Blueprint Academic Publishers

Journal of Frontiers in Humanities and Social Sciences
Journal ISSN: 3005-513X
4(1)
Received: November 13, 2025
Accepted: December 31, 2025
Published: January 04, 2026

The Moderating Effect of Environmental Dynamism on the Relationship Between Cyber Security and Sustainable Performance of SMEs in the Tourism Sector in Nairobi, Kenya

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Abstract

In the tourism sector, Small and Medium Enterprises (SMEs) are increasingly confronted by sophisticated cyber risks while navigating highly unpredictable market conditions. Implementing robust cybersecurity measures is essential for safeguarding digital infrastructure, preserving the confidence of stakeholders, and ensuring the long-term viability of the business. Nevertheless, the degree to which these security investments contribute to organizational sustainability is often shaped by environmental dynamism, characterized by rapid technological advancements, shifting legal frameworks and market instability. This study examined the moderating effect of environmental dynamism on the relationship between cybersecurity and sustainable performance among tourism SMEs in Nairobi, Kenya. An explanatory research design was adopted, utilizing a quantitative approach to analyze the variables. The target population comprised 1,200 managers from 120 licensed tourism firms in Nairobi, from which a sample of 300 respondents was selected using the Taro Yamane formula and stratified sampling. Primary data was collected through a structured 5-point Likert scale questionnaire, and the reliability of the instrument was confirmed using Cronbach's Alpha ($\alpha \geq 0.7$). Data was analyzed using descriptive statistics and inferential techniques, specifically multiple linear regression and hierarchical moderation analysis, processed via SPSS version 25. The study found that SMEs in Nairobi's tourism sector moderately implemented cybersecurity measures, with descriptive mean scores ranging from 3.06 to 3.16 across key indicators. Pearson correlation analysis showed a positive and significant relationship between cybersecurity and sustainable performance ($r = 0.492$, $p < 0.01$), while environmental dynamism was also positively correlated with sustainable performance ($r = 0.235$, $p < 0.05$). Regression analysis confirmed that cybersecurity significantly predicted sustainable performance ($\beta = 0.492$, $p < 0.01$) and environmental dynamism strengthened this effect as a moderating variable ($\beta = 0.235$, $p < 0.05$), indicating that

firms operating in more dynamic environments benefited more from robust cybersecurity practices. The study concludes that cybersecurity is a key driver of sustainable performance in tourism SMEs, particularly in volatile business. It recommends that managers adopt comprehensive cybersecurity strategies, conduct regular risk assessments, and provide continuous employee training. Policymakers should support SMEs by providing digital infrastructure, regulatory guidance, and incentives to promote cybersecurity adoption and enhance long-term sustainability.

Keywords: Cybersecurity, sustainable performance, environmental dynamism, SMEs, tourism sector, Nairobi, Kenya

Issue DOI: https://doi.org/10.69897/jofhscs.v4i1

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Funding: The author received no financial support for the research, authorship and/or publication of this article.

Data Availability Statement: The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials or upon a reasonable request.

Competing interests: The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Introduction

The global economy has experienced rapid digital transformation, positioning information technology at the core of modern commerce. Globally, tourism is one of the fastest-growing economic sectors, contributing over 10% of global GDP and supporting millions of jobs worldwide (Melkamu, 2023). Within this ecosystem, Small and Medium Enterprises (SMEs) such as hotels, tour operators, and travel agencies form the vital core of Kenya's economy, driving local income and urban growth. As these enterprises increasingly depend on digital tools for bookings, marketing, and payments, they have become tightly linked to the digital economy, where operational efficiency is now tethered to digital resilience.

Sustainable performance in tourism SMEs is a multidimensional construct encompassing economic viability, social responsibility, and long-term resilience (Seow et al., 2025). It goes beyond short-term profitability to include customer trust, regulatory compliance, and the ability to maintain services during crises. In advanced economies, tourism firms have aligned digital adoption with data protection and operational continuity to recover from shocks such as the COVID-19 pandemic (Gössling, 2021). In these contexts, cybersecurity supports sustainability through service reliability, data protection, and brand credibility.

In Sub-Saharan Africa, tourism contributes significantly to national economies, yet performance remains

uneven due to infrastructure gaps, policy instability, and weak ICT integration (Asongu et al., 2023). Kenya's tourism sector contributes approximately 10 percent of GDP and supports close to one million jobs (Onsomu et al., 2022). Nairobi functions as a regional tourism hub, where SMEs rely on digital booking systems, cloud platforms, and AI-supported customer engagement tools to compete in international markets (Tussyadiah & Park, 2018). Despite these advances, Nairobi's tourism SMEs face escalating cybersecurity threats, including phishing, ransomware, and unauthorized data access. SMEs often operate with limited financial and technical capacity, lack formal cybersecurity policies, and provide minimal staff training, increasing exposure to cyber incidents (Mulei, 2023). Empirical evidence from Kenya shows that cyberattacks reduce labour productivity and disrupt operations, particularly in firms without strong governance structures (Tetteh & Otioma, 2025).

Cybersecurity has direct implications for sustainable performance in tourism SMEs because these firms handle sensitive customer and payment data. Data breaches erode customer trust and damage international reputation, which remains central to tourism competitiveness. Although Kenya's Data Protection Act strengthened the regulatory environment, compliance among tourism SMEs in Nairobi remains inconsistent, exposing firms to legal and reputational risks (Wafula, 2022).

