Green Performance in SMEs: The Nexus of Knowledge Management and Cultural Infrastructure under Transformational Leadership

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Abstract: Escalating global environmental challenges have intensified pressure on businesses to adopt sustainable practices, particularly within Small and Medium-sized Enterprises (SMEs). While leadership is recognized as a pivotal driver of this transition, the specific internal organizational mechanisms through which leadership influences green outcomes remain underexplored. This study examined the impact of transformational leadership on green business performance in SMEs, focusing specifically on the mediating roles of knowledge management practices and cultural infrastructure. A quantitative research design was employed, utilizing survey data collected from 135 SMEs across diverse manufacturing and service sectors in Southeast Asia. Structural equation modeling was used to test the hypothesized relationships in the study. The findings indicate a significant positive relationship between transformational leadership and green business performance. Crucially, both knowledge management practices and cultural infrastructure were found to mediate this relationship significantly, both individually and in concert. This study underscores the strategic importance of nurturing robust knowledge management systems and a supportive cultural environment to translate transformational leadership initiatives into tangible green outcomes within SME. This study contributes to a more nuanced understanding of the pathways through which leadership fosters sustainability, offering interdisciplinary insights relevant to management, economics, and environmental studies.

Keywords: Transformational leadership, Green business performance, SMEs, Knowledge management, Cultural infrastructure

1. Introduction

Green Business Performance has emerged as a multifaceted construct encompassing the environmental, economic, and social dimensions of sustainability within an organizational context (Berberoglu, Kazancoglu and Sagnak, 2023). It extends beyond simple pollution control to include eco-innovation, resource efficiency, waste reduction, and integration of environmental considerations into core business strategies (Patwary *et al.*, 2024). Achieving superior green business performance is increasingly recognized as a critical factor for firms seeking to thrive in an environmentally conscious market (Wang *et al.*, 2023).

Small and Medium-sized Enterprises (SMEs) constitute approximately 90% of businesses worldwide and generate between 60% and 70% of employment across OECD countries (OECD, 2023). In developing economies, formal SMEs contribute up to 40% of the GDP, with these figures being significantly higher when informal businesses are included (World Bank, 2025). Despite their smaller scale, the collective environmental footprint of SMEs is substantial, accounting for approximately 60-70% of global industrial pollution (United States Environmental Protection Agency, 2025). Recent estimates suggest that SMEs collectively account for nearly 50% of global carbon emissions from business activities and consume more than 13% of the total global energy supply. The environmental impact of SMEs varies significantly across sectors and regions. Manufacturing SMEs, particularly in resource-intensive industries such as textiles, food processing, and metal fabrication, often generate disproportionate environmental impacts relative to their size (Chaudhry, Kumar and Chaudhary, 2025). In the emerging economies of Southeast Asia, where this study is situated, SMEs account for over 97% of all enterprises and employ 69% of the labor force, while contributing approximately 41% of GDP (United Nations, 2021). However, environmental compliance rates among these enterprises remain low, with only 30% of SMEs implementing systematic environmental management practices.

Leadership has emerged as a pivotal driver of sustainability transitions in this challenging landscape. Empirical research has established that leadership approach significantly influences an organization's environmental

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orientation and performance, with transformational leadership demonstrating robust correlations with successful sustainability outcomes (Zafar, Suseno and Ho, 2023). A 2023 global survey of SME managers found that organizations with transformational leaders were 2.7 times more likely to successfully implement comprehensive sustainability initiatives than those with transactional leadership styles. Existing scholarly work has extensively explored the direct and indirect links between transformational leadership and various aspects of environmental performance, including eco-innovation, sustainable practices and employee green behavior. A consistent positive correlation has been established, indicating that leaders who inspire and intellectually stimulate their teams are more likely to achieve environmentally friendly outcomes. However, many studies demonstrating a direct link between transformational leadership and positive outcomes, including green performance, often treat internal organizational processes as a "black box" (Bui, 2024). While transformational leadership is a known driver, how it translates vision into tangible green actions frequently depends on the intermediate mechanisms. This implies the need to open the black box by investigating the specific pathways through which leadership influences green outcomes, providing a more granular understanding of the causal chain. The literature has highlighted the importance of effective knowledge management practices in improving environmental performance (Velte, 2023). Through enhanced knowledge acquisition, sharing, and utilization, organizations can foster eco-innovation, solve environmental problems more efficiently, and optimize resource use, leading to tangible green results (Ullah Khan *et al.*, 2023). Similarly, the role of organizational culture in fostering environmental responsibility and sustainability initiatives is well documented (Chang and Hung, 2021). A culture that values environmental stewardship can significantly influence employee attitudes and behaviors, thereby promoting the adoption of green practices (Su *et al.*, 2020).

The relationship between transformational leadership and green business performance has been established in multiple contexts (Awan *et al.*, 2023; Niazi *et al.*, 2023); however, a critical research problem persists: we lack a comprehensive understanding of the specific organizational mechanisms through which transformational leadership translates into tangible environmental outcomes in SMEs. This represents both theoretical and practical challenges. From a theoretical perspective, existing research has predominantly examined knowledge management practices and cultural infrastructure as isolated mediators rather than as interacting components of a complex system. Ullah Khan *et al.* (2023); Makhloufi (2024) have demonstrated the mediating role of knowledge management between leadership and sustainability outcomes, reporting effect sizes ranging from 0.31 to 0.47. Concurrently, research by Pradana *et al.* (2022); Fok *et al.* (2023) has established cultural infrastructure as a significant mediator in environmental performance models. However, these parallel research streams have primarily developed independently, resulting in a fragmented understanding of the interaction of these internal capabilities. This fragmentation is particularly problematic, given the empirical evidence suggesting potential synergistic effects between knowledge systems and organizational culture. Kirschning and Mrożewski (2024) reported that knowledge sharing effectiveness increased by 37% in organizations with supportive cultural elements compared to those with strong knowledge systems but weak cultural support. Similarly, Rafi *et al.* (2022) found that cultural elements moderated the relationship between knowledge practices and organizational agility, suggesting complex interdependencies that remain under-theorized in sustainability contexts. From a practical perspective, this research has significant implications for SMEs attempting to enhance their environmental performance.

This study addresses this research problem by examining how knowledge management practices and cultural infrastructure function independently and synergistically as mediators of the transformational leadership-green performance relationship in SMEs. By investigating these complex interactions through the lens of Dynamic Capability Theory (Teece, 2016), this study moves beyond identifying simple linear relationships to understanding how these capabilities combine to create higher-order dynamic capabilities that are essential for environmental adaptation in resource-constrained contexts. This integrated approach responds to calls from scholars (Khan *et al.*, 2023)(Khan et al., 2023; Kelly & Howard, 2022) for more sophisticated models of sustainability transformation that reflect the complex, systemic nature of organizational change processes. The findings of this study have significant implications for both theory development in the sustainability leadership domain and practical applications for SME managers seeking to enhance their organizations' green performance despite resource constraints. By illuminating the internal mechanisms that translate leadership vision into tangible environmental outcomes, this study contributes to a nuanced understanding of organizational sustainability transformation within the critical yet understudied SME context.

