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Linking Green Product, Process, and Finance Innovations to Firm Competitive Performance: Insights from Namanve Industrial Cluster, Uganda

Ahabyoona Faith Mugisha[1], Mugisha Henry[2*], Lumu Emmanuel Roy Muyingo[3]
Bisaaso Rita[1]

[1,2]School of Management and Entrepreneurship, Department of Accounting, Finance and Microfinance, Kyambogo University, Uganda, Kampala, Uganda
[3] Business, Law, Communication, and Accounting, INTI International University, Malaysia

[*]**Email:** faithmugisha80@gmail.com; fmahabyoona@kyu.ac.ug

Abstract

This study examined how green product, process, and finance innovations influence the competitive performance of manufacturing firms in Uganda's Namanve Industrial Cluster. Guided by Porter's Green Innovation Theory and Financial Innovation Theory, it argues that environmentally driven innovations enhance operational efficiency and competitiveness when supported by effective financial mechanisms. Using a cross-sectional survey design and quantitative approach, data were collected from 51 of 54 targeted firms (response rate = 94.4%). Correlation results showed significant positive associations between green product ($r = .465^{**}$, $p < .01$), process ($r = .546^{**}$, $p < .01$), and finance innovations ($r = .749^{**}$, $p < .01$) with competitive performance. Hierarchical regression indicated that these variables jointly explained 67% of the performance variance, with green finance exerting the strongest predictive effect ($\beta = .521$, $p < .01$). The study concludes that green finance amplifies the performance impact of product and process innovations and recommends integrating circular economy practices and financial incentives to enhance sustainable competitiveness

Keywords

Green Product, Process, Finance Innovations, competitive performance, Uganda

Introduction

In today's rapidly evolving industrial landscape, competitive performance remains essential for firm survival, growth, and long-term sustainability. Heightened global competition, technological disruption, and rising environmental pressures continue to reshape traditional industrial models, compelling firms to adopt innovations that enhance efficiency while reducing ecological impact (Porter & van der Linde, 1995; Geissdoerfer et al., 2017). Within this context,

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green innovation, encompassing green product, process, and financial innovations, has become a strategic pathway for competitiveness. It integrates environmental responsibility with technological advancement and sustainable financing to improve productivity, profitability, and corporate reputation (Aldoghan & Sundram, 2023; Paul, 2024).

In developing economies such as Uganda, the intersection between sustainability and competitiveness is increasingly important. National frameworks, including Vision 2040 and the Green Growth Development Strategy (2017–2030), underscore the country's commitment to resource-efficient and environmentally responsible industrialization. The Namanve Industrial Cluster, Uganda's flagship manufacturing hub, reflects this transition, hosting firms across steel, agro-processing, construction materials, and related sectors. Despite supportive policies promoting cleaner production (National Industrial Policy, 2020), many firms continue to grapple with high production costs, inconsistent product quality, and inefficient resource utilization, undermining their competitive performance (Asiimwe & Tumwebaze, 2022).

While competitive performance is typically assessed through indicators such as market share, cost leadership, product quality, and operational efficiency (OECD, 2021; Porter, 1990), many firms in Namanve operate below optimal capacity and struggle with limited differentiation and inadequate access to affordable capital for technological upgrading (Kaggwa, 2020; UNIDO, 2023). Although various environmental initiatives, such as eco-design, renewable energy adoption, and waste recycling, have been introduced, their contribution to competitiveness remains empirically unclear (Mugisha, 2022). Prior studies have focused primarily on sustainability awareness rather than establishing measurable linkages between green innovation and firm performance.

This study is grounded in Porter's Green Innovation Theory, which posits that environmental challenges can stimulate innovations that generate both ecological and economic benefits (Dugoua & Dumas, 2021), and Financial Innovation Theory (Schumpeter, 1934), which highlights the role of innovative financing instruments in enabling technological upgrading. Integrating these perspectives provides a robust framework for assessing how environmentally responsible strategies supported by green finance enhance firm competitiveness.

Accordingly, this study examines how green product, process, and finance innovations influence competitive performance among firms in the Namanve Industrial Cluster. The findings aim to inform industrial policy, guide managerial decision-making, and advance understanding of sustainability-driven competitiveness in emerging economies

Methodology

This study adopted a systematic methodological framework to investigate the relationship between green product, green process, and green finance innovations and the competitive performance of manufacturing firms in the Namanve Industrial Cluster, Uganda. Guided by Porter's Competitive Advantage Theory (Porter & van der Linde, 1995) and Financial Innovation Theory (Schumpeter, 1934), the methodology was structured to empirically assess how environmentally oriented and financial innovations contribute to firm competitiveness through efficiency and differentiation.

A cross-sectional correlational survey design was employed, enabling the assessment of associations among study variables at a single point in time without manipulating the research

environment (Creswell & Creswell, 2022). A quantitative approach was selected to ensure objectivity, support statistical generalization, and facilitate hypothesis testing.

The study population consisted of all 63 manufacturing firms registered in the Namanve Industrial Cluster (UIA, 2022). These firms operate across steel manufacturing, beverages, packaging, construction materials, and agro-processing. Each firm served as a unit of analysis, while the unit of inquiry was a senior manager knowledgeable about innovation practices and competitive performance.

The sample size of 54 firms was determined using Yamane's (1967) formula at a 95% confidence level and a 5% margin of error. A mixed sampling strategy was applied: simple random sampling to select firms and purposive sampling to identify qualified respondents within each firm (Amin, 2005).

Primary data were collected through a structured, self-administered questionnaire organized into four sections aligned with the study constructs. All items were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The instrument was pretested using 10 firms outside the main sample.

