

TECHNOLOGY ADOPTION AND ENTREPRENEURIAL LEADERSHIP AS DRIVERS OF ORGANISATIONAL PERFORMANCE IN THE VHEMBE DISTRICT, SOUTH AFRICA

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Abstract

Background: In South Africa's socio-economically challenged Vhembe District, Limpopo Province, higher education institutions and Small, Medium, and Micro Enterprises (SMMEs) play a critical role in driving innovation, job creation, and regional development.

Purpose: This study examines how technology adoption and entrepreneurial leadership jointly function as drivers of organisational performance within the Vhembe District, focusing on High-Performance Computing (HPC) utilisation in higher education and entrepreneurial leadership practices in SMMEs.

Design/methodology/approach: This study adopts a comparative synthesis research design using a mixed-methods integrative approach. This study is based on a secondary analysis of two master's dissertations conducted in the same regional context. The first study investigated factors influencing HPC utilization at the a selected institution using quantitative questionnaires (n = 228) and qualitative interviews (n = 10), analyzed using SPSS and Atlas.ti. The second examined entrepreneurial leadership and SMME performance through qualitative interviews with 20 business owners and analyzed them thematically using Atlas.ti. Cross-domain thematic mapping was employed to identify the convergences, divergences, and synergies between technology adoption and leadership dynamics.

Findings/Results: The findings indicate that organizational support, perceived usefulness, and perceived ease of use significantly influence HPC utilization in higher education, while transformational and collaborative entrepreneurial leadership styles strongly enhance SMME performance. Shared challenges across both domains include resistance to change and resource constraints, whereas domain-specific barriers relate to infrastructural limitations in higher education and to market volatility in SMMEs.

Conclusion: Technology adoption and entrepreneurial leadership operate as interdependent and mutually reinforcing mechanisms for enhancing organisational performance in resource-constrained environments. Integrated strategies that combine targeted training, infrastructural support, leadership development, and university–SMME collaboration are essential for fostering innovation, sustainability, and socioeconomic development in the Vhembe District.

Originality/value (State of the art): This study contributes original value by offering an integrated, context-specific synthesis of technology adoption and entrepreneurial leadership in a shared rural setting. Unlike prior studies that examine these constructs independently, this study demonstrates how their alignment can jointly drive organizational performance in underdeveloped regions.

Keywords: entrepreneurial leadership, high-performance computing (HPC), SMME performance, technology adoption, Vhembe District

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INTRODUCTION

High-Performance Computing (HPC) systems comprise advanced computational infrastructures designed to process vast datasets and perform complex simulations at exceptional speeds, far exceeding the capabilities of standard computing systems (Dongarra & Meuer, 2019). Within higher education institutions, HPC plays a critical role in enabling data-intensive research, advanced modelling, and innovation across disciplines such as science, engineering and data analytics. Globally, the integration of HPC into universities aligns with broader development goals aimed at strengthening research capacity, enhancing innovation ecosystems, and improving the quality of higher education (National Research Council 2011).

Parallel to technological advancement, entrepreneurial leadership has emerged as a vital driver of organisational performance, particularly in resource-constrained environments. Entrepreneurial leadership integrates entrepreneurial orientation with leadership capabilities, such as vision, innovation, calculated risk-taking, and employee motivation. Leadership styles, including transformational, authentic, and servant leadership, stimulate innovation, adaptability, and sustained performance across organizations (Covin & Slevin, 2019). In the context of Small, Medium, and Micro Enterprises (SMMEs), entrepreneurial leadership is critical for navigating volatile markets and fostering growth under conditions of uncertainty (Muenda, 2024).

In South Africa, particularly in the Vhembe District of Limpopo Province, higher-education institutions and SMMEs are key pillars for socio-economic development, innovation, and job creation. However, the region remains socioeconomically disadvantaged, characterized by high poverty levels, unemployment, and infrastructural limitations. Limpopo's unemployment rate stood at 29.8% in the third quarter of 2025, with over 70% of households living below the upper poverty line, and youth unemployment continues to exacerbate inequality (Stats SA, 2025; Limpopo Development Plan, 2024). These structural challenges underscore the need for the effective utilization of technological resources in academia and strong leadership capabilities within SMMEs to drive sustainable development in the region.