2. Literature Review and Hypotheses Development

2.1 Dynamic Capability Theory

Traditional resource-based view (RBV) perspectives have been criticized for their static orientation, focusing on resources as fixed assets rather than adaptable capabilities (Barney, 1991; Wernerfelt, 2006). This limitation is particularly problematic when examining environmental performance, which requires continuous adaptation to rapidly evolving stakeholder expectations, regulatory frameworks, and technological innovations (Teece, 2018). In response to these limitations, Dynamic Capability Theory (DCT) has emerged as a more robust theoretical lens for understanding how organizations achieve sustainable competitive advantages in volatile environments through their ability to "integrate, build, and reconfigure internal and external competences" (Teece, Pisano and Shuen, 1997).

While DCT has gained significant traction in strategic management research, its application in environmental sustainability contexts remains underdeveloped, particularly for SMEs. Scholars such as Jiang *et al.* (2018) have begun to explore how environmental dynamic capabilities manifest in entrepreneurial ventures. However, as Alkaraan *et al.* (2024) note, there remains an insufficient understanding of the specific micro-foundations that constitute these capabilities. This represents a critical gap, as theories developed primarily through studies of large organizations may not adequately capture the unique resource constraints and organizational flexibility characteristics of SMEs (Crossley, Elmagrhi and Ntim, 2021).

Several contradictions exist in the current DCT applications for sustainability. For example, while Kuuluvainen (2012) emphasized the importance of formalized sensing and seizing routines, Amoah *et al.* (2022) found that successful green SMEs often rely on informal, leader-driven processes for environmental adaptation. Similarly, Gui, Lei and Le (2024) highlight knowledge codification as essential for capability development, whereas Harsono *et al.* (2025) suggest that tacit knowledge embedded in organizational culture may be more valuable for SMEs' environmental performance. These contradictions suggest the need for a more nuanced theoretical framework that accounts for both the formal and informal elements of capability development in resource-constrained contexts.

This study addresses these theoretical contradictions by conceptualizing transformational leadership, knowledge management practices, and cultural infrastructure not as isolated resources but as interconnected micro-foundations of dynamic capabilities that enable SMEs to sense environmental challenges, seize green opportunities, and transform their operations accordingly. This perspective extends DCT by examining how these elements function both independently and synergistically to enhance SME's adaptive capacity for environmental performance. The theoretical model is shown in Figure 1.

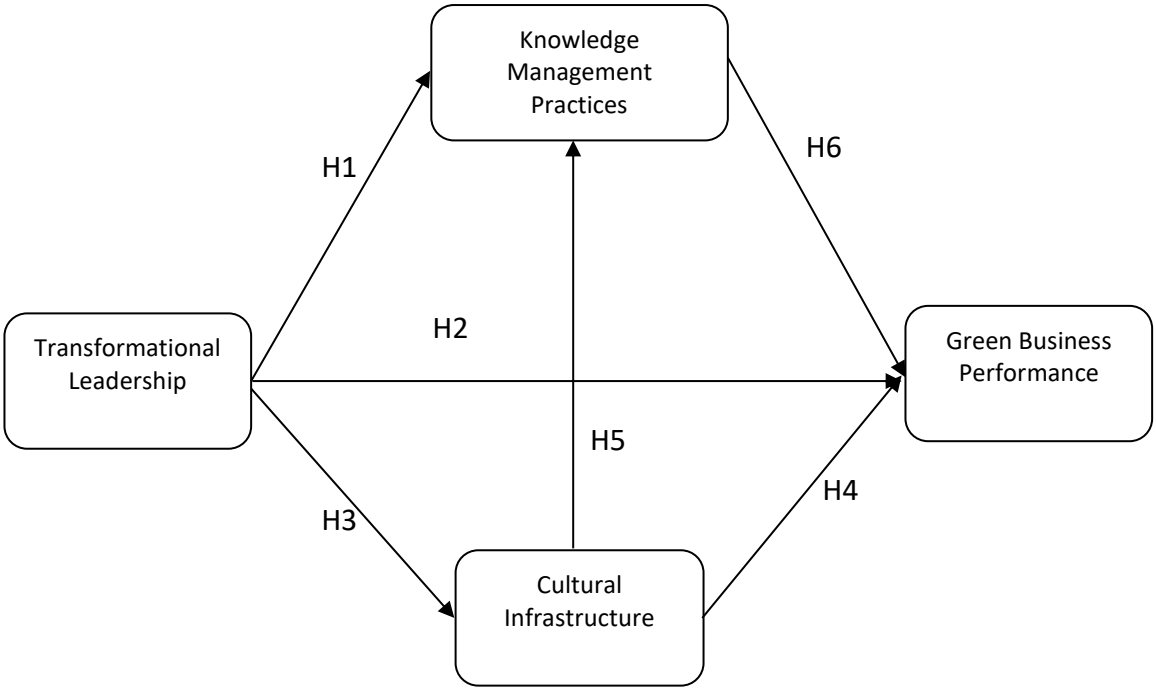

Figure 1: Theoretical model

2.2 Research Hypotheses Development

Transformational leadership (TL) is widely recognized for its profound influence on various organizational processes, including knowledge management (KM) (Harsono *et al.*, 2025). Leaders exhibiting idealized influence serve as role models, inspiring trust and respect, which are foundational for fostering an environment conducive to knowledge sharing and creation (Al-Husseini, El Beltagi, and Moizer, 2021). When employees perceive their leaders as credible and trustworthy, they are more likely to engage in open communication and share valuable insights, even tacit knowledge that might otherwise remain siloed (Kılıç and Uludağ, 2021). This trust reduces the perceived risks associated with knowledge sharing, such as the fear of losing a competitive advantage or being exploited (Al-Husseini, El Beltagi,. Furthermore, inspirational motivation, a core component of TL, involves articulating a compelling vision and setting high expectations, which can energize employees to actively participate in knowledge-related activities (Nguyen, Shen and Le, 2022). By linking knowledge management initiatives to broader organizational goals and a shared purpose, transformational leaders can enhance employee motivation to contribute to and utilize organizational knowledge. This shared vision can transform knowledge sharing from a mere task into a collective endeavor aimed at achieving common objectives, such as improving efficiency and fostering innovation (Bui, 2024).

