

GREEN TRANSFORMATIONAL LEADERSHIP AND GREEN INNOVATION
PERFORMANCE IN SMES: THE MEDIATING ROLES OF EMPLOYEE COMMITMENT
AND CREATIVITY

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received: Dec, 1st 2025</p> <p>Accepted: Feb, 2nd 2026</p> <p>Keywords:</p> <p>Green Transformational Leadership; Green Commitment; Green Creativity; Green Innovation Performance; SMEs.</p> <div>    </div>	<p>Objectives: This study examines the impact of green transformational leadership (GTL) on green innovation performance (GIP) in manufacturing small and medium-sized enterprises (SMEs), focusing on the mediating roles of employee green commitment and green creativity.</p> <p>Theoretical Framework: The research integrates Transformational Leadership Theory, Social Exchange Theory, and Self-Determination Theory to explain how leadership behaviours influence employee psychological attachment to environmental values and their creative engagement in sustainability-oriented initiatives.</p> <p>Method: A quantitative cross-sectional survey was conducted among 299 employees working in manufacturing SMEs in China. Data were analysed using hierarchical regression and structural equation modelling to test direct, indirect, and sequential mediation effects.</p> <p>Results and Discussion: The findings reveal that GTL positively influences green innovation performance. Employee green commitment and green creativity both significantly mediate this relationship. Moreover, a sequential mediation pathway was confirmed, where GTL enhances employee green commitment, which fosters green creativity and subsequently strengthens green innovation performance.</p> <p>Research Implications: The study highlights the importance of employee-level psychological and creative mechanisms in translating leadership orientation into organisational green innovation outcomes. It provides practical guidance for SME leaders seeking to enhance sustainability-driven innovation.</p> <p>Originality/Value: This research extends the green leadership literature by empirically demonstrating the dual and sequential mediating roles of commitment and creativity in SMEs, a context that remains underexplored in sustainability and innovation research.</p> <p>Doi: https://doi.org/10.26668/businessreview/2026.v11i3.5848</p>

LIDERANÇA TRANSFORMACIONAL VERDE E DESEMPENHO EM INOVAÇÃO VERDE EM
PMEs: OS PAPÉIS MEDIADORES DO COMPROMETIMENTO E DA CRIATIVIDADE DOS
FUNCIONÁRIOS

RESUMO

Objetivos: Este estudo examina o impacto da liderança transformacional verde (GTL) no desempenho da inovação verde (GIP) em pequenas e médias empresas (PMEs) do setor manufatureiro, com foco nos papéis mediadores do compromisso verde e da criatividade verde dos funcionários.

Estrutura teórica: A pesquisa integra a Teoria da Liderança Transformacional, a Teoria da Troca Social e a Teoria da Autodeterminação para explicar como os comportamentos de liderança influenciam o apego psicológico

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dos funcionários aos valores ambientais e seu envolvimento criativo em iniciativas orientadas para a sustentabilidade.

Método: Foi realizada uma pesquisa quantitativa transversal com 299 funcionários que trabalham em PMEs manufatureiras na China. Os dados foram analisados usando regressão hierárquica e modelagem de equações estruturais para testar os efeitos de mediação direta, indireta e sequencial.

Resultados e discussão: Os resultados revelam que a GTL influencia positivamente o desempenho da inovação verde. O compromisso ecológico e a criatividade ecológica dos funcionários mediam significativamente essa relação. Além disso, foi confirmada uma via de mediação sequencial, na qual a GTL aumenta o compromisso ecológico dos funcionários, o que promove a criatividade ecológica e, subsequentemente, fortalece o desempenho da inovação verde.

Implicações da pesquisa: O estudo destaca a importância dos mecanismos psicológicos e criativos dos funcionários na tradução da orientação da liderança em resultados de inovação verde organizacional. Ele fornece orientações práticas para líderes de PMEs que buscam aprimorar a inovação orientada para a sustentabilidade.

Originalidade/valor: Esta pesquisa amplia a literatura sobre liderança verde, demonstrando empiricamente os papéis mediadores duplos e sequenciais do compromisso e da criatividade nas PMEs, um contexto que permanece pouco explorado na pesquisa sobre sustentabilidade e inovação.

Palavras-chave: Liderança Transformacional Verde, Compromisso Verde, Criatividade Verde, Desempenho em Inovação Verde, PMEs.

LIDERAZGO TRANSFORMACIONAL ECOLÓGICO Y RENDIMIENTO DE LA INNOVACIÓN ECOLÓGICA EN LAS PYMES: EL PAPEL MEDIADOR DEL COMPROMISO Y LA CREATIVIDAD DE LOS EMPLEADOS

RESUMEN

Objetivos: Este estudio examina el impacto del liderazgo transformacional ecológico (GTL) en el rendimiento de la innovación ecológica (GIP) en las pequeñas y medianas empresas (pymes) manufactureras, centrándose en el papel mediador del compromiso ecológico y la creatividad ecológica de los empleados.