Existing research has examined the adoption and utilization of HPC systems within higher education institutions, focusing largely on technological acceptance, infrastructure readiness, and organizational support. For example, Ndwamai and Ngirande (2022), drawing on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), identified perceived usefulness, perceived ease of use, and organizational support as key determinants of HPC utilization in a South African university context. Despite investments such as the HPC system donated to the selected institution by the Council for Scientific and Industrial Research (CSIR) in 2016, utilization levels remain relatively low owing to challenges, including inadequate training, limited awareness, and unreliable infrastructure, particularly in rural-based universities (Aguilar et al. 2020; Ndwamai, 2023).

Similarly, extensive literature has explored entrepreneurial leadership and its influence on SMME performance. Studies have consistently shown that leadership styles such as transformational, authentic, and servant leadership positively affect business performance, innovation, and competitiveness, especially in developing economies (Dzomonda et al. 2017; Maziriri & Chivandi, 2020). In the Vhembe District, Muenda and Nkondo (2024) demonstrated that entrepreneurial leadership plays a significant role in enhancing SMME performance despite persistent challenges such as limited access to finance, market constraints and intense competition.

The Vhembe District relies heavily on higher-education institutions for knowledge generation and innovation and on SMMEs for employment creation and local economic development. Despite this, both sectors face parallel challenges, including limited resources, inadequate infrastructure, skills shortages and resistance to change. In higher education, the underutilization of HPC systems restricts research output and innovation potential. In SMMEs, weak entrepreneurial leadership constrains adaptability, competitiveness, and long-term survival. This study adopts a problem-solving approach to examine these challenges through a dual-lens framework. First, it analyses the factors influencing HPC utilization within a higher education institution, focusing on technological, organizational and human dimensions. Second, it examines how entrepreneurial leadership styles influence SMME performance within the same regional context. By

comparing and synthesizing insights from both sectors, this study proposes integrated strategies that leverage technological adoption and entrepreneurial leadership as mutually reinforcing mechanisms to enhance organizational performance, innovation, and sustainability in the Vhembe District.

Guided by the overarching research question: How do technology adoption and entrepreneurial leadership collectively enhance organizational performance in the Vhembe District's academic and SMME sectors? This study pursues the following objectives: To identify the key factors influencing the utilization of High-Performance Computing systems in higher education institutions and the performance of SMMEs in the Vhembe District; To compare the challenges associated with technology adoption in higher education and the implementation of entrepreneurial leadership styles in SMMEs; To propose context-specific strategies for integrating technological capability and entrepreneurial leadership to promote innovation, organisational performance, and sustainability in the Vhembe District.

METHODS

This study adopts an original comparative synthesis methodology that uses a mixed-methods integrative approach. This secondary analysis article systematically synthesizes empirical data drawn from exactly two recent master's dissertations conducted in the Vhembe District, Limpopo Province, South Africa: Ndwamai (2023) and Muenda (2024). The exclusive use of these two studies is deliberate and theoretically justified, as both originate from the same rural, resource-constrained socioeconomic context and examine complementary drivers of organizational performance.

The first data source (Ndwamai, 2023) focuses on technology adoption in higher education, specifically the utilization of High-Performance Computing (HPC) systems at the selected institution. It comprises both quantitative and qualitative data grounded in the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). The second data source (Muenda, 2024) examines entrepreneurial leadership styles and SMME performance in the Vhembe District using qualitative empirical evidence informed by leadership and entrepreneurship theories.

Together, these datasets provide rich, contextually aligned evidence from two interrelated organizational domains, higher education and SMMEs, allowing for an integrated analysis of how technological capability and leadership effectiveness jointly influence organizational performance.