The direct link between transformational leadership and various aspects of organizational performance, including environmental and green outcomes, has been a consistent theme in recent management literature (Zhao and Huang, 2022). Transformational leaders are uniquely positioned to champion sustainability initiatives and drive green business performance (GBP) because of their inherent characteristics (Niazi *et al.*, 2023). Through idealized influence, transformational leaders serve as powerful role models for promoting environmental responsibility (Awan *et al.*, 2023). When leaders demonstrate a genuine commitment to sustainability, employees are more likely to internalize these values and integrate them into their daily work practices (Majali *et al.*, 2022). This moral and ethical appeal can inspire employees to go beyond their prescribed duties and engage in discretionary pro-environmental behaviors such as conserving resources, reducing waste, and suggesting eco-friendly improvements (Le *et al.*, 2024). Their credibility and trustworthiness make their environmental vision more compelling and actionable (Tosun *et al.*, 2022).

Organizational culture, also known as cultural infrastructure (CI), represents the shared values, beliefs, norms, and assumptions that guide behavior within an organization (Christopher Mittelstaedt, 2024). Transformational leadership is widely acknowledged as a powerful force in shaping and transforming the organizational culture (Hofstede, 2011; Khoa and Huynh, 2024). Through their actions and communication, leaders can significantly influence prevailing cultural norms and values (Madi Odeh *et al.*, 2023). Through idealized influence, transformational leaders embody the values and behaviors they wish to see in their organizations (Velarde *et al.*, 2022). By consistently demonstrating a commitment to specific values, such as environmental responsibility, innovation, or collaboration, they serve as powerful role models, encouraging employees to adopt these values as their own (Virgiawan, Riyanto and Endri, 2021). Consistent modeling helps embed desired cultural traits within the organizational fabric (Qalati *et al.*, 2022). For instance, a leader who consistently prioritizes sustainability in decision-making sends a clear message about the importance of green values, thereby fostering a pro-environmental culture (Ismail, 2025). Therefore, this study proposes the following three hypotheses.

H1: Transformational Leadership positively impacts the Knowledge Management practices of SME.

H2: Transformational Leadership positively impacts the Green Business Performance of SME.

H3: Transformational Leadership positively impacts the cultural infrastructure of SMEs.

A cultural infrastructure that prioritizes environmental stewardship and sustainability can significantly enhance an SME's green business performance (Pradana *et al.*, 2022). A pro-environmental cultural infrastructure instills shared values and beliefs that emphasize ecological responsibility among employees (Abbas and Khan, 2023). When environmental protection is deeply embedded in organizational values, it becomes an intrinsic part of daily operations rather than a mere compliance requirement (Fok *et al.*, 2023). This leads to a collective commitment to green initiatives and fosters a sense of shared ownership of environmental outcomes (Begum *et al.*, 2023). Employees are more likely to proactively identify opportunities for waste reduction, energy efficiency, and eco-innovation when their actions align with their workplace's core values (Kamran *et al.*, 2025).

The relationship between cultural infrastructure and knowledge management practices is well-established and symbiotic in organizational theory (Rafi *et al.*, 2022). A supportive cultural infrastructure is a prerequisite for effective knowledge management, as it shapes employees' attitudes and behaviors towards knowledge creation, sharing, and utilization (Khoa and Huynh, 2023). A cultural infrastructure that values openness, trust, and

collaboration is fundamental to fostering knowledge sharing (Kirschning and Mrożewski, 2024). In an environment where employees trust their colleagues and leaders, they are more willing to share their tacit and explicit knowledge, knowing that their contributions will be valued and not exploited (Mojibi, Khojasteh and Khojasteh-Ghamari, 2015). Conversely, a culture characterized by distrust or competition can lead to knowledge hoarding, severely impeding effective KMP (Lam *et al.*, 2021). A collaborative culture encourages cross-functional communication and teamwork, which are essential for integrating diverse knowledge sets and solving complex problems (Azeem *et al.*, 2021). Hence, two hypotheses are proposed:

H4: Cultural Infrastructure positively impacts the Green Business Performance of SME.

H5: Cultural Infrastructure positively impacts Knowledge Management Practices of SME.

Effective Knowledge Management Practices are increasingly recognized as critical enablers for organizations seeking to improve their environmental performance and achieve superior green business performance (Abbas and Khan, 2023; Sahoo, Kumar and Upadhyay, 2023). The systematic creation, acquisition, sharing, and application of knowledge enables organizations to gain the necessary insights and capabilities to address environmental challenges and capitalize on green opportunities (Nasir *et al.*, 2024). Robust KMP facilitates the acquisition and creation of environmental knowledge (Makhloufi, 2024). This includes knowledge of new eco-friendly technologies, sustainable production processes, environmental regulations, market demands for green products, and best practices in waste management (Al-Husain *et al.*, 2025). By actively seeking and generating such knowledge, SMEs can identify areas for environmental improvement and innovation (Shehzad *et al.*, 2024). For example, acquiring knowledge of circular economy principles can lead to significant reductions in waste and resource consumption (Yin, Yu and Zhang, 2024). Hence, this study proposes the following hypothesis:

H6: Knowledge Management Practices positively impact the Green Business Performance of SME.

Transformational leadership inspires followers to go beyond transactional goals and internalize a broader organizational vision, often emphasizing innovation, learning, and sustainability. Transformational leaders foster a culture of knowledge sharing through intellectual stimulation and individualized consideration (Bass and Avolio, 1989). Such leaders encourage employees to create, share, and apply knowledge that supports environmental initiatives and green innovation (Dat *et al.*, 2025). Knowledge management practices (KMP), including knowledge acquisition, sharing, and application, serve as a critical mechanism linking leadership behaviors to performance outcomes (Nonaka, Toyama, and Konno, 2000). Through effective KMP, organizations can translate leaders' visions into actionable environmental strategies, such as eco-efficient production, sustainable supply chain management, and green product development. Nguyen and Sharma (2024); Chen *et al.* (2025) have shown that KMP mediates the effect of transformational leadership on innovation performance. Extending this to the environmental domain, it is reasonable to argue that transformational leaders enhance green business performance by establishing effective KMP systems that promote continuous learning, problem solving, and eco-innovation. Hence, this study proposes the following hypothesis:

H7: Knowledge Management Practices positively mediates the relationship between Transformational Leadership and Green Business Performance.

A strong cultural infrastructure can transform the visionary messages of transformational leaders into a collective commitment toward environmental goals. Transformational leaders, through idealized influence and inspirational motivation, instill pro-environmental values and encourage employees to align their behaviors with the organization's sustainability vision (Getzner, 2024). In this context, cultural infrastructure serves as a mediating mechanism by embedding green values into organizational routines, rituals, and decision-making processes (Christopher Mittelstaedt, 2024). When leaders promote trust, empowerment, and ethical responsibility, these values become integral to the organization's cultural fabric, which in turn drives long-term green performance outcomes—such as reduced environmental impact, compliance with environmental regulations, and an enhanced stakeholder reputation. Empirical evidence suggests that leadership styles can shape an organization's culture, which subsequently influences environmental and innovation outcomes (Khan *et al.*, 2020; Jain and Sharma, 2025). Therefore, hypothesis H8 was proposed:

H8: Cultural Infrastructure mediates positively the relationship between Transformational Leadership and Green Business Performance

3. Method

All constructs in this study were measured using established scales adapted from prior validated research to ensure reliability and validity within the specific context of Vietnamese SMEs. A 7-point Likert scale, ranging from

1 (Strongly Disagree) to 7 (Strongly Agree), was utilized for all items, a common practice in social science research for capturing nuanced perceptions and attitudes (Nunnally and Bernstein, 1994; Hair *et al.*, 2019). This scale format provides sufficient granularity for statistical analysis while being easily comprehensible to respondents.