Validity was evaluated through expert review, and Content Validity Index (CVI) scores for all constructs exceeded the 0.70 benchmark. Reliability was established through a pilot test involving 20 respondents, with all Cronbach's alpha coefficients surpassing the recommended 0.70 threshold, demonstrating strong internal consistency.

Data were coded, cleaned, and analyzed using IBM SPSS Version 25. Descriptive statistics summarized firm characteristics, while Pearson correlation and multiple linear regression assessed the strength and predictive effects of green innovations on competitive performance. The regression model followed the specification: $Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\varepsilon Y$

The study complied with ethical requirements of APA (2022) and UNCST, ensuring informed consent, confidentiality, voluntary participation, and secure data handling.

Results and Discussion

Demographics. Of 51 managerial respondents, gender distribution was balanced (Male 51%, Female 49%). All respondents held tertiary qualifications (78.4% Bachelor's; 21.6% Master's). The modal age group was 38–47 years (47.1%) and most respondents had 4–6 years in their current position (35.3%). Over half the firms (51%) had operated for 10+ years. These characteristics indicate experienced informants with operational knowledge appropriate for assessing innovation and performance.

Descriptive results. Construct grand means (5-point Likert) were: Green Process 3.67, Competitive Performance 3.03, Green Product 2.70, Green Finance 2.56. Product-level practices are partially embedded: recyclable materials scored highest (M=3.84) while avoidance of non-recyclables and degradable inputs remained low (M≈2.1–2.6), showing uneven adoption. Process innovations are comparatively mature—closed-loop systems and air-pollution controls recorded high, tightly clustered means (M≥3.94), and environmental reporting was consistent (M=3.73). Green finance is weakest: while prioritised conceptually (M=3.20), actual budget allocation (M=2.02) and affordability (M=1.80) are low, indicating an intention–resource gap. Competitive performance is strongest in cost reduction and waste minimization (M≈3.86–3.90) but weaker on unit cost, maintenance, logistics and on-time delivery metrics (means <3.2), reflecting operational bottlenecks.

Inferential results. Pearson correlations show significant positive associations between innovations and performance: green finance (r=.749, p<.01), green process (r=.546, p<.01), green product (r=.465, p<.01). Hierarchical regression (controls → product → process → finance) yields progressive R^2 increases from .215 to .670. Green product initially adds substantial explanatory power (β=.537); process adds further value (β=.243); adding green finance produces the largest marginal gain (β=.521) and reduces but does not eliminate product/process effects. Thus, finance appears to amplify the performance returns of product and process innovations.

Row	Model 1 (Controls Only)	Model 2 (Model 1 + Green Product)	Model 3 (Model 2 + Green Process)	Model 4 (Full Model: + Green Finance)
1	Gender: 0.019 (0.116), β = .023	Gender: –0.019 (0.097), β = –.023	Gender: –0.007 (0.095), β = –.009	Gender: –0.022 (0.078), β = –.027
2	Age: –0.008 (0.090), β = –.018	Age: –0.002 (0.075), β = –.005	Age: –0.012 (0.073), β = –.028	Age: –0.016 (0.060), β = –.036
3	Education: 0.346 (0.174), β = .359*	Education: 0.267 (0.145), β = .277*	Education: 0.212 (0.146), β = .220	Education: 0.121 (0.122), β = .125
4	Years in position: 0.134 (0.074), β = .359*	Years in position: 0.147 (0.061), β = .397*	Years in position: 0.122 (0.062), β = .328	Years in position: 0.089 (0.051), β = .241
5	Firm age: –0.111 (0.071), β = –.279	Firm age: –0.040 (0.061), β = –.101	Firm age: –0.008 (0.063), β = –.020	Firm age: –0.010 (0.052), β = –.024
6	—	Green product: 0.340 (0.074), β = .537*	Green product: 0.267 (0.084), β = .422*	Green product: 0.114 (0.077), β = .180
7	—	—	Green process: 0.284 (0.163), β = .243**	Green process: 0.179 (0.137), β = .153
8	—	—	—	Green finance: 0.351 (0.076), β = .521**
9	Model R^2 = .215	Model R^2 = .470	Model R^2 = .504	Model R^2 = .670
10	F = 2.460, p = .047	F = 6.490, p < .001	F = 6.248, p < .001	F = 10.654, p < .001

Discussions: Findings align with the study objective: process and product innovations positively affect competitiveness, but structured green finance is the principal enabler. Novelty: the analysis quantifies finance's amplification effect in an emerging-market cluster, showing finance both raises explained variance (to ≈67%) and moderates' product/process coefficients, evidence that financing determines whether technical and product investments scale and deliver measurable performance gains. This extends Porter's efficiency/differentiation channels by empirically integrating a Schumpeterian finance mechanism.

Comparatively, results mirror regional studies reporting process-led operational gains but limited product differentiation without finance (e.g., Kaggwa, UNIDO). The intention–resource gap echoes findings on SME green adoption constraints in low-income contexts. Policy implication: prioritize targeted green financing (blended finance, guarantees) combined with technical support and shared infrastructure to convert process wins into consistent market and financial advantages across the cluster.

Conclusion

This study demonstrates that green product, process, and finance innovations each contribute positively to competitive performance for manufacturers in the Namanve Industrial Cluster. Process innovations deliver the most consistent operational gains (efficiency, waste reduction), product innovations contribute to differentiation but are unevenly adopted, and green finance is the most powerful predictor, acting as an enabler that unlocks and amplifies the benefits

of product and process investments. The combined model explains a substantial share of performance variance (≈ 67%), suggesting that an integrated strategy, aligning finance, operations, and product design, yields the greatest competitive advantage.

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