEs by sector (e.g., retail, manufacturing, services), which may affect the ease and effectiveness of digital adoption. Future study may perform sectoral comparisons to ascertain whether sector-specific challenges moderate the impact of digital leadership and green innovation. In addition, the literature study highlights a scarcity of research on digital leadership and green digital innovation in Enugu State and Africa at large. This scarcity may constrain the study's capacity to establish a solid local evidence base, thereby impacting the contextual applicability of the theoretical frameworks (TOE and DC) utilized.

## Informed Consent Statement

Informed consent was obtained from all participants involved in the study.

## Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data is not publicly available due to restrictions.

## Conflicts of Interest

The author declares no conflict of interest

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