Transformational leadership (TRL) was measured using a 5-item scale adapted from the Multifactor Leadership Questionnaire (MLQ) developed by Bass and Avolio (1989), a widely recognized and empirically robust instrument for assessing transformational leadership behaviors (Nguyen and Sharma, 2024; Chen *et al.*, 2025). The MLQ's dimensions of idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration are well-suited to capture the essence of leaders who inspire and empower their followers. Knowledge management practices (KMP) were assessed using a 4-item scale derived from the work of Khoa and Huynh (2023); Khoa (2024), which focuses on the processes of knowledge creation, sharing, and application within an organization. This scale was chosen for its comprehensive coverage of key KM dimensions relevant to organizational performance and innovation. Cultural infrastructure (CUI) was measured using a 4-item scale adapted from Denison and Mishra (1995); Tsetim, Adegbe and Agema (2020), focusing on cultural traits such as adaptability, consistency, involvement, and mission, particularly as they relate to environmental values and openness to change. This scale is theoretically grounded in organizational culture literature and has been widely used to assess cultural dimensions that influence organizational effectiveness. Green Business Performance (GBP) was measured using a 4-item scale adapted from previous studies on environmental performance and sustainability outcomes (e.g., Ullah Khan *et al.* (2023); Phu and Khoa (2025)). This scale captures various facets of GBP, including eco-innovation, resource efficiency, and waste reduction. To ensure content validity, the questionnaire was reviewed by three academic experts and two industry practitioners. A pilot test with 30 participants was conducted to refine wording and clarity. Reliability was assessed through Cronbach's alpha and composite reliability (CR), both exceeding the 0.70 threshold. Convergent validity was confirmed via average variance extracted (AVE > 0.50), and discriminant validity was evaluated using the Fornell–Larcker criterion and the HTMT ratio, both within recommended limits (HTMT < 0.85).

A non-probability sampling strategy, specifically a combination of convenience sampling and snowball sampling, was employed to select 153 SME managers. Convenience sampling was initially used to access a readily available group of managers through professional networks and business associations in major economic hubs of Vietnam (e.g., Ho Chi Minh City, Hanoi, Danang). All procedures followed the ethical standards of academic research and the Institutional Review Board of the Industrial University of Ho Chi Minh City. Participation was voluntary, and respondents were assured of anonymity and confidentiality throughout the study. Informed consent was obtained at the beginning of the survey, and no identifiable personal data were collected. Participants were informed that the data would be used solely for academic purposes and that they could withdraw at any time without consequences. Ethical clearance was granted prior to data collection.

Data collection spanned from January to May 2025. Upon receipt, all collected data underwent a rigorous cleaning process, including checking for missing values, outliers, and potential response biases (e.g., straight-lining). Incomplete questionnaires or those with clear patterns of inconsistent responses were excluded from the final dataset, resulting in a robust sample of 153 valid responses for analysis. The sample size of 153 managers is considered adequate for conducting Partial Least Squares Structural Equation Modeling (PLS-SEM), particularly given the number of constructs and indicators in the model, which adheres to the general guidelines for minimum sample sizes in PLS-SEM (Hair et al., 2017). The sample size was determined based on both statistical power analysis and methodological recommendations for PLS-SEM. Following the "10-times rule" (Hair et al., 2019), the minimum required sample equals ten times the most significant number of structural paths directed at any construct in the model. Since the most complex construct in this model had four predictors, a minimum of 40 respondents was required to ensure statistical power. However, to enhance statistical power and generalizability, 153 valid responses were collected, which far exceeded the minimum requirement for this study.

Additionally, a priori power analysis using G*Power 3.1 confirmed that this sample size achieves a power level above 0.95 for detecting medium effect sizes ($f^2 = 0.15$) at $\alpha = 0.05$. The demographic profile of the 153 SME managers who participated in the study is summarized in Table 1. The sample represents a diverse range of firm sizes, primary industries, and green application fields, providing a comprehensive overview of the SME landscape in Vietnam.

Table 1: Respondent Descriptive Statistics (N=153)

Characteristic	Category	Frequency	Percentage (%)
Firm Size	Small (10-49 employees)	85	55.6
	Medium (50-250 employees)	68	44.4
Primary Industry	Manufacturing	62	40.5
	Services	58	37.9
	Retail/Wholesale	21	13.7
	Agriculture/Food Processing	12	7.8
Green Application Field	Waste Reduction/Recycling	55	35.9
	Energy Efficiency	48	31.4
	Sustainable Product/Service Development	30	19.6
	Green Supply Chain Management	20	13.1

Smart PLS 4.0 was selected as the primary analytical tool for several reasons. First, Partial Least Squares Structural Equation Modeling (PLS-SEM) is particularly appropriate for exploratory and prediction-oriented research, especially when the conceptual model involves multiple mediating constructs (Hair et al., 2021). Second, PLS-SEM is suitable for complex models with latent variables measured by multiple indicators and does not require data to meet strict normality assumptions. Third, compared with covariance-based SEM (e.g., AMOS or LISREL), PLS-SEM is more robust for smaller to moderate sample sizes and for models emphasizing variance explanation rather than model fit (Sarstedt et al., 2019). Given that the study focused on predictive relationships and mediation effects rather than theory confirmation, Smart PLS was deemed more suitable.

Given that all data were self-reported and collected from a single source, potential standard method bias (CMB) was carefully addressed. Procedurally, CMB was minimized by assuring respondent anonymity, varying item order, and using different response formats. Statistically, Harman's single-factor test revealed that no single factor accounted for more than 40% of the total variance. Additionally, a full collinearity test (VIF < 3.3) in Table 4 confirmed the absence of substantial CMB, following Kock's (2015) guidelines. Before analysis, skewness and kurtosis values were examined, indicating that the data did not fully meet multivariate normality assumptions. Accordingly, PLS bootstrapping procedures with 5,000 resamples were applied to estimate standard errors and significance levels, as recommended by Hair et al. (2021). Bootstrapping enhances the robustness of path estimates and provides bias-corrected confidence intervals, thereby ensuring the reliability of hypothesis testing results.