The relationship between cybersecurity and sustainable performance operates within a dynamic external environment. Environmental dynamism reflects the speed and unpredictability of changes in technology, customer preferences, competition, and regulation. Research shows that environmental dynamism shapes how firm capabilities translate into performance outcomes, particularly in technology-dependent sectors (Wang & Zhang, 2025).

Tourism is especially sensitive to environmental volatility due to fluctuating travel demand, regulatory changes, global crises, and rapid digital innovation (Dutta, 2024). In Nairobi, tourism SMEs face shifting market trends, evolving digital marketing practices, and frequent technological change. Under such conditions, cybersecurity systems that lack flexibility may fail to support continuity, while adaptive security practices can strengthen resilience and long-term performance.

Despite growing recognition of cybersecurity risks, empirical studies in Kenya largely treat cybersecurity and firm performance as a direct relationship. Limited research has examined how environmental dynamism alters this relationship within the tourism SME context. This gap restricts practical insight for managers and policymakers seeking to align cybersecurity investments with sustainable performance goals. Investigating the moderating effect of environmental dynamism is therefore necessary to explain performance differences among tourism SMEs in Nairobi and to support informed digital and security decision-making in an increasingly volatile operating environment.

Empirical Review

Cybersecurity and Sustainable Performance

Cybersecurity is defined as the protection of digital systems and data from unauthorized access and malicious attacks, playing a fundamental role in maintaining the integrity of online operations (Firmansyah, 2024). It involves a comprehensive variety of measures,

such as multi-factor authentication and threat intelligence, to mitigate risks associated with malware and phishing. Beyond technical fixes, modern cybersecurity incorporates incident response and ethical hacking to proactively identify vulnerabilities.

However, establishing a robust security posture remains a challenge for many firms due to resource constraints and the ongoing need to balance security with user privacy (Von Solms & Van Niekerk, 2013). An approach, integrating advanced technology with user awareness and stringent policy frameworks, is essential for addressing the contemporary threat landscape.

Global research increasingly demonstrates that cybersecurity governance is a direct determinant of firm resilience and long-term sustainability. Karadayi-Usta (2024) utilized Picture Fuzzy Sets and MACTOR analysis to identify that data breaches and third-party vulnerabilities are the primary risks facing the hospitality sector, noting that integrated risk management is essential for building customer trust and operational stability. Similarly, Al-Somali et al. (2024) employed structural modeling to show that strong cybersecurity governance in SMEs correlates with financial stability and continuity. These findings are supported by Arroyabe et al. (2024), whose mixed-methods study revealed that a lack of "cyber hygiene" significantly damages SME reputations and increases recovery costs, while Florido-Benítez (2024) argued that proactive, risk-oriented strategies are superior to fragmented, compliance-only approaches for ensuring service continuity.

In Africa, the cybersecurity is characterized by rising threats and varying levels of preparedness. The KPMG (2022) Africa Cyber Security Outlook identified an increase in ransomware and phishing attacks, particularly within the tourism sector, and recommended national incident response systems to mitigate systemic risk. Regional studies, such as those by Gundu and Mmango (2024) in South Africa, suggest that collaborative governance and the sharing of best practices can significantly strengthen the security posture of smaller firms. Furthermore, PT Security (2024) highlighted that weak patch management in the commercial sector has increased exposure to targeted campaigns, while Florido-Benítez (2024) emphasized that harmonized digital safety standards across Africa are necessary to bolster traveler confidence and overall sector performance.

Kenyan studies provide specific evidence linking digital security to the survival and performance of local SMEs. Mulei (2023) investigated Nairobi-based firms and found that cybercrime incidents significantly reduced operational uptime and increased transaction costs, particularly for those lacking basic technical controls. National reports from the KE-CIRT/CC (2022) echoed these concerns, noting a rise in malware incidents and a trend of low reporting among tourism SMEs, which hinders national response efforts. Additionally, Karanja and Gatobu (2024) observed that insecure IoT devices and weak system configurations expand the attack surface for Kenyan firms, increasing recovery costs. Finally, AFRALTI/TRI (2022) identified significant readiness gaps among tourism MSMEs in Kenya, concluding that targeted resilience programs are vital for reducing disruptions. Consequently, this study hypothesizes that:

H_{01}: *Cybersecurity has no significant effect on the sustainable performance of SMEs in the tourism sector in Nairobi, Kenya.*

Environmental Dynamism and Sustainable Performance

Environmental dynamism, characterized by market turbulence, infrastructural shifts, and rapidly changing business conditions, plays a critical role in shaping firm performance and sustainability outcomes. Global studies consistently highlight that firms must align their internal capabilities with these external pressures to remain viable. Habibullah and Kamal (2024) demonstrated that environmental dynamism moderates the relationship between stakeholder engagement and firm performance among tourism SMEs, suggesting that firms leveraging external support systems sustain performance better under dynamic conditions. Similarly, Nguyen et al. (2019) found that in the Vietnamese tourism sector, dynamism strengthens the link between digital marketing and dynamic capabilities, which ultimately boosts competitive advantage. Furthermore, Tjahjadi et al. (2020) emphasized that in dynamic markets like in the East Java Province of Indonesia, IT capability alone is insufficient; it must be aligned with a green market orientation to secure sustainable performance.

