

The mediating role of green knowledge sharing on the relationship between green transformational leadership and green innovation

William Makumbe and Theresa Lisita
*Business School, North-West University – Potchefstroom Campus,
Potchefstroom, South Africa*

Abstract

Purpose – This study aims to examine the mediating role of green knowledge sharing on the relationship between green transformational leadership (GTL) and green innovation.

Design/methodology/approach – A quantitative research design was adopted, with data collected from small to medium enterprises (SME) respondents. The hypothesised relationships were tested using partial least squares-structural equation modelling, which enabled the simultaneous assessment of measurement and structural models, as well as mediation effects.

Findings – The results of this study indicated that GTL has a significant positive effect on green innovation and green knowledge sharing. Green knowledge sharing also significantly influenced green innovation and partially mediated the relationship between GTL and green innovation. These findings suggest that leadership influences environmental innovation both directly and indirectly through knowledge-based processes.

Practical implications – The findings of this study highlight the need for organisations to develop leadership capabilities that foster not only environmental commitment but also knowledge-sharing cultures that enable innovation.

Originality/value – By integrating the Natural Resource-Based View and the Knowledge-Based View, this study provides a process-oriented explanation of how leadership capabilities are translated into environmental innovation outcomes. The findings revealed that green knowledge sharing is a critical mechanism linking GTL and green innovation, thereby addressing the “black box” in prior research. This study also contributes empirical evidence from Zimbabwean manufacturing SMEs, a context that remains underexplored in sustainability research. Overall, this study advances understanding of green innovation as a knowledge-driven organisational capability.

Keywords Green transformational leadership, Green innovation, Knowledge sharing, Manufacturing sector

Paper type Research paper

Introduction and background

With more than 3.6 billion people worldwide susceptible to the effects of climate change, resulting in approximately 7 million deaths (Demir *et al.*, 2025), the call for sustainable, environmentally friendly manufacturing practices has dominated the literature and business



discussions over the past few years. According to the [World Economic Forum Report \(2024\)](#), more than 50% of global emissions arise from the construction, food processing, freight and logistics, fast-moving consumer goods and electronics sectors. For manufacturing firms, it is believed that minimising environmental pollution and efficiently using resources are critical to driving superior firm performance and competitiveness ([Chavira et al., 2023](#)). To this end, green innovation, which encompasses the development of environmentally friendly products and processes that incorporate green inputs, efficient use of raw materials and green product design ([Singh et al., 2020](#)), has become an increasingly pivotal avenue for achieving sustainability. One of the antecedents that triggers green innovation is green transformational leadership (GTL) ([Begum et al., 2022](#); [Chen et al., 2023](#)). In support of this, authors such as [Niazi et al. \(2023\)](#) argued that GTL can inspire a vision and motivate employees to serve as role models in environmental management.

Because of the pivotal role of GTL in enhancing environmental management, there has been an upsurge in research on this concept ([Malik et al., 2024](#); [Tosun et al., 2022](#); [Li et al., 2020](#); [Majali et al., 2022](#); [Sun et al., 2022](#); [Demir et al., 2025](#)). However, this growing body of literature confirms the prominent role of GTL in sustainability efforts beyond Africa. Hence, more studies are required in the African context, which hosts 30 of the world's most vulnerable countries in terms of climate adaptation capacity and ecosystem damage ([UNDP, 2024](#)). GTL in Africa can facilitate the development of innovative ideas critical for protecting the environment.

Specifically, this study examines the mediating role of green knowledge sharing in the relationship between GTL and green innovation in the small to medium enterprises (SME) manufacturing context. This aligns with calls for more literature from diverse socio-economic contexts that examines the mediating effect of green knowledge sharing on the relationship between GTL and employees' green innovative behaviours ([Lu et al., 2024](#)). Furthermore, authors such as [Begum et al. \(2022\)](#) argued that extensive research on the antecedents of green innovation has yet to yield a consistent conclusion; hence, this study focuses on GTL and green knowledge sharing as predictors of green innovation.

This study is significant because it extends the evidence base in the green management literature by examining the mediating role of green knowledge sharing in the relationship between GTL and green innovation in the context of Zimbabwean SMEs. By providing empirical evidence from an under-researched emerging economy, this study extends green leadership theory and the knowledge-based view by demonstrating that leadership-driven environmental values translate into innovation outcomes only when supported by effective knowledge-sharing mechanisms. Practically, the findings offer valuable insights about different factors that drive green innovation. This understanding helps SME leaders, policymakers and researchers seeking cost-effective pathways to promote sustainability-driven innovation.

This study proceeds as follows: the next section presents a review of related literature, including theoretical fundamentals and hypothesis development. Thereafter, a discussion of methods and materials ensues, followed by a discussion of the results. Finally, conclusions, implications for theory and practice and suggestions for further research are presented.

Literature review

Theoretical framework

Natural resource-based view (NRBV) and knowledge-based view (KBV). The relationships explored in this study can be understood through a combined perspective of the Resource-Based View (RBV) and the Knowledge-Based View (KBV), as both theories provide a

strong conceptual basis for explaining how natural resources and green knowledge serve as key tools for value creation and environmental sustainability.

From the perspective of the Natural Resource-Based View (NRBV) (Hart, 1995), businesses depend on natural ecosystems for their survival. In line with Hart's (1995) argument, competitive advantage can be rooted in capabilities that facilitate environmentally sustainable economic activity. In furthering this view, Niazi *et al.* (2023) posited that NRBV explains how organisations can attain competitive advantage through strengths and capabilities that foster sustainable development. The theory is applicable in this research because GTL and green knowledge sharing can serve as organisational capabilities that trigger green behaviours in organisational contexts. Green transformational leaders can be categorised as agents of change and as influencers of creative behaviour at the workplace (Begum *et al.*, 2022a). Through their charismatic behaviour, they can inspire people to engage in environmentally conscious behaviours (Niazi *et al.*, 2023).