Marco teórico: La investigación integra la teoría del liderazgo transformacional, la teoría del intercambio social y la teoría de la autodeterminación para explicar cómo los comportamientos de liderazgo influyen en el apego psicológico de los empleados a los valores medioambientales y en su compromiso creativo con iniciativas orientadas a la sostenibilidad.

Método: Se realizó una encuesta cuantitativa transversal entre 299 empleados que trabajan en pymes manufactureras en China. Los datos se analizaron utilizando regresión jerárquica y modelos de ecuaciones estructurales para comprobar los efectos de mediación directos, indirectos y secuenciales.

Resultados y discusión: Los resultados revelan que el GTL influye positivamente en el rendimiento de la innovación ecológica. El compromiso ecológico y la creatividad ecológica de los empleados median significativamente en esta relación. Además, se confirmó una vía de mediación secuencial, en la que el GTL mejora el compromiso ecológico de los empleados, lo que fomenta la creatividad ecológica y, posteriormente, refuerza el rendimiento de la innovación ecológica.

Implicaciones de la investigación: El estudio destaca la importancia de los mecanismos psicológicos y creativos a nivel de los empleados para traducir la orientación del liderazgo en resultados de innovación ecológica de la organización. Proporciona orientación práctica a los líderes de las pymes que buscan mejorar la innovación impulsada por la sostenibilidad.

Originalidad/valor: Esta investigación amplía la bibliografía sobre liderazgo ecológico al demostrar empíricamente las funciones mediadoras duales y secuenciales del compromiso y la creatividad en las pymes, un contexto que sigue sin estar suficientemente explorado en la investigación sobre sostenibilidad e innovación.

Palabras clave: Liderazgo Transformacional Ecológico, Compromiso Ecológico, Creatividad Ecológica, Rendimiento de la Innovación Ecológica, PYMES.

1 INTRODUCTION

Small and medium-sized enterprises (SMEs) represent the backbone of national economies, contributing substantially to employment, innovation, and industrial development. In China, SMEs account for more than 60% of gross domestic product and nearly 80% of urban employment (National Bureau of Statistics of China, 2022), positioning them as key actors in both economic growth and environmental sustainability. At the same time, rapid industrialization has intensified environmental challenges, leading to growing regulatory pressure and stakeholder expectations for sustainable business practices. For manufacturing SMEs in particular, green innovation performance (GIP)—reflected in environmentally friendly products and cleaner production processes—has become an important mechanism for balancing competitiveness with regulatory compliance (Liu, Zhu, & Li, 2020; Yang et al., 2024).

Leadership is widely regarded as a critical determinant of how organizations respond to sustainability-related challenges. While large firms often rely on formal environmental management systems and dedicated sustainability units, SMEs typically operate under significant resource constraints. Consequently, their engagement in green innovation relies heavily on leaders' values, vision, and daily practices. In this context, green transformational leadership (GTL), which extends transformational leadership principles to environmental objectives, has attracted increasing attention in recent research (Dong, Wong, & Lee, 2022; Ullah, Ahmad, Scholz, & Rehman, 2023). Prior studies suggest that GTL is associated with a range of pro-environmental behaviors and innovation-related outcomes, particularly in settings characterized by regulatory pressure and limited organizational resources (Elshaer et al., 2024; Srivastava et al., 2024).

Despite the growing interest in GTL, two important gaps remain in the literature. First, existing studies have predominantly focused on large organizations or service-sector contexts, leaving manufacturing SMEs—especially those in emerging economies such as China—relatively underexplored (Li et al., 2020). Second, although GTL has been linked to green employee behaviors, the employee-level psychological mechanisms through which leadership orientations are associated with organizational green innovation performance remain insufficiently understood. Clarifying these mechanisms is important for explaining how leadership influences not only individual attitudes and behaviors but also firm-level innovation outcomes, such as green product and process innovation (Zhang, Luo, & Xie, 2022).

To address these gaps, the present study examines employee green commitment (GCm) and green creativity (GC) as mediating mechanisms in the relationship between GTL and green innovation performance in SMEs. Employee green commitment reflects employees' psychological attachment to environmental values and sustainability goals, which may encourage sustained engagement in green initiatives (Paillé, Chen, Boiral, & Jin, 2016). Green creativity refers to the generation of novel and useful ideas aimed at improving environmental performance and supporting innovation (Chen & Chang, 2013). Prior research indicates that both constructs represent important micro-level foundations of green innovation, particularly in resource-constrained organizational environments (Kim et al., 2019; Li et al., 2020).

The empirical setting of this study is manufacturing SMEs located in Shandong Province, China. Shandong is one of the country's most industrialized regions and has experienced increasing environmental regulation intended to promote cleaner production and innovation-oriented sustainability practices (Liu et al., 2020; Yang et al., 2024). This context provides an appropriate setting for examining how leadership and employee-level mechanisms are associated with green innovation performance under conditions of regulatory pressure.