The original studies employed complementary data collection techniques that were appropriate for their respective research designs. For the HPC utilisation component (Ndwamai, 2023), quantitative data were collected using self-administered structured questionnaires ($n = 228$) distributed to academics and postgraduate students across multiple faculties at the a selected institution. The questionnaires used five-point Likert scales to measure TAM and UTAUT constructs, including perceived ease of use, perceived usefulness, organisational support, awareness, attitudes, and actual system utilisation. Qualitative data were collected through semi-structured interviews ($n = 10$) with selected academics and students who had direct exposure to HPC systems, allowing for deeper exploration of experiences and contextual barriers.

For the entrepreneurial leadership component (Muenda, 2024), qualitative data were gathered through semi-structured, in-depth interviews with 20 SMME owners and managers operating in the Vhembe District of Limpopo Province. This technique enabled the capture of rich narratives on leadership styles (transformational, authentic, and servant leadership), decision-making practices, and the perceived impacts on business performance. Participants were drawn from diverse sectors, including IT, hospitality, retail and manufacturing, to enhance the contextual breadth.

This study employs an original comparative thematic synthesis technique designed to integrate and reinterpret the findings across both domains. Quantitative data from the HPC study were analyzed using SPSS version 28. The reliability of the measurement scales was assessed using Cronbach's alpha coefficients. An exploratory factor analysis was conducted to identify the underlying constructs influencing HPC adoption. Pearson's correlation analysis was used to examine the relationships between key variables, including perceived usefulness, perceived ease of use, organizational support, awareness, attitudes, and actual HPC utilization. Qualitative data from both studies were analyzed using thematic analysis supported by Atlas.ti version 23. The analysis followed a systematic coding

process consisting of familiarization, open coding, axial coding, and selective coding. Core themes were developed around the drivers, barriers, performance outcomes, and strategic responses.

The central analytical contribution of this study lies in cross-domain thematic mapping, whereby themes from the HPC utilization context were systematically compared with those from the SMME leadership context using a matrix-based framework. This process identified (i) convergent themes (e.g., organizational support, adaptability, innovation orientation), (ii) divergent challenges specific to each domain, and (iii) emergent synergies where technology and leadership mutually reinforce organizational performance. Triangulation between quantitative correlations and qualitative narratives enhanced the analytical validity and interpretive robustness.

The literature consistently highlights entrepreneurial leadership and technology adoption as complementary drivers of organisational performance, particularly in resource-constrained and rural environments. Entrepreneurial leadership, characterized by vision, innovation, risk-taking, and proactive decision-making, enables organizations to navigate uncertainty and pursue sustainable performance outcomes (Covin & Slevin, 2019). Transformational, authentic, and servant leadership styles are particularly relevant in emerging economies. Transformational leadership enhances innovation, employee engagement, and organizational change through inspiration and motivation (Bass & Avolio, 1994), whereas authentic leadership fosters trust, ethical behavior, and resilience in volatile contexts (Walumbwa et al. 2008). Servant leadership, aligned with African philosophies such as Ubuntu, emphasizes empowerment and community impact, making it particularly suitable for South Africa's socioeconomic realities (Van Dierendonck et al. 2013). Empirical studies confirm that these leadership approaches positively influence SMME performance, including financial outcomes, innovation capacity and customer satisfaction (Dzomonda et al. 2017; Sandybayev, 2019).

In South Africa, small, medium, and micro enterprises (SMMEs) contribute substantially to economic activity and employment; however, they experience persistently high failure rates, particularly in rural provinces such as Limpopo. Structural constraints, including limited access to finance, inadequate infrastructure, skills

shortages, and market volatility, intensify leadership challenges and resistance to change (Mhlongo & Daya, 2023). These difficulties are more pronounced in districts such as Vhembe, where geographic isolation, energy insecurity, and institutional gaps restrict both business growth and technology adoption (Muenda, 2024). Prior studies emphasize that context-specific, adaptive leadership is critical for overcoming these barriers, as managerial shortcomings and external pressures remain the leading causes of SMME failure in rural South Africa (Leboea, 2017; Matekenya & Moyo, 2022).