Across the African continent, environmental and governance pressures significantly influence the benefits derived from tourism. A World Bank/AFD synthesis by Christie et al. (2014) concluded that coordinated policy and infrastructure investments are essential to protect tourism performance under dynamic conditions. Safety and security also emerge as vital components of resilience; Florido-Benítez (2024) argued that while safety threats reduce demand in dynamic African contexts, investments in safety systems allow firms to maintain revenue flows during shocks. This is supported by Ojonta and Ogbuabor (2024), who found that governance quality is a critical moderator that mitigates the negative environmental impacts of international tourism, thereby supporting sustainable performance.

In Kenya, empirical evidence highlights the necessity of building adaptive capabilities to navigate market turbulence. At the national level, the Tourism Research Institute (2023) identified systemic shocks such as infrastructure gaps and insecurity as major drivers of dynamism, recommending diversification to protect firm-level resilience. In the specific context of Nairobi, Kisilu (2024) demonstrated that strategic promotion and marketing agility allow tour operators to adapt to shifting demand patterns. Based on these discussions, the study hypothesized that:

H_{02}: Environmental dynamism has no significant effect on the sustainable performance of the SMEs in the tourism sector Nairobi Kenya

Moderating Role of Environmental Dynamism

Environmental dynamism represents the rate and unpredictability of changes within a firm's external environment, encompassing shifts in technology, customer preferences, and regulatory frameworks. In organizational research, dynamism is frequently analyzed as a contingency factor that alters the strength or direction of the relationship between internal capabilities and firm performance. Global empirical studies consistently highlight that environmental dynamism acts as a powerful catalyst or "noise" factor in the performance equation. Suder (2025) explored the role of the external environment in the hotel industry, finding that environmental uncertainty significantly moderated the link between entrepreneurial orientation and firm success. The study concluded that

strategic flexibility is more valuable when market conditions are turbulent. Similarly, Yu et al. (2023) argued that environmental uncertainty drives "process ambidexterity," where firms must balance routine operations with rapid flexibility to survive. Faruquee et al. (2024) further demonstrated that the effect of dynamism on proactive resilience is dual-edged; while it necessitates innovation, it can also lead to "dark side" effects such as resource exhaustion if governance mechanisms are weak. These global findings suggest that for tourism SMEs, the effectiveness of digital tools like cybersecurity is inherently tied to how quickly the external landscape is shifting.

In Africa, research emphasizes how dynamism often manifests as political instability, rapid digital leapfrogging, and fluctuating regulatory environments. Habibullah and Kamal (2024) investigated SMEs and found that environmental dynamism significantly moderated the relationship between strategic planning and performance. Their results indicated that in highly volatile African markets, rigid strategies failed, while dynamic capabilities allowed firms to pivot and capture new opportunities. In the tourism sector specifically, Asongu et al. (2023) highlighted that political and legal stability or the lack thereof creates a dynamic environment that dictates whether tourism management practices translate into economic development. For Sub-Saharan African SMEs, environmental dynamism often acts as a "buffer" or "barrier," where the lack of a stable ICT policy can weaken the performance gains typically expected from digital investments (Achieng, 2022).

In Kenya, empirical evidence focuses on the high-velocity nature of the digital and wildlife tourism sectors. Nairobi's tourism SMEs operate in a space characterized by rapid changes in travel advisories, seasonal climate variability, and evolving digital marketing trends. Rotich (2025) noted that climate change and policy shifts create a dynamic environment that forces Kenyan tourism firms to constantly adapt their operational models to remain sustainable. Furthermore, studies on Kenyan SMEs by Mumassabba (2024) revealed that environmental dynamism moderates the relationship between risk management strategies and competitiveness. Specifically, in the presence of high market turbulence, firms with robust risk and security protocols outperformed those with reactive postures. This suggests that for Nairobi-based tourism firms, cybersecurity is not just a technical requirement but a strategic necessity that becomes even more critical when the business environment is unpredictable. Consequently, this study hypothesizes that:

H_{03}: *Environmental dynamism has no moderating effect on the relation between cyber security and the sustainable performance of the SMEs in the tourism sector Nairobi Kenya*.

Theoretical Review

The Technology-Organization-Environment (TOE) framework, developed by Tornatzky and Fleischer (1990), serves as a comprehensive multi-perspective model for understanding the adoption and implementation of technological innovations within an organization. Unlike theories that focus solely on the technical aspects of an innovation, TOE posits that the process of adopting technology is influenced by three distinct contexts: the technological, organizational, and environmental. These three elements interact to influence how a firm identifies and implements digital solutions, ultimately determining the impact of those technologies on firm performance

(Malik et al., 2021). In this study, the technological context refers to the specific ICT components utilized by the SMEs, namely cybersecurity. This context examines how the availability and perceived benefits of these tools shape the digital resilience of tourism firms. The organizational context encompasses internal characteristics such as firm size, managerial support, and resource availability (Badghish, 2024). It provides the bridge between technology adoption and the achievement of sustainable performance, as internal firm capacity determines how effectively security measures are integrated into business operations. The environmental context is specifically operationalized in this study through environmental dynamism. This describes the external arena including market turbulence, regulatory shifts, and competitor behavior in which Nairobi's tourism SMEs conduct their business. The TOE theory is suited for this research because it accounts for the environment as a critical factor that can alter organizational outcomes (Hui & Mohammadi, 2024). Applying the TOE framework, the study can explain how the interaction between digital security (technology), internal firm capacity (organization) and market volatility (environment) determines the sustainable success of the tourism sector in Kenya.