The study draws on Transformational Leadership Theory (Bass, 1990), Social Exchange Theory (Blau, 1964), and Self-Determination Theory (Deci & Ryan, 1985) to develop the proposed framework. Transformational Leadership Theory explains how leaders' vision, role-modeling, and support may shape employee orientations toward sustainability. Social Exchange Theory suggests that employees may reciprocate environmentally supportive leadership with stronger commitment and engagement. Self-Determination Theory highlights the role of intrinsic motivation in sustaining creative and proactive green behaviors. Integrating these perspectives provides a comprehensive explanation of the employee-level pathways linking leadership with green innovation performance in SMEs.

Accordingly, this study aims to examine: (1) the relationship between GTL and green innovation performance in SMEs, (2) the mediating role of employee green commitment, (3) the mediating role of employee green creativity, and (4) the sequential mediating effect of green commitment and creativity. By focusing on manufacturing SMEs in an emerging economy, the study contributes to the literature on green leadership and sustainability by clarifying how employee-level mechanisms are associated with organizational green innovation performance.

1.1 RESEARCH OBJECTIVES

1. To examine the direct effect of GTL on green innovation performance in SMEs.
2. To test the mediating role of employee green commitment in the relationship between GTL and green innovation.
3. To test the mediating role of employee green creativity in the relationship between GTL and green innovation.
4. To assess the chain mediation effect of green commitment and creativity between GTL and green innovation.

1.2 CONTRIBUTIONS OF THE STUDY ARE THREEFOLD

By clarifying how GTL influences innovation through employee-level mechanisms, this research extends the scope of leadership and sustainability studies in SMEs. The study provides actionable insights for SME leaders on how to embed sustainability by cultivating employee commitment and creativity. By focusing on manufacturing SMEs in Shandong, China, the study addresses the scarcity of leadership research in emerging-market contexts.

In summary, this study responds to the urgent need for SMEs to align economic development with environmental responsibility. By investigating the mechanisms through which GTL fosters employee commitment, creativity, and ultimately green innovation, it provides both academic and practical insights for building more sustainable enterprises.

2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 THEORETICAL FOUNDATION

This study draws on three theoretical perspectives to explain how green transformational leadership (GTL) influences green innovation performance (GIP) in small and medium-sized enterprises (SMEs): Transformational Leadership Theory (Bass, 1990), Social Exchange Theory (Blau, 1964), and Self-Determination Theory (Deci & Ryan, 1985).

Transformational Leadership Theory emphasizes how leaders articulate a compelling vision, inspire followers, role-model values, and provide intellectual stimulation and support.

When extended to environmental objectives, these behaviors form the basis of GTL, in which leaders motivate employees toward sustainability goals (Mittal & Dhar, 2016).

Social Exchange Theory provides the mechanism of reciprocity. Employees interpret GTL behaviors such as prioritizing sustainability and supporting green initiatives as signals of organizational commitment. In response, they reciprocate with heightened commitment and innovative behavior (Paillé et al., 2016; Kim et al., 2019).

Self-Determination Theory further enriches the model by explaining why employees sustain green behavior over time. GTL enhances intrinsic motivation by satisfying needs for autonomy, competence, and relatedness, which encourage employees to contribute creatively and persistently to green outcomes (Li et al., 2020).

Taken together, these perspectives explain how leadership behaviors influence employee psychological states (commitment and creativity), which in turn translate into organizational innovation outcomes.

2.2 GREEN TRANSFORMATIONAL LEADERSHIP

GTL extends transformational leadership into the sustainability domain. It involves articulating a green vision, acting as a role model for eco-friendly practices, intellectually stimulating employees to rethink environmental challenges, and providing individualized consideration for those engaging in green initiatives (Robertson & Barling, 2017; Dong et al., 2022). Unlike large corporations with formalized sustainability departments, SMEs often lack the institutional infrastructure for environmental management. In such settings, leaders' personal commitment and behavior largely determine whether sustainability is integrated into organizational strategy (Ullah et al., 2023). GTL therefore provides the “*soft infrastructure*” by aligning employees with environmental goals through values and inspiration rather than through costly systems. In China, where many SMEs face tightening ecological regulations but limited resources, the role of leadership becomes particularly salient (Liu et al., 2020). Recent studies increasingly confirm the importance of GTL in driving sustainable outcomes. For example, Dong et al. (2022) demonstrated that GTL enhances employees' green creativity through intrinsic motivation, while Li et al. (2020) found that such leadership practices directly stimulate both employee creativity and organizational environmental performance. Similarly, Ullah et al. (2023) reported that GTL significantly improves the sustainable performance of SMEs in emerging markets, and recent work documents consistent mechanisms through

perceived support, culture, and climate (Abourobah, Bajaba, & Yaqub, 2024; Elshaer et al., 2024; Saleem, Mateou, & Malik, 2024; Srivastava et al., 2024). Taken together, this body of evidence indicates that GTL is a powerful antecedent of SME green innovation performance and warrants closer empirical examination. However, most GTL studies are based on large firms or Western contexts. The dynamics in SMEs, especially in China's manufacturing sector, remain underexplored. Moreover, while prior studies establish links to green behavior, fewer examine GTL's effect on green innovation performance, which reflects organizational-level outcomes like product and process innovation.