Parallel challenges are evident in higher education, particularly regarding the adoption of advanced technologies, such as high-performance computing (HPC). Technology acceptance research, grounded in models such as TAM and UTAUT, identifies perceived usefulness, ease of use, and organizational support as central determinants of adoption (Davis, 1989; Venkatesh et al. 2003). In rural universities, infrastructural constraints, limited awareness beyond STEM disciplines, and insufficient training frequently hinder effective HPC utilization (Kneale et al. 2018). However, entrepreneurial and transformational leadership within academic institutions cultivates innovative research cultures, promotes interdisciplinary collaboration, and improves engagement with advanced digital tools, even in resource-limited settings.

The literature increasingly points to strong synergies between entrepreneurial leadership and technology adoption. Organizational support, adaptability, and user or employee engagement underpin both domains, creating opportunities for mutual reinforcement. Effective leadership accelerates technology uptake by shaping innovation-oriented cultures, whereas digital tools such as HPC, cloud computing, and data analytics enhance leaders' capacity for evidence-based decision-making and strategic planning (Mandelli et al. 2020). For SMMEs, digital technologies improve competitiveness through market analysis, operational efficiency, and predictive modelling, which are especially valuable in volatile rural markets. Conversely, universities can extend their technological capabilities to surrounding communities through partnerships that support local enterprise development.

Within the Vhembe District, this interaction between leadership and technology is particularly salient. Empirical work has shown that transformational

and collaborative leadership styles help overcome resistance to change and resource constraints in SMMEs, while organizational support and training improve technology utilization in higher education (Muenda, 2024). These findings align with the broader South African and international literature but also underscore the dominant influence of contextual factors such as infrastructure deficits, unemployment, and energy instability. Overall, the literature suggests that aligning adaptive leadership with targeted technological support can bridge the divide between academia and SMMEs, fostering innovation, resilience, and sustainable performance in rural areas. This integrated framework offers a foundation for scalable interventions in other underdeveloped districts in South Africa and similar contexts in sub-Saharan Africa.

Hypotheses and Theoretical Justification

Although the study is primarily integrative and interpretive, the synthesis allows for the formulation of theoretically informed hypotheses that guide the comparative analysis.

H1: Organizational support positively influences the utilization of High-Performance Computing systems in higher education institutions.

Justification: TAM and UTAUT posit that facilitating conditions and institutional support significantly influence technology adoption and use behaviour (Venkatesh et al. 2003). Empirical evidence from rural universities further confirms the critical role of organizational support in overcoming infrastructure- and skills-related barriers.

H2: Entrepreneurial leadership styles (transformational, authentic, and servant leadership) positively influence the performance of SMMEs in resource-constrained environments.

Justification: Entrepreneurial leadership theory suggests that visionary, empowering, and value-driven leadership enhances innovation, employee commitment, and adaptability, which are essential for SMME survival and growth in volatile markets.

H3: The presence of enabling organizational conditions strengthens the relationship between technological capability and organizational performance.

Justification: The Resource-Based View (RBV) theory argues that resources such as advanced technology only generate competitive advantage when

effectively supported by organizational capabilities and management practices.

H4: Technology adoption and entrepreneurial leadership function as complementary mechanisms that jointly enhance organizational performance in socio-economically constrained contexts.

Justification: Dynamic Capabilities Theory emphasizes the integration of technological resources and leadership-driven adaptability as critical for sustained performance, particularly in environments characterized by uncertainty and resource scarcity.

The conceptual framework (Figure 1) illustrates how organizational support enables both technology adoption (HPC utilization) and effective entrepreneurial leadership practice. Technology adoption and entrepreneurial leadership are complementary drivers that jointly influence organizational performance. In resource-constrained contexts, such as the Vhembe District, their interaction fosters innovation, adaptability, and sustainability across both higher education institutions and SMMEs.

RESULTS

The results integrate quantitative and qualitative data from the synthesized sources, providing a unified view of technology adoption and entrepreneurial leadership in the Vhembe District.

High-Performance Computing (HPC) Utilisation at the Selected Institution

The sample for HPC-related data comprised 228 participants from the selected institution, including academics (lecturers and researchers), master's students, and PhD candidates across various faculties (stratified to represent Science, Engineering, and Agriculture; Management, Commerce, and Law; Humanities; and Health Sciences). Most participants were from non-STEM faculties, where HPC awareness and usage were notably lower than in STEM faculties.