Methodology

Study Area

The study was conducted within the tourism sector of Nairobi County, Kenya's primary economic hub and the center of its tourism industry. Nairobi was chosen due to its high concentration of tourism-related SMEs, including hotels, travel agencies, and tour operators that relied heavily on digital infrastructure for global competitiveness.

Research Design

The study was grounded in an explanatory research design, which was selected to facilitate the identification of causal relationships between the hypothesized variables without direct manipulation. This quantitative approach was well-suited for evaluating the research hypotheses and provided a structured method for explaining how environmental dynamism moderated the connection between ICT adoption specifically cybersecurity and the sustainable performance of tourism enterprises.

Target Population

The target population comprised 1,200 top-level managers drawn from 120 licensed and classified tourism firms as identified by the Kenya Association of Tour Operators (KATO) and the Kenya Association of Travel Agents (KATA). While the unit of analysis remained the 120 registered firms, the managers served as the unit of inquiry to provide detailed operational and strategic information regarding the firm's cybersecurity posture and performance metrics.

Sampling Design and Procedure

A sample size of 300 respondents was determined using the Taro Yamane (1973) formula, based on a population of 1,200 managers and a 5 percent margin of error. This sample size met the requirements for explanatory studies and provided adequate statistical power for regression and moderation analysis. Stratified random sampling was applied to give proportional representation across firms and managerial levels, reducing selection bias and improving generalizability.

Data Collection and Research Instruments

Primary data were collected using a structured questionnaire administered

to the sampled managers. The questionnaire allowed efficient data collection from a relatively large sample within a limited time frame. The instrument consisted of four sections covering firm background information, cybersecurity practices, environmental dynamism, and sustainable performance. All substantive items were measured using a five-point Likert scale ranging from strongly disagree to strongly agree.

Reliability and Validity

A pilot study was conducted using 30 questionnaires administered to tourism SMEs in Mombasa County, which share operational characteristics with firms in Nairobi. The pilot test supported refinement of the instrument and assessment of reliability and validity. Reliability was assessed using Cronbach's alpha, with values of 0.70 and above accepted as satisfactory. Content validity was established through expert review, while construct validity was assessed using factor analysis with acceptable Kaiser–Meyer–Olkin values above 0.5.

Data Analysis and Model Specification

Data were coded and analyzed using SPSS version 25. Descriptive statistics summarized respondent characteristics and variable distributions using means, standard deviations, frequencies, and percentages. Inferential analysis involved correlation and multiple regression techniques. Moderation analysis was conducted by introducing an interaction term between cybersecurity and environmental dynamism. A significant interaction coefficient indicated the presence of a moderating effect, consistent with established moderation testing procedures (Baron & Kenny, 1986; Judd et al., 2014).

A multiple regression model analysis was employed as below:

$Y= \beta_{0+C}$..... Model 1

$Y= \beta_0 +C+ \beta_1X_1 + \varepsilon$.....Model 2

$Y= \beta_0 +C+ \beta_1X_1 + \beta_2ED+ \beta_3X_1{*}ED+ \varepsilon$.....Model 3

Whereby:

Y= Sustainable performance

B_0= Constant

X_1= cyber security

ED= Environmental dynamism

ε= Error term

C= control variable (age, experience and gender)

$\beta_1, \beta_2, \beta_3$ = Regression Coefficients

Results and Discussion

Descriptive Statistics of Sustainable Performance

Sustainability performance variable was measured using 15 items each rated on the Likert scale; 5 = Strongly Agree, 1=Strongly Disagree. These descriptive statistics provided insight into how well an organization managed its environmental, social, and governance (ESG) responsibilities.

Responses to economic indicators, such as profitability (ECO1, M = 3.08, SD = 1.288) and cost-efficiency strategies (ECO2, M = 3.08, SD = 1.286), suggested moderate financial stability with some variability across firms. Market adaptability (ECO3, M = 3.10, SD = 1.307) and revenue diversity (ECO4, M = 3.11, SD = 1.288) showed slightly positive perceptions but with dispersed views. Investment in innovation and infrastructure (ECO5, M = 3.11, SD = 1.284) reflected moderate commitment to long-term growth. Social sustainability indicators, including fair employee treatment (SOC1, M = 3.10, SD = 1.290) and investment in employee well-being (SOC2, M = 3.08, SD = 1.289), displayed neutral to moderately positive perceptions, indicating variability in organizational practices. Community development participation (SOC3, M =

3.10, SD = 1.305), health and safety (SOC4, M = 3.07, SD = 1.292), and inclusivity in decision-making (SOC5, M = 3.06, SD = 1.301) followed a similar pattern of moderate engagement with some inconsistency.

Environmental sustainability indicators ranged from eco-friendly practices (EVS1, M = 3.07, SD = 1.278) to investments in green innovations (EVS5, M = 3.12, SD = 1.265). Overall, environmental measures were moderately adopted, with green innovation showing the highest positive perception. The overall mean for sustainable performance was 3.09 (SD = 1.214), indicating that firms were, on average, moderately engaged in sustainability practices, with a range of responses from low to high integration of economic, social, and environmental dimensions.