4. Results

Convergent validity assesses the extent to which items that are theoretically related are, in fact, related in the empirical data. It is typically evaluated using Cronbach's Alpha (α), Composite Reliability (CR), Average Variance Extracted (AVE), and Outer Loadings. For good convergent validity, Cronbach's Alpha and CR values should ideally be above 0.70, indicating internal consistency and reliability of the scales (Hair *et al.*, 2019). AVE values should be above 0.50, signifying that a latent construct accounts for more than half of the variance of its indicators (Fornell and Larcker, 1981). Outer loadings (OL) of individual items should be above 0.70, indicating that the items are strongly associated with their respective constructs. Table 2 presents the results of convergent validity for all constructs. As evidenced in Table 2, all constructs demonstrate excellent convergent validity. The Cronbach's Alpha values range from 0.763 (KMP) to 0.909 (TRL), all of which are well above the recommended threshold of 0.70, confirming the high internal consistency and reliability of the measurement scales. Similarly, the Composite Reliability (CR) values, ranging from 0.849 (KMP) to 0.931 (TRL), further reinforce the reliability of the constructs, indicating that the items consistently measure their respective latent variables. The Average Variance Extracted (AVE) values for all constructs are also robust, ranging from 0.584 (KMP) to 0.769 (CUI), all of which exceed the 0.50 criterion. This indicates that more than 70% of the variance in the indicators is explained by their respective constructs, demonstrating strong convergent validity.

Furthermore, the outer loadings for all individual items fall within the range of 0.732 to 0.965, consistently above the 0.70 threshold. This confirms that each item contributes significantly to its respective construct, providing strong empirical support for the measurement model's convergent validity. These results collectively affirm that

the scales used in this study are reliable and accurately measure the intended constructs within the context of Vietnamese SMEs.

Table 2: Convergent Validity Results

Items	Outer loading				α	CR	AVE
	CUI	GBP	KMP	TRL			
CUI1	0.813				0.899	0.93	0.769
CUI2	0.867						
CUI3	0.856						
CUI4	0.965						
GBP1		0.776			0.864	0.909	0.715
GBP2		0.805					
GBP3		0.825					
GBP4		0.963					
KMP1			0.760		0.763	0.849	0.584
KMP2			0.732				
KMP3			0.801				
KMP4			0.762				
TRL1				0.825	0.909	0.931	0.729
TRL2				0.804			
TRL3				0.861			
TRL4				0.860			
TRL5				0.915			

Discriminant validity ensures that a construct is truly distinct from other constructs in the model. It confirms that a construct measures something unique and not merely a reflection of other constructs. This study assessed discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) criterion, which is considered a more robust method than the Fornell-Larcker criterion, particularly in PLS-SEM (Henseler, Ringle and Sarstedt, 2014). As presented in Table 3, all HTMT values are well below the conservative threshold of 0.85 (and also below 0.90). The highest HTMT value observed is 0.707 (between GBP and CUI), which is comfortably within the acceptable range. This indicates that each construct in the model is empirically distinct from the others, confirming strong discriminant validity. The low inter-construct correlations, as indicated by the HTMT ratios, suggest that the measurement model effectively differentiates between the latent variables. This robust discriminant validity provides confidence that the study's findings are based on distinct conceptualizations and measurements of transformational leadership, knowledge management practices, cultural infrastructure, and green business performance, thereby strengthening the credibility of the subsequent structural model analysis.

Table 3: Discriminant validity Results

	CUI	GBP	KMP	TRL
CUI				
GBP	0.707			
KMP	0.519	0.561		
TRL	0.366	0.469	0.445	

Based on the updated data in Table 4, the structural model demonstrates moderate explanatory power and strong predictive relevance across all endogenous constructs. The R^2 values indicate that Transformational Leadership (TRL) and Cultural Infrastructure (CUI) explain 25.0% of the variance in Knowledge Management Practices (KMP), while TRL accounts for 13.4% of the variance in Cultural Infrastructure (CUI). Green Business Performance (GBP) shows a higher R^2 value of 0.480, indicating that TRL, KMP, and CUI together explain 48.0% of its variance. Although these R^2 values fall within the low to moderate range, they still reflect meaningful explanatory contribution within the model. The f^2 effect sizes further clarify the relative influence of each

predictor. TRL has minor effects on KMP ($f^2 = 0.082$), CUI ($f^2 = 0.154$), and GBP ($f^2 = 0.038$), suggesting that while TRL contributes to each construct, its influence is modest. KMP shows a medium effect on GBP ($f^2 = 0.203$), highlighting its important role in enhancing green business performance. Similarly, CUI contributes a small-to-medium effect on GBP ($f^2 = 0.139$), reinforcing its relevance as a predictor of green business outcomes. The Q^2_predict values for KMP (0.125), CUI (0.108), and GBP (0.206) are all well above zero, confirming the model's predictive relevance. Notably, GBP exhibits the strongest predictive accuracy, consistent with its higher R^2 value. Overall, despite moderate explanatory strength, the model demonstrates solid predictive capability, indicating that the relationships among TRL, KMP, CUI, and GBP are meaningful in forecasting future outcomes, particularly in the context of green business performance.

Table 4: R^2, f^2, and Q^2 Values

Endogenous Construct	R^2	f^2 (from TRL)	f^2 (from KMP)	f^2 (from CUI)	Q^2_predict
Knowledge Management Practices (KMP)	0.250	0.082	-	0.132	0.125
Cultural Infrastructure (CUI)	0.134	0.154	-	-	0.108
Green Business Performance (GBP)	0.480	0.09	0.038	0.319	0.206

Table 5 presents the PLS-SEM path coefficients and VIF values for all relationships. Additionally, Variance Inflation Factor (VIF) values were checked to ensure the absence of multicollinearity, with VIF values below 3 indicating the absence of multicollinearity issues (Hair Jr *et al.*, 2016). All hypotheses were accepted, as indicated by significant p-values (typically < 0.05) and t-values greater than 1.96 (for a two-tailed test at 5% significance level).

Table 5: Path Coefficients, VIF, and f^2 Values

Hypothesis	Relationship	Beta (β)	Std. Error	t-value	p-value	VIF	Outcome
H1	TRL -> KMP	0.266	0.087	3.094	0.002	1.154	Accepted
H2	TRL -> GBP	0.241	0.059	6.894	0.000	1.249	Accepted
H3	TRL -> CUI	0.366	0.088	4.139	0.000	1.000	Accepted
H4	CUI -> GBP	0.466	0.066	6.894	0.000	1.306	Accepted
H5	CUI -> KMP	0.338	0.119	2.892	0.005	1.154	Accepted
H6	KMP -> GBP	0.162	0.078	2.079	0.038	1.334	Accepted

Beyond direct effects, this study also investigated the indirect effects of transformational leadership on green business performance through the mediating roles of cultural infrastructure. Mediation analysis was conducted using the bootstrapping procedure in SmartPLS software, which is robust for estimating indirect effects (Preacher, Rucker, &. Table 6 presents the results of the mediation analysis. Among the examined pathways, cultural infrastructure emerges as a significant mediator, as evidenced by the positive and statistically significant indirect effect of TRL → CUI → GBP ($\beta = 0.123$, $p = 0.022$). This finding suggests that transformational leadership primarily enhances green business performance by fostering a supportive cultural environment that reinforces sustainability-oriented values, norms, and behaviors.