Hypothesis 1 (H1): GTL has a positive effect on green innovation performance in SMEs.

2.3 EMPLOYEE GREEN COMMITMENT

Employee green commitment refers to the psychological attachment to environmental values and goals (Paillé et al., 2016). It reflects a sense of moral obligation and personal responsibility to support sustainability, distinguishing it from general organizational commitment, which primarily emphasizes loyalty to the organization. In SMEs, where formal environmental policies and structures are often absent, employees' discretionary commitment becomes particularly critical. A workforce with strong green commitment ensures consistent environmental performance even when resources are scarce (Saleem, Qadeer, & Mahmood, 2021). Such employees often champion green initiatives, adopt eco-friendly practices, and persist in pro-environmental behavior even without direct incentives (Kim et al., 2019). Empirical research provides increasing support for the role of green commitment in sustainability outcomes. For instance, Al-Ghazali, Afsar, and Javed (2020) demonstrated that responsible leadership enhances employee green commitment, which subsequently predicts green behavior. Similarly, Kim et al. (2019) showed that green commitment is a key predictor of voluntary workplace green behaviors that extend beyond formal requirements. Zhang et al. (2022) further confirmed that employees' green self-efficacy and commitment mediate the relationship between GTL and employee green behavior. Extending this perspective, Ullah et al. (2023) found that in SMEs, green commitment functions as a central psychological mechanism through which leadership translates into sustainability outcomes. More recent evidence shows that organizational support processes reinforce this mechanism (Ding et al., 2023; Elshaer et al., 2024).

Hypothesis 2 (H2): Employee green commitment mediates the relationship between GTL and green innovation performance.

2.4 EMPLOYEE GREEN CREATIVITY

Green creativity refers to the ability to generate novel and useful ideas that address environmental challenges and improve eco-performance, including the design of new green products and the adoption of cleaner production methods (Chen & Chang, 2013). Within SMEs, green creativity plays an especially critical role because these firms often lack the resources to establish dedicated R&D departments. In such contexts, employees' creative contributions enable firms to comply with increasingly stringent ecological regulations, differentiate their products in competitive markets, and sustain long-term competitiveness despite resource limitations (Li et al., 2020). A growing body of research confirms the importance of green creativity for achieving sustainable outcomes. Dong et al. (2022), for instance, found that GTL enhances employee green creativity by fostering intrinsic motivation and strengthening employees' identification with environmental values. Similarly, Li et al. (2020) demonstrated that GTL stimulates the generation of creative ideas that feed directly into organizational green innovation. Mittal and Dhar (2016) further emphasized the relevance of GTL in the SME sector by showing its significant effect on creativity in service firms, underscoring the cross-industry applicability of these findings. More recently, Ullah et al. (2023) provided evidence from emerging markets that creativity operates as a key mediating mechanism linking leadership with sustainable SME performance, corroborated by newer studies that emphasize culture, mindfulness, and green climate as enabling contexts (Abourobah et al., 2024; Srivastava et al., 2024).

Hypothesis 3 (H3): Employee green creativity mediates the relationship between GTL and green innovation performance.

2.5 CHAIN MEDIATION OF COMMITMENT AND CREATIVITY

Green commitment and creativity may also operate sequentially, forming a chain mediation mechanism. Employees who are highly committed to environmental values are more inclined to devote effort toward generating creative solutions, and these ideas directly enhance organizational green innovation performance (Sun, Fang, & Lim, 2020). Prior studies provide

evidence consistent with this sequential logic. For example, Zhang et al. (2022) demonstrated that the effects of leadership often cascade through multiple psychological mechanisms rather than being transmitted directly. In line with this reasoning, Sun et al. (2020) found that employee commitment fosters greater creativity, which subsequently contributes to higher levels of green innovation. Extending this line of work, Ullah et al. (2023) confirmed that commitment and creativity jointly explain how leadership practices translate into improved sustainability outcomes in SMEs, a pattern echoed in recent research linking GTL to creativity through effective and contextual pathways (Abourobkbah et al., 2024; Ding et al., 2023).