Table 1: Descriptive statistics for sustainable performance

Descriptive Statistics					
	N	Min	Max	Mean	Std. Dev
ECO1: Our organization consistently generates sufficient profits to support long-term operations and growth.	283	1	5	3.08	1.288
ECO2: In the firm we have implemented cost-reduction strategies that enhance efficiency without compromising product or service quality.	283	1	5	3.08	1.286
ECO3: Our organization remains competitive by adapting to changing market trends and consumer demands.	283	1	5	3.10	1.307
ECO4: In the firm we have diverse and stable revenue streams that reduce dependence on a single source of income.	283	1	5	3.11	1.288
ECO5: Our organization invests in innovation and infrastructure to secure long-term financial growth.	283	1	5	3.11	1.284
SOC1: Our organization ensures fair treatment for all employees no bias of gender, age, or background.	283	1	5	3.10	1.290
SOC2: The organization actively invest in employee well-being programs, such as healthcare, training, and work-life balance initiatives.	283	1	5	3.08	1.289
SOC3: Our organization engages in meaningful community development initiatives that improve the quality of life for local residents.	283	1	5	3.10	1.305
SOC4: The firm uphold strong workplace health and safety standards to protect employees from occupational risks.	283	1	5	3.07	1.292
SOC5: Our organization fosters a culture of inclusivity, diversity, and participation in decision-making at all levels.	283	1	5	3.06	1.301

EVN1: Our organization adopts eco-friendly practices to reduce negative impacts on the natural environment.	283	1	5	3.07	1.278
ENV2: The firm actively implement energy-efficient processes and technologies to reduce consumption of non-renewable resources.	283	1	5	3.06	1.314
ENV3: Our organization has effective waste management and recycling programs that promote circular economy principles.	283	1	5	3.11	1.278
ENV4: The comply with environmental regulations and standards to ensure sustainable operations.	283	1	5	3.06	1.274
ENV5: Our organization invests in green innovations and sustainable products that contribute to environmental preservation.	283	1	5	3.12	1.265
The overall descriptive for SP	283	1.00	5.00	3.0865	1.21416

Source: Researcher, (2025)

Descriptive statistics for Cyber Security

Cyber security variable was measured using 5 items each rated on the Likert scale; 5 = Strongly Agree, 1=Strongly Disagree. The findings are presented in Table 2.

Table 2: Descriptive Statistics for cyber security

Descriptive Statistics					
	N	Min	Max	Mean	Std. Dev
CSS 1: Our organization has effective cybersecurity measures in place to protect sensitive data and digital assets.	283	1	5	3.10	1.290
CSS2: The firm comply with national and international cybersecurity regulations and standards in our operations.	283	1	5	3.08	1.289
CSS3: Our organization conducts regular risk assessments to identify and mitigate potential cybersecurity threats.	283	1	5	3.10	1.305
CSS4: Our organization has a robust incident response system that ensures resilience in the face of cyberattacks.	283	1	5	3.07	1.292
CS5: Our firm provide continuous training and awareness programs to employees on cybersecurity best practices.	283	1	5	3.06	1.301

Source: Researcher, (2025)

The first indicator, assessing whether organizations had effective cybersecurity measures to protect sensitive data and digital assets (CSS1), recorded a mean of 3.10 with a standard deviation of 1.290. This suggests that while many firms had established some protective measures, there was noticeable variation in implementation and maturity levels across organizations.

The second item, compliance with national and international cybersecurity regulations and standards (CSS2), had a mean of 3.08 and a standard deviation of 1.289. This indicates moderate adherence to regulatory requirements, with some firms fully compliant and others only partially observing best practices. For the third indicator, which measured the frequency and effectiveness of regular risk assessments to identify and mitigate cybersecurity threats (CSS3), the mean was 3.10 with a standard deviation of 1.305, reflecting that most organizations performed risk assessments but with varying levels of rigor and consistency.

Regarding the fourth item, robustness of incident response systems to ensure resilience in the face of cyberattacks (CSS4), the mean was 3.07 with a standard deviation of 1.292. This suggests that while several firms had mechanisms in place to respond to cyber incidents, the application and readiness of these systems differed across the sample. Finally, the fifth indicator, which captured continuous training and awareness programs for employees on cybersecurity best practices (CSS5), showed a mean of 3.06 with a standard deviation of 1.301. This indicates moderate implementation of training initiatives, though differences exist in prioritization and scope among firms.

Descriptive Statistics for Environmental Dynamism

Environmental dynamisms variable was measured using 6 items each rated on the Likert scale; 5 = Strongly Agree, 1=Strongly Disagree The results concerning the descriptive statistics for the environmental dynamism (ED) dimension revealed that firms functioned in moderately dynamic environments with differences in the degree to which external forces shaped their environments as indicated in Table 3.

Table 3: Descriptive statistics for environmental dynamism

Descriptive Statistics					
	N	Min	Max	Mean	Std. Dev
ED1: The business environment the firm operate in is highly unpredictable, with frequent changes that affect our operations.	283	1	5	3.05	1.225
ED2: Technological advancements in our industry occur rapidly and require continuous adaptation.	283	1	5	3.06	1.222
ED3: Customer needs and preferences in our market change quickly and unexpectedly.	283	1	5	3.07	1.256
ED4: Our organization faces intense competition due to constantly changing industry dynamics.	283	1	5	3.06	1.262
ED5: The firm experience frequent shifts in government regulations and policies that impact our business strategies.	283	1	5	3.06	1.223
The overall descriptive for EVD	283	1.00	5.00	3.0654	1.16571

Source: Researcher, (2025)

For the first predictor ED1, the business environment the firm functioned in was so dynamic that the firm operated under an unpredictable environment with

considerable frequent changes in operational shifts repeated within the period under study. The results returned a M= 3.05 and SD= 1.225. This showed that firms did operate under moderate unpredictability but there was a greater disproportion in the estimation as some firm operated under extreme stability while others operated under extreme unpredictability and instability.