In contrast, knowledge management practices do not independently mediate the TRL–GBP relationship, as the indirect effect through KMP is small and non-significant ($\beta = 0.043$, $p = 0.13$).

Additionally, the sequential mediation pathway TRL → CUI → KMP → GBP does not reach significance ($\beta = 0.02$, $p = 0.235$), suggesting that although CUI contributes to KMP, the accumulated indirect influence is insufficient to translate leadership effects into performance gains through both mediators simultaneously. Nevertheless, the total indirect effect of TRL on GBP remains significant, indicating that transformational leadership has a meaningful indirect influence on green performance, with cultural infrastructure playing a central mediating role in this process. This highlights the importance of cultivating a sustainability-oriented culture as the primary mechanism linking leadership behaviors to enhanced environmental outcomes.

Table 6: Mediation Analysis Results (Indirect Effects)

Relationship	Indirect effect (β)	Std. Error	t-value	p-value	Outcome
TRL -> KMP -> GBP	0.043	0.028	1.516	0.130	No Mediation
TRL -> CUI -> GBP	0.123	0.054	2.283	0.022	Significant Mediation

Relationship	Indirect effect (β)	Std. Error	t-value	p-value	Outcome
TRL -> CUI -> KMP -> GBP	0.020	0.017	1.188	0.235	No Mediation
Total Effect (TRL -> GBP)	0.233	0.061	3.819	0.000	Significant

5. Discussion

The research result was presented in Figure 2. Our results strongly support H1, demonstrating that Transformational Leadership has a significant and positive impact on Knowledge Management Practices in SMEs (β = 0.266, p < 0.01). This aligns seamlessly with prior research that posits transformational leaders, through their idealized influence and intellectual stimulation, foster an environment of trust and open communication that is conducive to knowledge creation and sharing (Al-Husseini, El Beltagi and Moizer, 2021). In the unique landscape of SMEs, where formal knowledge systems might be less developed, the personal influence of a transformational leader becomes even more critical. Their ability to inspire a shared vision for learning and to provide individualized consideration for employee development directly translates into more effective knowledge acquisition, dissemination, and application (Al-Husseini, El Beltagi and Moizer, 2021). This finding extends the literature by empirically validating this relationship within a specific, under-researched context, emphasizing how the human element of leadership can overcome structural limitations in smaller firms to cultivate a vibrant knowledge ecosystem. This is particularly relevant in emerging economies like Vietnam, where informal networks often play a more significant role than formalized structures in knowledge transfer (Kılıç and Uludağ, 2021).

The direct positive impact of Transformational Leadership on Green Business Performance (H2: β = 0.241, p < 0.001) is consistent with a growing body of literature that links visionary leadership to improved environmental outcomes (Niazi *et al.*, 2023). Transformational leaders, by inspiring commitment and stimulating innovation, directly motivate employees to engage in pro-environmental behaviors and seek out green solutions (Awan *et al.*, 2023). This direct effect highlights the leader's pivotal role in driving sustainability, even before considering the mediating internal mechanisms (Le *et al.*, 2024). However, the relatively smaller effect size compared to the indirect pathways (as seen in the R^2 and f^2 values for GBP and the mediation analysis) suggests that while direct leadership is important, its full potential is realized when channeled through robust internal capabilities. This finding subtly reinforces the "black box" argument from the introduction, indicating that while a direct link exists, the *how* is equally, if not more, important for a comprehensive understanding of leadership's impact on green performance.

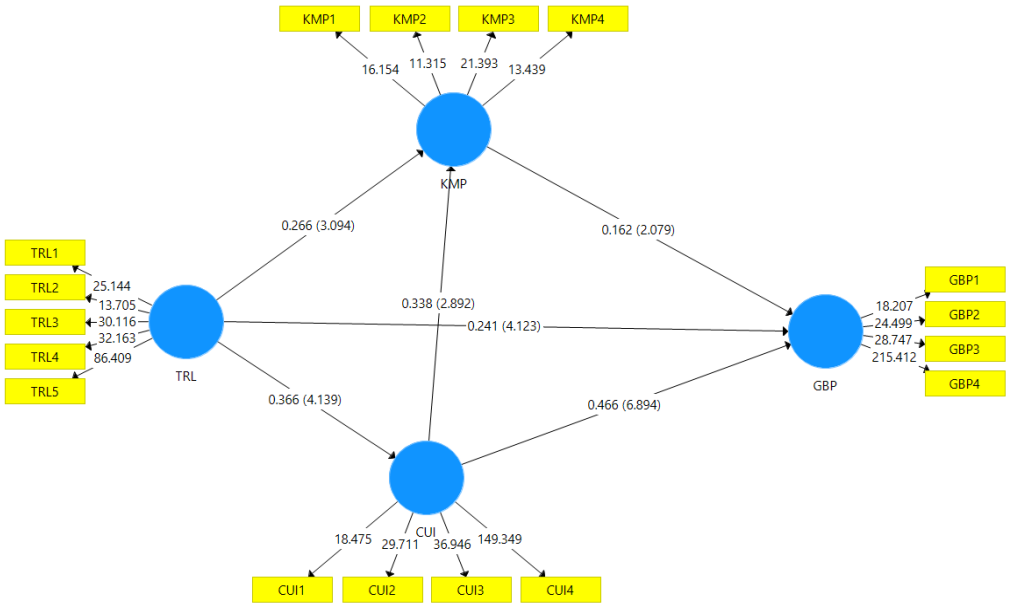

Figure 2: The PLS-SEM result

Similarly, H3, which posited a positive impact of Transformational Leadership on Cultural Infrastructure, was strongly supported (β = 0.366, p < 0.001). This result aligns with established theories on the role of leadership in shaping organizational culture (Hofstede, 2011; Khoa and Huynh, 2024). Transformational leaders, by

embodying desired values (idealized influence) and articulating a compelling future (inspirational motivation), effectively instill a cultural fabric that is adaptable, collaborative, and mission-driven (Madi Odeh *et al.*, 2023). For SMEs, the leader's direct engagement and pervasive influence mean that their values and vision are more readily absorbed into the nascent or evolving cultural infrastructure (Qalati *et al.*, 2022). This study explicitly highlights how transformational leaders can cultivate a pro-environmental cultural infrastructure, a critical precursor to green initiatives, by consistently prioritizing sustainability and encouraging employees to adopt eco-friendly norms (Ismail, 2025). This extends the cultural leadership literature by focusing on the specific outcome of a green-oriented culture, demonstrating that leaders are not just agents of general cultural change but can specifically steer culture towards sustainability.