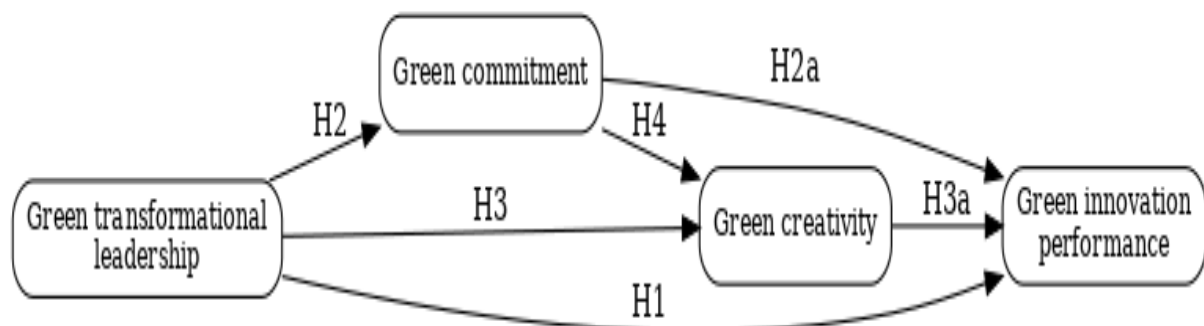
Hypothesis 4 (H4): Employee green commitment and green creativity sequentially mediate the relationship between GTL and green innovation performance.

2.6 CONCEPTUAL FRAMEWORK

The conceptual framework (Figure 1) illustrates the hypothesized relationships: GTL influences green innovation performance directly and indirectly through green commitment and green creativity, both individually and sequentially.

Figure 1

Conceptual Framework



3 METHODOLOGY

3.1 RESEARCH TECHNIQUE

This study employed a quantitative, cross-sectional survey design to examine how green transformational leadership (GTL) influences green innovation performance (GIP) through employee green commitment (GCm) and green creativity (GC). The survey technique was

chosen because it allows systematic data collection from a relatively large sample, ensuring reliability and comparability across constructs (Podsakoff, MacKenzie, & Podsakoff, 2012). A cross-sectional approach is common in leadership and organizational behavior research and is appropriate for identifying relationships between constructs within a defined time frame.

Data collection was carried out among manufacturing SMEs in Shandong Province, China. This region was selected due to its high concentration of SMEs and increasing regulatory pressure to adopt green practices (Liu et al., 2020; Yang et al., 2024). SMEs were identified using official government criteria (fewer than 500 employees and annual revenue below 200 million RMB). A purposive sampling method was adopted to target firms from sectors most affected by environmental regulations, including chemicals, textiles, machinery, and electronics.

A total of 400 questionnaires were distributed to employees across hierarchical levels, with an emphasis on those engaged in operations, production, and innovation activities. After excluding incomplete responses, 299 valid questionnaires were retained for analysis, yielding a 74.8% response rate. Consistent with prior leadership and sustainability research, this study adopts an employee-perception approach to capture micro-level mechanisms underlying green innovation in SMEs.

Table 1

Respondent Demographics (N = 299)

Variable	Category	No. of Respondents	%
Gender	Male	171	57
	Female	128	43
Age	20–29	64	21
	30–39	112	37
	40–49	86	29
	50+	37	13
Education	High school	88	29
	Bachelor	163	55
	Master+	48	16
Tenure in organization	<3 years	97	32
	3–6 years	103	34
	7–10 years	63	21
	>10 years	36	13
Position	Line employee	137	46
	Supervisor	96	32
	Manager	66	22

3.2 RESEARCH INSTRUMENTS

All variables were measured using well-established multi-item scales adapted from prior peer-reviewed studies to ensure content validity. Responses were captured on a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). To ensure cross-cultural accuracy, all items were translated into Chinese and then back translated into English following Brislin’s (1980) recommended procedure.

Green transformational leadership (GTL) was measured using 12 items adapted from Mittal and Dhar (2016). These items capture the extent to which leaders articulate a vision, role-model eco-friendly behavior, provide intellectual stimulation, and offer individualized consideration in environmental matters. A sample item is: *“My leader encourages me to think creatively about environmental problems.”*

Employee green commitment (GCm) was assessed using six items from Paillé et al. (2016), which reflect employees’ psychological attachment to their organization’s environmental values. A sample item is: *“I feel emotionally attached to my company’s environmental values.”*

Green creativity (GC) was measured with seven items adapted from Chen and Chang (2013). These items capture the generation of novel and useful ideas that contribute to environmental improvement. An illustrative statement is: *“I frequently come up with novel ideas for improving environmental performance.”*

Green innovation performance (GIP) was measured with eight items adapted from Chen and Chang (2013), covering both product and process innovation outcomes. A representative item is: *“Our company frequently introduces eco-friendly products.”*

Finally, several demographic variables gender, age, education, tenure, and organizational position were included as controls, as prior research has suggested that these factors may influence employees’ environmental attitudes and behaviors.

3.3 RELIABILITY AND VALIDITY

Reliability and validity of the instruments were assessed using confirmatory factor analysis (CFA). All Cronbach’s alpha values exceeded the 0.80 threshold, confirming internal consistency. Convergent validity was supported with average variance extracted (AVE > 0.50)

and composite reliability ($CR > 0.70$). Discriminant validity was confirmed as the square root of AVE for each construct exceeded inter-construct correlations (Fornell & Larcker, 1981).