For the second predictor ED2 which predicted the pace of technological changes in the environment as being so rapid and dynamic that firms and the industry as a whole had to constantly readapt and shift. The results returned a M= 3.06 and SD= 1.222. This showed that the firms in the study context recognized the rapid changes in technology but the impact of the pace had shifted disproportionally across the firms in the environment with some firms rapidly adapting as others falling so far behind that they to the extreme of so slow that have technological stagnation. The third predictor ED3 which encompassed the changes and operational shifts with a M= 3.07 and SD= 1.256 described that market customer needs and preferences changed rapidly and in the context the firm shifted so considerably. The firm was described to have shifted casually with some undergoing an extreme amount centrifugal changes in their environment while others remained operated in a considerably stable environment.

Regarding the fourth indicator on how organizations encounter competitive rivalry due to dynamic industry changes (ED4), average rating results yielded 3.06 mean and SD= 1.262. While, on average, competition might be viewed as fairly strong, there seems to be disparity on how different firms perceive the level rivalry spawned from changes in the industry. In the fifth indicator where regulatory shifts that impact business strategies are considered (ED5), there is a M= 3.06 and SD=1.223. While deeply, and at times diversified, shifts are made in the regulatory framework, it seems that impact on the business, and in the level of shifts to business strategies are framed as moderate. Moreover, the additional indicator (ED6) had a M= 3.09 and a SD=1.243, reinforces the framing that the firms were experiencing, to some moderate extent, changes in their external environments, with the divergence in the answers speaking to the difference in how intense such changes were.

Cumulatively, the results portray a meaningful level of stability on the EVD framework. From a M= 3.07, and a SD= 1.166, it is fair to conclude firms made more impact shifts on their business. While some firms work under highly turbulent conditions, there are others with less frequent operational interruptions. At the same time, operational and industry diversity must be considered when comparing shifts across business.

Correlation Analysis

Correlation analysis was conducted to examine the strength and direction of the linear relationships among the key study variables: sustainable performance (SP), cybersecurity (CS), and environmental dynamism (ED). Pearson's correlation coefficient (r) was used, which ranges from -1 to +1. A positive value indicates a direct relationship, while a negative value indicates an inverse relationship. The closer the value is to ±1, the stronger the association. Significance levels were interpreted at 0.01 and 0.05. Results are summarized in Table 4.

Table 4: Pearson Correlation Coefficients

Variables	SP	CS	ED
Sustainable Performance (SP)	1		
Cyber Security (CS)	.492**	1	
Environmental Dynamism (ED)	.235**	.118*	1

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

***Source**: Researcher, (2025)*

The results show a moderate, positive, and statistically significant relationship between cybersecurity and sustainable performance ($r = 0.492$, $p < 0.01$). This indicates that tourism SMEs with stronger cybersecurity practices tend to report higher levels of sustainable performance. Improved data protection, system reliability, and transaction security likely support operational stability and stakeholder confidence. Environmental dynamism also demonstrates a positive and significant relationship with sustainable performance ($r = 0.235$, $p < 0.01$), though the association is weaker. This suggests that SMEs operating in more dynamic environments benefit from adaptability and responsiveness, which contributes to better sustainability outcomes. The correlation between environmental dynamism and cybersecurity is positive but weak ($r = 0.118$, $p < 0.05$). This implies that firms facing dynamic external conditions may slightly increase their focus on cybersecurity, though environmental changes alone do not strongly drive cybersecurity adoption.

Hypotheses Testing and Regression Findings

The analysis focused on the effect of cybersecurity on sustainable performance and the moderating role of environmental dynamism among tourism SMEs in Nairobi County. Firm age and managerial experience were retained as control variables to isolate the net effects of the main study variables.

Direct Effect of Cybersecurity on Sustainable Performance

The first hypothesis (H_{01}) stated that cyber security has no significant effect on the sustainable performance of the SMEs in the tourism sector Nairobi Kenya. The findings are presented in Table 5. The regression analysis results show a positive and significant effect of cyber security on sustainable performance ($\beta = 0.351$, $p < 0.05$). This finding implies that improvements in cyber security practices are associated with enhanced sustainable performance among SMEs operating in the tourism sector. The positive coefficient suggests that as SMEs strengthen their cyber security infrastructure through measures such as data protection, threat detection, and secure digital transactions they experience notable gains in sustainability. These gains may stem from reduced vulnerability to cyber threats, improved stakeholder trust, enhanced operational continuity, and compliance with regulatory standards, all of which contribute to long-term organizational resilience and responsible business conduct. This finding is consistent with Mulei (2023), who investigated the influence of cybercrime on SME performance in Nairobi. Mulei's survey revealed that cybercrime incidents reduced uptime and increased transaction costs, with firms lacking basic controls suffering the greatest losses. The current regression result reinforces Mulei's conclusion by showing that SMEs that