Quantitative analysis showed significant positive correlations with actual HPC utilization (Table 1). Perceived usefulness emerged as the strongest driver ($r = .591, p < .05$), meaning that participants who viewed HPC as enhancing research productivity (e.g., faster data processing in computational tasks) were far more

likely to use it. Perceived ease of use ($r = .409, p < .05$) and organizational support ($r = .355, p < .05$) followed, indicating that user-friendly interfaces and institutional resources (training and technical help) encouraged adoption. Awareness ($r = .287, p < .05$) and positive attitudes ($r = .321, p < .05$) also played supportive roles.

Qualitative insights from experienced users (primarily in the Chemistry and Mathematics departments) reinforced these findings. Participants valued HPC for accelerating complex simulations and big data analysis but reported low overall utilization due to limited training opportunities, unreliable power and hardware, and insufficient awareness campaigns, particularly acute in rural university settings with resource constraints.

Entrepreneurial Leadership in Vhembe District SMMEs

The sample consisted of 20 SMME owners and managers operating in diverse sectors (e.g., retail, hospitality, manufacturing, and IT) in the Vhembe District. Most small-scale enterprises (fewer than 50 employees) face typical rural challenges: limited capital, geographic isolation, and dependence on local markets. The thematic analysis revealed three interconnected themes (Table 2).

Impact Performance: Transformational and collaborative leadership styles strongly influenced positive outcomes. Owners described how visionary motivation led to revenue growth, cost efficiency, and new product and service development. Collaborative approaches enhanced employee engagement and customer satisfaction. One owner noted, “Transformational leadership played a key role in enhancing customer satisfaction. Our focus on creating a motivated workforce translated into improved service quality.”

Challenges: Implementation faced substantial hurdles related to the sample’s context. Internal resistance arose from employees’ familiarity with existing routines (“People are comfortable with what they know”), while external factors included market volatility, regulatory burdens, and severe resource shortages (funding, skilled labor, and time) common in rural SMMEs with limited access to finance and training.

Implementation Strategies: Successful owners countered these challenges through leadership development initiatives, employee empowerment (e.g., idea-sharing platforms), and cultivating adaptive culture practices that proved feasible even in constrained environments.

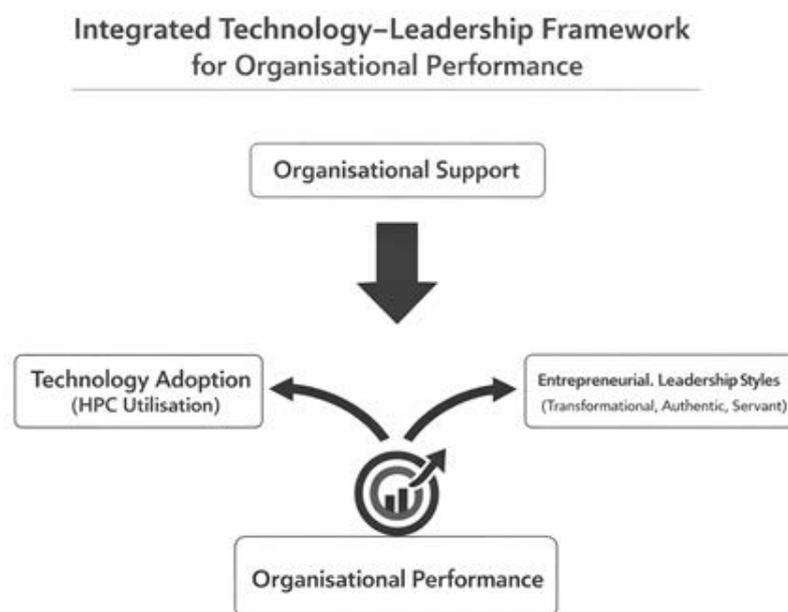


Figure 1. Integrated technology–leadership framework for organisational performance (Muenda et al. 2024)