Table 2

Reliability and Validity Statistics

Construct	Items	Cronbach's α	CR	AVE
GTL	12	0.91	0.93	0.62
GCm	6	0.88	0.90	0.61
GC	7	0.89	0.91	0.60
GIP	8	0.92	0.94	0.64

3.4 DATA ANALYSIS TECHNIQUE

Data was analyzed using SPSS 26 and AMOS 24. Hierarchical regression analysis was first conducted to assess direct effects. Mediation effects were tested using structural equation modeling (SEM) with maximum likelihood estimation and bootstrapping (5,000 resamples). Model fit indices were evaluated against Hu and Bentler's (1999) cutoffs (CFI and $TLI > 0.90$, $RMSEA < 0.08$, $SRMR < 0.08$). Common method bias was assessed using Harman's single-factor test, which showed no serious concern as the first factor accounted for only 34% of variance ($< 50\%$). Consistent with prior leadership and sustainability research, this study adopts an employee-perception approach to capture micro-level mechanisms underlying green innovation in SMEs.

4 RESULTS

4.1 DESCRIPTIVE STATISTICS AND CORRELATIONS

Descriptive statistics and correlations for the study variables are presented in Table 3. On average, respondents reported moderately high perceptions of green transformational leadership ($M = 3.87$, $SD = 0.64$), green commitment ($M = 3.74$, $SD = 0.69$), green creativity ($M = 3.81$, $SD = 0.67$), and green innovation performance ($M = 3.78$, $SD = 0.71$). These means suggest that employees generally perceived their leaders to be environmentally oriented, and that they themselves were engaged in commitment, creativity, and innovation related to sustainability.

The correlation matrix provides preliminary evidence for the proposed relationships. GTL was strongly and positively correlated with GCm ($r = 0.52$, $p < 0.01$), GC ($r = 0.49$, $p < 0.01$), and GIP ($r = 0.47$, $p < 0.01$). Similarly, GCm and GC showed significant positive correlations with GIP ($r = 0.44$ and $r = 0.46$, $p < 0.01$, respectively). These findings indicate that the constructions are related in the expected direction and provide initial support for the hypothesized mediation effects.

Table 3

Descriptive Statistics and Correlations (N = 299)

Variable	Mean	SD	1	2	3	4
1. GTL	3.87	0.64	—			
2. GCm	3.74	0.69	0.52**	—		
3. GC	3.81	0.67	0.49**	0.50**	—	
4. GIP	3.78	0.71	0.47**	0.44**	0.46**	—

Note: ** $p < 0.01$.

4.2 DIRECT EFFECTS OF GTL ON GIP

Hierarchical regression analysis was used to test the direct effect of GTL on GIP, controlling for gender, age, education, tenure, and position. As shown in Table 4, GTL had a significant positive effect on GIP ($\beta = 0.29$, $t = 6.02$, $p < 0.001$). Control variables were non-significant.

Table 4

Regression Results for Direct Effects

Predictor	β	t	Sig.
GTL → GIP	0.29	6.02	0.000
Controls	ns	—	—

These results provide strong support for H1, confirming that leaders who demonstrate green transformational behaviors contribute significantly to organizational green innovation performance. Practically, this means that SMEs benefit directly when leaders articulate a green vision and role-model sustainable practices.

4.3 MEDIATION ANALYSIS

To test the indirect effects, structural equation modeling (SEM) was applied with bootstrapping based on 5,000 resamples. The results are summarized in Table 5.

For H2, the findings indicate that GTL significantly predicted GCm ($\beta = 0.52$, $p < 0.001$), and GCm in turn significantly predicted GIP ($\beta = 0.21$, $p < 0.01$). The bootstrapped indirect effect of GTL on GIP via GCm was statistically significant ($\beta = 0.11$, 95% CI [0.06, 0.18]), thereby supporting the mediating role of employee green commitment.

With respect to H3, GTL was also found to significantly predict GC ($\beta = 0.49$, $p < 0.001$), and GC was positively related to GIP ($\beta = 0.23$, $p < 0.01$). The indirect effect of GTL on GIP via GC was significant ($\beta = 0.12$, 95% CI [0.07, 0.19]), confirming the mediating role of green creativity.

Finally, H4 proposed a sequential chain mediation in which GTL influences GCm, which in turn fosters GC, ultimately leading to enhanced GIP. The results provided strong support for this hypothesis: GTL significantly predicted GCm ($\beta = 0.52$, $p < 0.001$), GCm predicted GC ($\beta = 0.30$, $p < 0.01$), and GC predicted GIP ($\beta = 0.23$, $p < 0.01$). The sequential indirect effect was significant ($\beta = 0.08$, 95% CI [0.04, 0.14]), confirming that green commitment and creativity jointly mediate the GTL–GIP relationship.