Hypothesis H4, confirming that Cultural Infrastructure positively impacts Green Business Performance ($\beta = 0.466$, $p < 0.001$), underscores the profound influence of an organization's underlying values on its environmental actions. A pro-environmental and adaptable culture fosters a collective commitment to sustainability, encouraging employees to proactively engage in environmentally friendly behaviors and adopt eco-friendly initiatives (Abbas and Khan, 2023). This cultural alignment ensures that green strategies are not merely superficial or top-down mandates but are organically integrated into the daily operations and decision-making processes of the SME (Pradana *et al.*, 2022). The significant R^2 value for GBP (0.480) further emphasizes the combined explanatory power of TRL, KMP, and CUI. This high R^2 suggests that these three constructs, particularly through their mediating interplay, account for a substantial portion of the variance in green business performance, indicating a robust and comprehensive model.

Crucially, the study's findings illuminate the significant mediating roles of KMP and CUI. H5, confirming that Cultural Infrastructure has a positive impact on Knowledge Management Practices ($\beta = 0.338$, $p < 0.01$), aligns with the understanding that culture provides fertile ground for knowledge to flourish (Kirschning and Mrożewski, 2024). A culture of trust, openness, and collaboration, fostered by transformational leaders, directly facilitates knowledge sharing and creation, thereby reducing barriers to information flow and encouraging collective learning (Mojibi, Khojasteh and Khojasteh-Ghamari, 2015). This is particularly vital in SMEs, where informal knowledge networks are often more prevalent than formal systems; a supportive culture ensures these informal channels are effective and productive (Lam *et al.*, 2021). This finding reinforces the sequential nature of some organizational capabilities, where culture can precede and enable effective knowledge management, providing a deeper understanding of the antecedents of robust KM systems.

Furthermore, H6, which established a positive impact of Knowledge Management Practices on Green Business Performance ($\beta = 0.162$, $p < 0.05$), is strongly supported. This finding is consistent with the literature, which emphasizes KMP as a critical enabler for eco-innovation and environmental problem-solving (Nasir *et al.*, 2024). When SMEs effectively acquire, share, and apply environmental knowledge—regarding new green technologies, waste reduction techniques, or sustainable supply chain practices—they are better equipped to implement tangible improvements in their green performance (Abbas and Khan, 2023; Sahoo, Kumar and Upadhyay, 2023). This is particularly relevant for resource-constrained SMEs, where efficient knowledge utilization can compensate for limited financial resources in their pursuit of sustainability (Makhloufi, 2024). The ability to leverage existing and newly acquired knowledge efficiently becomes a strategic asset for SMEs navigating environmental demands.

The study's most significant finding is that Cultural Infrastructure serves as the primary mediating mechanism between Transformational Leadership and Green Business Performance ($\beta = 0.123$, $p = 0.022$). This finding strongly aligns with Dynamic Capability Theory (Teece, 2016), which emphasizes how organizational culture serves as a foundational micro-foundation for adaptive capabilities. This finding is particularly relevant in the Vietnamese context, where collectivist cultural values traditionally emphasize group harmony and shared responsibility (Hofstede, 2011). Vietnamese SMEs operate within a cultural framework where leadership influence is often more pronounced due to hierarchical respect and collective decision-making processes (Khoa and Huynh, 2024). The significant mediation effect suggests that Vietnamese managers who demonstrate transformational leadership can leverage these cultural tendencies to embed environmental values deeply within their organizations, creating what Abbas and Khan (2023) describe as "organizational green culture." Contrary to theoretical expectations, Knowledge Management Practices did not significantly mediate the transformational leadership-green performance relationship ($\beta = 0.043$, $p = 0.130$). This finding challenges much of the existing literature, which positions knowledge management as a critical pathway for leadership influence on performance outcomes (Al-Husseini, El Beltagi and Moizer, 2021). However, this result makes practical sense within the Vietnamese SME context. Many Vietnamese SMEs operate with informal knowledge-sharing systems rather than formalized knowledge management structures (Lam *et al.*, 2021). The limited financial resources

and technical expertise characteristic of Vietnamese SMEs may constrain their ability to develop sophisticated knowledge management practices that can effectively mediate leadership influence, as Kirschning and Mrożewski (2024) note. Knowledge sharing effectiveness may depend more on supportive cultural elements than on formal knowledge systems, which aligns with this study's findings. The non-significant mediation suggests that in Vietnamese SMEs, transformational leaders may need first to establish cultural foundations before knowledge management practices can become effective mediators. This interpretation is supported by the significant direct relationship between Cultural Infrastructure and Knowledge Management Practices ($\beta = 0.338$, $p < 0.01$), indicating that culture precedes and enables effective knowledge management in this context.

The study found that sequential mediation through Cultural Infrastructure to Knowledge Management Practices was not significant ($\beta = 0.020$, $p = 0.235$). This finding reveals important insights about the complexity of organizational transformation in Vietnamese SMEs. While Cultural Infrastructure influences both Green Business Performance directly and Knowledge Management Practices indirectly, the accumulated effect through both pathways does not create additional synergistic benefits. This result contrasts with Dynamic Capability Theory's emphasis on interconnected micro-foundations (Teece, Pisano and Shuen, 1997), suggesting that in the Vietnamese SME context, cultural and knowledge-based pathways may operate more independently than theoretically expected. The practical implication is that Vietnamese SME managers should prioritize cultural transformation as the primary mechanism for implementing green initiatives, while treating knowledge management as a secondary capability that emerges from, rather than amplifies, cultural change.

6. Conclusion

6.1 Theoretical Contributions

Firstly, this research significantly advances Dynamic Capability Theory by empirically demonstrating how specific micro-foundations—namely, Transformational Leadership, Knowledge Management Practices, and Cultural Infrastructure—function as critical dynamic capabilities or their enablers in driving Green Business Performance within SMEs. While DCT has been widely applied at the firm level, this study provides a granular understanding of the internal organizational mechanisms through which firms sense, seize, and transform their resources for environmental adaptation (Teece, 2016). By demonstrating that TRL fosters KMP and CUI, which in turn drive GBP, we illustrate a clear pathway for how leadership cultivates the adaptive capacities necessary for achieving a sustainable competitive advantage. This moves beyond abstract discussions of dynamic capabilities to concrete, measurable organizational processes, offering a more complete picture of how firms build resilience and responsiveness to environmental pressures.

Secondly, the study enriches leadership theories, particularly transformational leadership, by elucidating its indirect pathways to green business performance. While direct links between TRL and various performance outcomes are well-documented, our findings highlight the crucial individual and sequential mediating roles of CUI. This "opening of the black box" provides a more sophisticated understanding of *how* transformational leaders translate their vision and inspiration into tangible environmental results. It suggests that TRL's effectiveness in driving sustainability is significantly amplified when it successfully cultivates a supportive organizational culture. This multi-layered model provides a more comprehensive framework for understanding the influence of leadership on complex organizational outcomes, such as green performance. It encourages future research to explore similar mediating mechanisms in other contexts and to consider the interplay between multiple internal capabilities.