invest in cybersecurity infrastructure not only reduce vulnerability but also achieve measurable sustainability gains. KE-CIRT/CC (2022) provided national-level evidence through quarterly incident reporting, highlighting rising phishing and malware attacks and low incident reporting among tourism SMEs. The Nairobi regression result aligns with this evidence, suggesting that SMEs that adopt proactive cybersecurity measures such as incident reporting and awareness campaigns are better positioned to sustain performance and protect customer trust. Karanja and Gatobu (2024) examined IoT and cyberattacks among Kenyan fintech firms, finding that weak system configurations and insecure devices increased exposure. Their recommendation for stronger configuration standards and security controls resonates with the Nairobi finding: SMEs that implement robust cybersecurity practices experience improved operational continuity and reduced recovery costs, which directly support sustainability outcomes. AFRALTI/TRI (2022) emphasized the importance of digital resilience and cyber hygiene training for tourism MSMEs during COVID-19. The regression result confirms that such resilience-building measures translate into sustainable performance by reducing operational disruptions and supporting recovery during shocks

Table 5: Regression results of direct effect

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
2	(Constant)	-2.429	.240		-10.118	.000
	Firm Age	.227	.035	.218	6.440	.000
	Experience	.243	.035	.232	6.885	.000
	Cyber Security	.487	.034	.481	14.284	.000
	Model Summary					
	R	0.830				
	R^2 Change	0.590				
	Std. Error of the Estimate	0.68345				
	Model Fit					
	F change	174.966				
	Sig.	0.000				

a. Dependent Variable: Sustainable Performance

Source: Researcher, (2025)

Effects of Environmental Dynamism on Sustainable Performance

The second hypothesis (H_{02}) stated that environmental dynamism has no significant effect on the sustainable performance of the SMEs in the tourism sector Nairobi Kenya. Controlling for firm age ($\beta = 0.219$, $p < 0.05$) and experience ($\beta = 0.208$, $p < 0.05$), the regression analysis revealed a positive and statistically significant effect of environmental dynamism on sustainable performance ($\beta = 0.177$, $p < 0.05$). This implies that as environmental dynamism increases characterized by frequent, unpredictable changes in market conditions, regulations,

customer preferences, or technological demands sustainable performance among tourism SMEs tends to increase. Further it implies that older and more experience firms have an effect on sustainable performance compared to young and firms with less experience.

Table 6: effect of environmental dynamism on the relationship between AI and sustainable performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
3	(Constant)	-2.897	.244		-11.860	.000
	Firm Age	.228	.034	.219	6.800	.000
	Experience	.218	.034	.208	6.429	.000
	Environmental Dynamism	.184	.034	.177	5.435	.000

Model Summary	
R	0.848
R^2 Change	0.030
Std. Error of the Estimate	0.65075
Model Fit	
F change	29.535
Sig.	0.000

a. Dependent Variable: Sustainable Performance

***Source**: Researcher, (2025)*

Moderating Effect of Environmental Dynamism on Cyber Security and Sustainable Performance

The third hypothesis (H_{03}) stated environmental dynamism has no moderating effect on the relation between cyber security and the sustainable performance of the SMEs in the tourism sector Nairobi Kenya.

Table 7: Moderating effect of environmental dynamism on the cybersecurity–sustainable performance relationship

Variable	Beta	Sig.
Firm Age	0.223	.000
Experience	0.212	.000
Cybersecurity	0.351	.000
Environmental Dynamism	-0.311	.035
Cybersecurity × Environmental Dynamism	0.170	.188

***Source**: Researcher, (2025)*

Model 3 tested the moderating effect of environmental dynamism on the relationship between cybersecurity and sustainable performance. The interaction term is positive but statistically non-significant (β = 0.170, p = 0.188). This result leads to failure to reject the null hypothesis. Environmental dynamism does not significantly alter the strength of

the cybersecurity–sustainable performance relationship.

Figure 1 displays the third interaction effect which explores how environmental dynamism moderates the relation between cyber security and sustainable performance. The findings suggest that both the level of cyber security and the degree of environmental dynamism jointly shape organizational outcomes in meaningful ways. In relatively stable environments characterized by low environmental dynamism—enhancing cyber security from a low to high level leads to a moderate improvement in sustainable performance. This indicates that even in predictable settings, robust cyber security contributes positively to organizational sustainability, likely by safeguarding digital assets and ensuring operational continuity.

However, the impact of cyber security becomes more pronounced under conditions of high environmental dynamism. In such volatile contexts, organizations with low cyber security capacity report a marginally higher performance than those in stable environments, possibly due to adaptive responses to external pressures. Yet, when cyber security is elevated to a high level, sustainable performance surges to 3.450. This substantial increase highlights the strategic importance of cyber resilience in dynamic environments, where threats are more frequent and complex. The interaction effect thus reveals that environmental dynamism amplifies the benefits of cyber security. While foundational security measures yield consistent gains in stable settings, their transformative potential is most evident when organizations face uncertainty and rapid change. Conversely, insufficient cyber security in such contexts may expose institutions to heightened risks and performance constraints.