4.5 STRUCTURAL MODEL

Table 5

Mediation Analysis Results (Bootstrapping, N = 299)

4.2.1 Indirect Effects

Path Tested	β	SE	95% CI	Result
GTL → GCm → GIP	0.11	0.03	[0.06, 0.18]	Supported (H2)
GTL → GC → GIP	0.12	0.03	[0.07, 0.19]	Supported (H3)
GTL → GCm → GC → GIP	0.08	0.02	[0.04, 0.14]	Supported (H4)

These findings strongly support H2–H4. Employee green commitment and creativity each act as significant mediators, and their sequential effect further strengthens the relationship between GTL and GIP. This confirms that the influence of leadership is not only direct but also channeled through psychological and behavioral mechanisms at the employee level.

4.6 MODEL FIT

The hypothesized mediation model showed good fit indices: $\chi^2/df = 2.11$, CFI = 0.94, TLI = 0.93, RMSEA = 0.062, SRMR = 0.045. These values meet the recommended thresholds (Hu & Bentler, 1999), suggesting the model adequately represents the observed data. A good model fit increases confidence in the robustness of the hypothesized framework, supporting the theoretical model that links GTL, employee-level mediators, and organizational green innovation.

4.7 SUMMARY OF HYPOTHESES TESTING

The results provided consistent support for all four hypotheses proposed in this study. First, in line with H1, GTL was found to have a significant positive effect on green innovation performance, confirming that leadership directly contributes to organizational environmental outcomes. Second, the findings for H2 demonstrated that employee green commitment mediated the relationship between GTL and GIP, indicating that leadership fosters psychological attachment to environmental values which, in turn, enhances innovation. Third, the analysis supported H3, showing that green creativity also mediated the GTL–GIP relationship, thereby confirming the role of employees' innovative ideas as a mechanism through which leadership influences organizational performance. Finally, the sequential mediation proposed in H4 was supported, revealing that GTL increases employees' green commitment, which subsequently fosters creativity, and together these processes lead to improved green innovation performance. Taken as a whole, these results confirm that GTL exerts both direct and indirect effects on organizational innovation. Importantly, the mediating roles of green commitment and creativity emphasize that the impact of leadership is not confined to providing direction or vision but also operates by shaping employees' psychological states and creative engagement, which together serve as the foundation for sustained innovation in SMEs. Recent studies in diverse SME settings reinforce these pathways (Abourokbah et al., 2024; Ding et al., 2023; Elshaer et al., 2024; Srivastava et al., 2024; Zaid & Yaqub, 2024; Yang et al., 2024).

5 DISCUSSION

5.1 SUMMARY OF FINDINGS

This study investigated how green transformational leadership (GTL) influences green innovation performance (GIP) among SMEs in Shandong Province, China, with a focus on the mediating roles of employee green commitment (GCm) and green creativity (GC). The results provide robust evidence that GTL not only directly predicts GIP but also indirectly enhances it through employees' psychological and creative engagement. Specifically, the findings confirm four main insights: (1) GTL is positively associated with SME green innovation outcomes, (2) employee green commitment mediates the GTL–GIP relationship, (3) employee green creativity mediates the GTL–GIP relationship, and (4) commitment and creativity jointly form a sequential pathway linking leadership to innovation. These results highlight the multi-level influence of leadership in resource-constrained contexts: leaders inspire direction, employees internalize values, and innovation emerges as a collective outcome (see also Abourobkbah et al., 2024; Srivastava et al., 2024; Ding et al., 2023; Elshaer et al., 2024).

The results align with and extend existing scholarship on leadership and sustainability. Consistent with Ullah et al. (2023), this study shows that GTL strengthens organizational sustainability performance. The findings also echo Dong et al. (2022), who identified a positive link between GTL and green creativity, reinforcing the idea that leadership behaviors are central to green innovation in SMEs. Unlike prior work focused largely on large corporations (Mittal & Dhar, 2016), this study demonstrates the relevance of GTL in the SME sector of an emerging economy. The finding that GCm mediates the GTL–GIP relationship supports Paillé et al. (2016), who argued that leadership inspires psychological attachment to environmental values. It extends their work by showing that this attachment not only predicts behavior but also contributes to organizational innovation outcomes. This suggests that in SMEs, where formal green systems are limited, commitment acts as a substitute mechanism for sustainability. The results are consistent with Chen and Chang (2013), who emphasized creativity as a driver of green product innovation. They also support Li et al. (2020), who found that GTL fosters creative eco-ideas by stimulating intrinsic motivation. By linking creativity explicitly to SME innovation performance, this study strengthens the argument that employee-generated ideas can translate into strategic innovation advantages. The sequential effect of GCm and GC adds nuance to existing research. While previous studies examined commitment and creativity

separately (Zhang et al., 2022), few have tested them together in a sequential model. Recent evidence likewise indicates that GTL shapes passion, support, and culture that enable creativity to flourish into innovation (Abourobah et al., 2024; Elshaer et al., 2024; Srivastava et al., 2024).