Thirdly, this research makes a unique contribution to the literature on green business performance, specifically addressing the challenges and opportunities within the SME context. Much of the existing sustainability research tends to focus on large corporations, often overlooking the distinct operational realities of SMEs, such as resource constraints and informal structures. By focusing exclusively on Vietnamese SMEs, this study provides context-specific empirical evidence that these internal capabilities are not only relevant but are critical for SMEs to achieve their green objectives. It demonstrates that even with limited resources, SMEs can leverage effective leadership, knowledge management, and a supportive culture to improve their environmental footprint and economic sustainability significantly. This contextualized understanding is vital for developing theories that are truly applicable and actionable for the vast majority of businesses globally, particularly in emerging markets where SMEs are the backbone of economic growth and environmental impact.

6.2 Practical Contributions

For SME managers, the research underscores the paramount importance of adopting a transformational leadership style. Leaders should actively articulate a clear and inspiring vision for environmental sustainability,

emphasizing its long-term benefits for the business and society. Beyond vision, managers must intellectually stimulate their teams, encouraging employees to challenge existing processes and propose innovative, eco-friendly solutions. Providing individualized support and development opportunities for employees to acquire green skills and knowledge is also crucial. By embodying these transformational behaviors, managers can directly and indirectly drive their SME's green transition, fostering a proactive and engaged workforce committed to sustainability. This leadership approach is convenient in SMEs due to the closer proximity and direct influence leaders have on their teams.

Furthermore, SME managers should prioritize the development of robust knowledge management practices. This does not necessarily require expensive, formal IT systems but rather a culture that encourages open communication, informal knowledge sharing, and learning from both successes and failures in green initiatives. Managers should create platforms, even simple ones like regular brainstorming sessions, internal knowledge-sharing forums, or cross-departmental project teams, where employees can exchange ideas on waste reduction, energy efficiency, and sustainable product development. Actively applying this acquired knowledge to improve operational processes and product design will directly translate into enhanced green business performance. Investing in training programs that focus on practical environmental knowledge and its application can yield significant returns.

The study also highlights the critical role of cultural infrastructure. SME managers must actively cultivate a pro-environmental organizational culture where sustainability is not just a policy but a deeply embedded value. This involves leading by example, integrating environmental considerations into daily decision-making, and celebrating green achievements. Fostering a culture of trust, collaboration, and openness to change will further enhance the effectiveness of knowledge management practices and ensure that all employees enthusiastically embrace green initiatives. A supportive culture can act as a powerful internal driver, compensating for external resource limitations often faced by SMEs, by fostering collective ingenuity and commitment towards shared environmental goals.

For policymakers in Vietnam and other developing nations, these findings suggest the need for targeted interventions that support the development of transformational leadership capabilities and internal organizational capacities within SMEs. This could include offering subsidized leadership training programs focused on sustainability, establishing knowledge-sharing platforms or industry clusters for green technologies and best practices, and providing incentives for SMEs to adopt pro-environmental cultural values. Policies that facilitate access to environmental knowledge and encourage collaborative networks among SMEs could significantly accelerate their green transformation, contributing to broader national sustainability goals and fostering a more resilient and environmentally responsible economy.

6.3 Limitations and Future Research

Despite its significant contributions, this study is subject to several limitations that offer fertile ground for future research. Firstly, its cross-sectional design, while suitable for identifying relationships, precludes definitive causal inferences. Future research could employ longitudinal designs to track the evolution of these relationships over time and establish stronger causality between transformational leadership, knowledge management practices, cultural infrastructure, and green business performance. Secondly, the study focused on SMEs in Vietnam, and while this provides valuable context-specific insights, the generalizability of these findings to SMEs in other cultural or economic contexts (e.g., developed nations, different regulatory environments) may be limited. Comparative studies across diverse regions would enhance the external validity of the model. Thirdly, the reliance on self-reported survey data introduces the potential for common method bias. Future studies could mitigate this by incorporating multi-source data (e.g., objective performance metrics, peer ratings of leadership, archival data) or employing experimental designs. Fourthly, while the chosen scales are well-established, their adaptation to the Vietnamese SME context, though carefully executed, might have introduced subtle nuances; future research could further validate these adapted scales or develop new ones specifically tailored to this context. Finally, this study examined specific mediating roles; future research could explore additional mediators (e.g., green innovation, employee engagement in sustainability, technological readiness) or moderating factors (e.g., industry type, competitive intensity, government support) that might influence these relationships, thereby building more complex and comprehensive models of green business performance in SMEs. Investigating potential negative impacts or challenges that hinder these relationships would also provide valuable insights for practitioners.

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Appendix 1: Measurement Scales

1. Transformational Leadership (TRL)

Adapted from Bass and Avolio (1989) - Multifactor Leadership Questionnaire (MLQ)

TRL1: My leader serves as a role model for environmental responsibility and sustainability practices.

TRL2: My leader inspires and motivates employees with a compelling vision for environmental sustainability.

TRL3: My leader intellectually stimulates employees to think creatively about environmental problems and solutions.

TRL4: My leader provides individualized support and coaching to help employees develop green skills and knowledge.

TRL5: My leader demonstrates idealized influence by consistently prioritizing environmental values in decision-making.

2. Knowledge Management Practices (KMP)

Adapted from Khoa and Huynh (2023); Khoa (2024)

KMP1: Our organization actively acquires new environmental knowledge and green technologies from external sources.

KMP2: Our organization effectively shares environmental knowledge and best practices among employees.

KMP3: Our organization systematically creates new environmental knowledge through research and experimentation.

KMP4: Our organization successfully applies environmental knowledge to improve our green business practices.

3. Cultural Infrastructure (CUI)

Adapted from Denison and Mishra (1995); Tsetim, Adegbe and Agema (2020)

CUI1: Our organizational culture strongly emphasizes environmental stewardship and sustainability values.

CUI2: Our organizational culture promotes adaptability and openness to green innovations and changes.

CUI3: Our organizational culture encourages employee involvement in environmental initiatives and decision-making.

CUI4: Our organizational culture maintains consistency in pursuing environmental mission and green objectives.

4. Green Business Performance (GBP)

Adapted from Ullah Khan et al. (2023); Phu and Khoa (2025)

GBP1: Our organization has significantly improved its eco-innovation capabilities and green product development.

GBP2: Our organization has achieved substantial improvements in resource efficiency and energy conservation.

GBP3: Our organization has successfully reduced waste generation and improved waste management practices.

GBP4: Our organization has enhanced its overall environmental performance and sustainability outcomes.