Comparative Analysis

The integrated analysis reveals both convergence and divergence in the dynamics of technology adoption within higher education and entrepreneurial leadership in SMMEs, shaped by the shared rural constraints in the Vhembe District. Across both contexts, similarities were more pronounced, reflecting common challenges associated with resource-limited environments. Organisational support emerged as a critical enabler: institutional training and technical assistance were fundamental to effective high-performance computing (HPC) utilisation, paralleling how leadership development programmes and employee empowerment initiatives facilitated entrepreneurial leadership in SMMEs. Resistance to change further constrained performance in both domains, driven by limited awareness and familiarity with HPC systems among academics and employee adherence to established practices within SMMEs, underscoring cultural inertia as a persistent barrier to innovation. Despite these parallels, notable differences were evident. HPC utilization is primarily hindered by technical and infrastructural constraints, including unreliable power supply, outdated hardware, and discipline-specific awareness gaps beyond STEM fields. In contrast, SMME performance is more strongly affected by external and market-related pressures, such as regulatory complexity, funding limitations, and economic volatility. Moreover, the outcomes of leadership differed in emphasis: entrepreneurial leadership in SMMEs translated directly into measurable business

performance indicators, including revenue growth and customer satisfaction, whereas HPC adoption yielded predominantly research-oriented benefits, such as enhanced data-processing capacity and advanced modelling capabilities. Comparative summary of key elements in Table 3.

These patterns suggest strong potential for synergy. For instance, university-led HPC training could extend to SMMEs for data-driven decision-making, and adaptive entrepreneurial leadership could foster a campus culture that is more open to technological innovation. This integrated view demonstrates how aligning support systems across sectors can address shared rural constraints and amplify regional performance.

Synergies in Driving Organisational Performance

The empirical results demonstrate that organizational support and adaptability are pivotal drivers in both domains. In HPC utilization, perceived usefulness ($r = .591, p < .05$) and organizational support ($r = .355, p < .05$) strongly predicted adoption, confirming that institutional training and infrastructure directly enhance user confidence and research productivity. This aligns with prior findings in developing contexts, where organisational facilitating conditions significantly boost technology acceptance (Venkatesh et al. 2003; Oliveira et al. 2014), but extends them by quantifying the effect in a rural African university stronger than in urban studies due to baseline resource scarcity.

Table 1. Key Correlations Influencing HPC Utilisation

Factor	Correlation (r)	p-value
Perceived Usefulness	.591	< .05
Perceived Ease of Use	.409	< .05
Organisational Support	.355	< .05
Awareness	.287	< .05
Attitude	.321	< .05

Table 2. Core themes in entrepreneurial leadership and SMME performance

Theme	Key Elements	Sample Context Illustration
Impact on Performance	Revenue growth, innovation, engagement, satisfaction	Visionary motivation in small retail/hospitality firms
Challenges	Internal resistance, resource scarcity, external volatility	Rural funding gaps and employee skepticism
Strategies	Development programs, empowerment, adaptability	Idea platforms in micro-enterprises

Similarly, transformational and collaborative leadership empirically drove SMME outcomes, with owners reporting tangible revenue growth, innovation (new products/services), and improved customer satisfaction through a motivated workforce. These results corroborate those of Dzomonda et al. (2017), who found that entrepreneurial orientation positively impacts South African SME performance, and Sandybayev (2019), who linked effective leadership to organizational gains. However, the rural sample in this study shows even greater reliance on collaborative elements, as isolated SMMEs depend more on internal empowerment than external networks.

Context-Specific Challenges in Vhembe District

The socio-economic conditions of the Vhembe District profoundly shape these barriers. Limpopo Province has an unemployment rate of 29.8% (Stats SA, Q3 2025), with Vhembe’s rural municipalities often exceeding 40% youth unemployment and poverty rates above 70% (Limpopo Socio-Economic Review, 2024). Limited public investment leaves infrastructure underdeveloped frequent power outages and poor connectivity directly constrain HPC reliability, explaining low utilization outside STEM faculties and weaker perceived ease of use compared to better-resourced urban institutions (Aguilar et al. 2020).