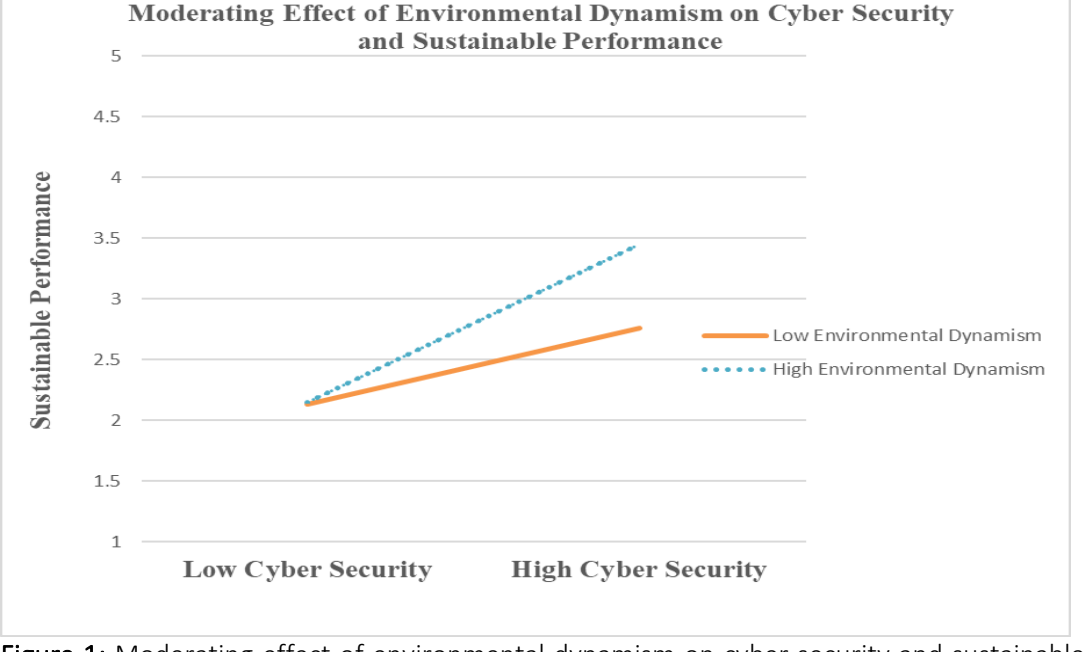

Figure 1: Moderating effect of environmental dynamism on cyber security and sustainable performance

***Source**: Researcher, (2025)*

Conclusion

The study reveals that cybersecurity adoption among SMEs in Nairobi's tourism

sector is moderate, as indicated by descriptive statistics with mean scores ranging from 3.06 to 3.16 across key indicators. Organizations demonstrate varying levels of implementation in areas such as risk assessments, incident response systems, and employee cybersecurity training, reflecting a mix of awareness and resource capacity. Correlation analysis revealed a positive and significant relationship between cybersecurity and sustainable performance, while environmental dynamism also showed a significant, though weaker, positive correlation with sustainable performance. Regression results further confirmed that cybersecurity is a significant predictor of sustainable performance and environmental dynamism positively moderates this relationship, indicating that firms operating in more dynamic environments gain greater benefits from robust cybersecurity practices. Hence, the findings suggest that SMEs with stronger cybersecurity measures achieve higher sustainable performance, particularly when they operate in rapidly changing, competitive, or uncertain market conditions.

Recommendations

Managerial Recommendations

From a managerial perspective, the study emphasizes that ICT integration, particularly cybersecurity, should be a strategic priority for SMEs rather than a peripheral operational upgrade. Firms must embed cybersecurity measures into core operations to protect digital assets, maintain stakeholder trust, and comply with regulatory requirements. Effective cybersecurity enhances organizational resilience and ensures continuity of operations in dynamic business environments. Managers should adopt comprehensive strategies that combine technological deployment with risk management and continuous learning to maximize sustainable performance.

Firms should invest in robust cybersecurity infrastructure, including threat detection systems, secure digital transactions, and resilient incident response frameworks. Such investments reduce operational risks and strengthen the organization's ability to respond effectively to cyber threats. Regular risk assessments are essential to proactively identify vulnerabilities and implement corrective measures. Equally important is the establishment of continuous employee training programs that provide awareness of emerging threats and promote adherence to cybersecurity protocols.

Standardizing cybersecurity practices across the organization is recommended to ensure consistent implementation. This includes developing internal guidelines and frameworks aligned with national and international standards. Periodic evaluation of cybersecurity measures will allow managers to monitor effectiveness, incorporate new technologies, and adjust strategies in response to evolving threats and dynamic external conditions.

Policy Recommendations

Policymakers should create an enabling environment that supports SMEs in integrating ICT for sustainable performance. Targeted incentives such as grants, tax reliefs, and subsidized training programs can reduce financial and technical barriers, empowering SMEs to adopt advanced technologies, including cybersecurity. Developing reliable digital infrastructure, such as broadband connectivity, secure data platforms, and stable power supply, is critical to reduce vulnerability to environmental dynamism and operational disruptions.

Regulatory frameworks that promote cybersecurity governance and data protection should be strengthened. SMEs relying on digital platforms to manage operations, customer information, and financial transactions require enforceable standards for data privacy, compliance, and accountability. Sector-specific guidelines should also be developed to help SMEs align ICT adoption with sustainability objectives, including best practices for digital tools, benchmarks for environmental scanning, and templates for integrating ICT into organizational strategy.

Future studies

Future researchers could examine the role of organizational readiness or government support as potential moderators that might bridge the gap between resource availability and technology adoption. Given the rapid advancement of digital tools, specifically looking at the moderating role of technological turbulence as a distinct construct from general environmental dynamism could provide deeper insights into how the pace of tech innovation itself affects security strategy. Such studies would continue to build on the Technology-Organization-Environment (TOE) framework by refining the specific factors that lead to long-term sustainability in the global south.

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