5.3 THEORETICAL CONTRIBUTIONS

This study sharpens the theory of green transformational leadership (GTL) by specifying where and how it matters. First, it extends GTL beyond large, resource-rich firms to resource-constrained Chinese manufacturing SMEs, a context in which leadership becomes especially salient because formal environmental systems are thin. Second, it articulates a dual employee mechanism with distinct theoretical roles: green commitment as reciprocity/obligation (Social Exchange) that aligns values, and green creativity as autonomy-driven intrinsic motivation (Self-Determination) that converts alignment into novel, eco-useful ideas. Third, it proposes a plausible serial process—GTL → commitment → creativity → green innovation performance (GIP)—arguing that value internalization typically lowers perceived risk and enables ideation in SMEs (while being cautious about temporal claims in cross-sectional data). Fourth, it advances a contingent substitution thesis: in SMEs, employee commitment can partly compensate for weak green infrastructure, acting as “soft” scaffolding through which leadership influences innovation. Fifth, it bridges micro to firm outcomes by making the aggregation logic explicit (aligned values → ideas → product/process innovation), and it delineates boundary conditions—higher regulatory pressure and greater resource scarcity should strengthen the pathway. Finally, by operationalizing GIP as both product and process innovation, it clarifies the most appropriate criterion for sustainability-oriented leadership research.

5.4 PRACTICAL IMPLICATIONS

For small business owners, the results show how important it is to create and keep talking about a clear green vision. This vision should be turned into basic, quantifiable goals, such cutting down on energy usage, waste, or water use by a certain amount. These goals must be verified regularly to make sure everyone is doing their part. Leaders could also show others how to be environmentally friendly by doing things like using less paper, using less energy, and

sourcing responsibly in their everyday lives. These behaviours that others may see develop trust and make employees want to do the same.

It is also crucial to get employees to care about the environment. SMEs may make their HR policies more environmentally friendly by connecting some of their performance reviews to eco-friendly practices, including environmental principles in training programs, and giving workers credit for helping with eco-friendly projects. Even small things like symbolic prizes, public praise during staff meetings, or "green employee of the month" honors may make employees more attached to sustainability.

Leaders can also set up systems that actively encourage employees to be creative. This may be accomplished through creating places for people to share ideas (like "green idea days" once a month), encouraging departments to work together, and giving modest amounts of money or micro-grants to test out employee-led sustainability projects. It is also very important to make the workplace a psychologically secure place where workers may suggest new ideas without being afraid of being criticized. This method makes sure that new ideas are made and tested with little expense.

The results demonstrate to policymakers that they need to create programs that teach SME leaders how to be sustainable leaders. These might be brief leadership training, practical toolkits, or mentorship programs made specifically for small and medium-sized businesses (SMEs). Policy tools like tax breaks, targeted subsidies, and innovation prizes may make green projects a lot less expensive, which can encourage small and medium-sized businesses to adopt eco-innovation. It's important that regulatory frameworks don't include strict, one-size-fits-all rules. Instead, governments should set several levels of compliance criteria and flexible reporting systems that take into account the limited resources of smaller businesses while still making sure that progress toward sustainability goals can be measured. This kind of focused help lets small and medium-sized businesses (SMEs) build environmentally friendly principles into their operations and slowly grow their green innovation activities.

5.5 LIMITATIONS AND FUTURE RESEARCH

While the study contributes meaningfully to theory and practice, some limitations should be noted. Causal inferences remain tentative. Future studies could adopt longitudinal or experimental designs to confirm causality. Findings may not generalize across industries or countries. Comparative studies in other emerging economies could test external validity.

Although reliability and validity tests confirmed robustness, common method bias remains a possibility. Multi-source or longitudinal data could strengthen future findings. Service-sector SMEs may experience different leadership innovation dynamics. Extending research across sectors would enrich generalizability.

5.6 FUTURE RESEARCH DIRECTIONS

Future research could extend the present study in several important ways. First, scholars should explore additional mediating mechanisms that may further explain how GTL translates into green innovation performance. Constructs such as green organizational identity or psychological empowerment may provide deeper insights into the psychological processes that connect leadership with employee behavior, thereby enriching the explanatory power of existing models. Second, future studies may investigate contextual moderators that shape the strength of the GTL–innovation relationship. Factors such as environmental regulation intensity, industry competition, or market turbulence could either amplify or attenuate leadership effects. For example, in highly regulated environments, leadership may become more salient as firms adapt to external pressures, whereas in turbulent markets, creativity may play an even more critical role in sustaining innovation. Finally, researchers are encouraged to extend the chain mediation model by employing dynamic and longitudinal designs. Time-lagged data or experimental methods would allow for the observation of how employee commitment evolves into creativity and, ultimately, into innovation performance. Such approaches would provide more robust evidence for the sequential mechanisms proposed here and capture the temporal dynamics of leadership influence on sustainability outcomes in SMEs.

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