For SMMEs, these conditions exacerbate resource scarcity: national SMME failure rates reach 70–80% within five years (SEDA, 2023), but rural areas like Vhembe face higher risks due to restricted access to finance (only 15–20% of rural SMMEs secure formal funding) and skilled labour migration to urban centres (World Bank South Africa SME Report, 2024). This explains the empirical findings of severe internal resistance and market volatility impacts, extending Mhlongo and Daya (2023) by linking leadership challenges directly to macroeconomic volatility and geographic isolation.

Managerial Implications

The findings suggest that organizational performance in resource-constrained contexts depends on the alignment of technology and leadership skills. For higher education managers, the effective use of High-Performance Computing systems requires strong organizational support through training, technical assistance, and awareness initiatives, rather than technology investment alone. For SMME managers, adopting entrepreneurial leadership styles that emphasize vision, adaptability, and employee empowerment can enhance innovation and improve business performance. Managers in both sectors should therefore integrate leadership development with technology adoption strategies to improve organisational outcomes.

Table 3. Comparative summary of key elements

Aspect	HPC Utilisation (Higher Education)	Entrepreneurial Leadership (SMMEs)	Similarities	Differences
Primary Drivers	Perceived usefulness/ease of use, organisational support (training, infrastructure)	Transformational/collaborative styles, empowerment programmes	Organisational/institutional support essential for success	Technical perceptions (TAM/UTAUT) vs. relational styles
Main Barriers	Limited training, unreliable infrastructure, low awareness	Internal resistance, resource scarcity, market volatility	Resistance to change due to familiarity	Infrastructure/power issues vs. external market/regulatory pressures
Performance Impacts	Accelerated research (e.g., simulations in STEM)	Revenue growth, innovation, employee/customer satisfaction	Enhanced outcomes through support and adaptability	Research productivity vs. financial/operational gains
Overcoming Strategies	Workshops, technical assistance	Leadership development, idea platforms, adaptive culture	Training and empowerment initiatives	Faculty-specific vs. employee-focused

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study demonstrates that technology adoption and entrepreneurial leadership function as interdependent drivers of organizational performance in the rural context of the Vhembe District. Empirical evidence indicates that perceived usefulness and organizational support significantly influence high-performance computing utilization in higher education, while transformational and collaborative leadership enhances innovation, revenue growth, and customer satisfaction among SMMEs. Despite shared challenges such as resource constraints, resistance to change, infrastructure limitations, and funding shortages, the findings reveal strong potential synergies through organizational support and cross-sector collaboration. By integrating leadership development, targeted training, and university SMME partnerships, institutions can overcome contextual barriers and promote innovation, create jobs, and enhance economic resilience. This study contributes context-specific insights to the South African development discourse, emphasizing the need for locally tailored policies to support inclusive and sustainable growth in underdeveloped regions.

Recommendations

This study provides stakeholder-focused recommendations for enhancing organizational performance in resource-constrained regions, such as the Vhembe District, by aligning technology adoption with entrepreneurial leadership. This highlights the role of policymakers in supporting HPC infrastructure, digital transformation, and university–industry collaboration through targeted funding and incentives. Universities are encouraged to strengthen cross-faculty technology training and outreach partnerships with local enterprises, while SMME owners are urged to adopt collaborative leadership practices and engage with universities to support data-informed decision-making. Overall, this study underscores the importance of cross-sector collaboration and institutional support in promoting innovation, job creation, and sustainable regional development.

Future studies could empirically test the integrated technology–leadership framework using primary data and larger samples across different regions. Longitudinal research is recommended to examine how

technology adoption and entrepreneurial leadership influence performance over time. Comparative studies across rural and urban contexts may also provide deeper insights into contextual differences in organisational performance drivers.

While both studies align with existing literature, they diverge in emphasising context-specific nuances. For instance, Ndwamai (2022) challenges the universal applicability of TAM by highlighting infrastructure barriers, while Muenda (2024) questions the direct link between leadership styles and financial outcomes because of external market forces. These divergences underscore the need for localized strategies in developing countries.

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