On the other hand, the KBV (Grant, 2002), which posits that knowledge is a strategic resource of the firm, amplifies the relationships in this study. This research places ecological knowledge as a central asset. The transfer of ecological knowledge is not limited to the dissemination of information; rather, it is an essential mediation that nurtures the relationship between GTL and green innovation. The creation of the knowledge reservoir is built through interactions, experiences and the continuous exchange between leadership, staff and other stakeholders. This fosters a culture of learning and adaptation where ecological knowledge becomes an integral part of sustainability efforts.

Green transformational leadership

Leadership scholarship increasingly acknowledges the tension between organisational profitability and environmental sustainability, positioning leadership as a critical mechanism for reconciling economic and environmental objectives (Renwick *et al.*, 2013; Robertson and Barling, 2013). Within this discourse, GTL has emerged as an important construct explaining how leaders influence environmentally responsible organisational behaviour (Chen and Chang, 2013; Graves *et al.*, 2013). Existing studies generally agree that GTL positively influences environmental outcomes such as green creativity, environmental performance and green innovation (Li *et al.*, 2020; Tosun *et al.*, 2022). However, despite this broad consensus, the literature remains theoretically fragmented regarding how and under what conditions GTL produces these outcomes.

A dominant stream of research conceptualises GTL primarily as a motivational leadership style that inspires employees to exceed environmental performance expectations through vision articulation and value alignment (Bass and Riggio, 2006; Chen and Chang, 2013). For example, studies grounded in transformational leadership theory argue that GTL enhances employees' environmental commitment and willingness to engage in pro-environmental behaviours (Robertson and Barling, 2013; Graves *et al.*, 2013). In contrast, another stream of research suggests that GTL exerts influence through not only motivation but also cognitive and knowledge-based mechanisms that shape how employees interpret environmental challenges and generate innovative solutions (Singh *et al.*, 2020; Le and Lei, 2019). These competing perspectives indicate that the mechanisms linking GTL to green innovation remain insufficiently theorised.

Moreover, much of the existing literature relies heavily on direct-effect models that assume that GTL automatically translates into green innovation outcomes (Jia *et al.*, 2018; Begum *et al.*, 2022). Accordingly, several empirical studies report significant positive relationships between GTL and green innovation (Chen and Chang, 2013; Singh *et al.*, 2020), and the findings are often treated as universally applicable across organisational contexts.

This assumption is problematic because green innovation is a complex organisational process that requires not only leadership support but also the mobilisation, exchange and integration of environmental knowledge across employees and functional units. As a result, direct-effect explanations may oversimplify the processes through which leadership capabilities are converted into innovation outcomes. Because of this, this investigation introduces a mediation mechanism through which GTL impacts green innovation.

Green knowledge sharing

Although prior studies acknowledge the importance of knowledge management for organisational competitiveness and innovation (Kokt and Makumbe, 2020; Rubel *et al.*, 2020), the literature remains fragmented regarding the specific role of knowledge processes in achieving environmental innovation outcomes. Existing research generally agrees that knowledge sharing enhances organisational learning and innovation capability (Nonaka and Takeuchi, 1995; Wang and Noe, 2010); however, scholars differ in their explanations of how knowledge-sharing processes contribute to environmentally oriented outcomes. One stream of literature conceptualises knowledge sharing primarily as an operational activity involving the dissemination and transfer of information among employees (Ben Arfi *et al.*, 2018). In contrast, another stream argues that knowledge sharing constitutes a strategic organisational capability through which firms integrate, recombine and apply specialised knowledge to address complex organisational challenges, including sustainability-related problems (Grant, 1996; Spender, 1996).

Despite these advances, the literature on green knowledge sharing remains theoretically underdeveloped in several respects. First, most studies conceptualise green knowledge sharing as an independent organisational practice associated with positive environmental outcomes (Song *et al.*, 2020; Abbas and Sağsan, 2019), rather than as an explanatory mechanism linking organisational antecedents to green innovation. For example, studies on environmental management and green innovation frequently identify knowledge sharing as a beneficial organisational behaviour (Shujahat *et al.*, 2019; Singh *et al.*, 2020), yet they often examine its direct effects in isolation from broader leadership and organisational processes. Consequently, the literature provides a limited explanation of how environmental leadership behaviours stimulate innovation through knowledge-related processes.

Second, existing research presents inconsistent assumptions regarding the relationship between leadership and green innovation. A dominant stream of studies grounded in transformational leadership theory assumes that GTL directly enhances green creativity and innovation by motivating employees toward pro-environmental goals (Chen and Chang, 2013; Jia *et al.*, 2018). While these studies provide evidence of significant positive relationships, they often overlook the organisational processes required for innovative environmental ideas to emerge, circulate and become institutionalised. In contrast, knowledge-based perspectives suggest that innovation outcomes depend less on leadership influence alone and more on the organisation's capacity to mobilise and integrate knowledge across employees and functional units (Le and Lei, 2019; Donate and de Pablo, 2015). These competing perspectives indicate that the relationship between GTL and green innovation may be more process-driven than direct-effect models suggest.

Furthermore, the current literature insufficiently addresses the social and collaborative dimensions of green innovation (Albort-Morant *et al.*, 2016). Green innovation differs from conventional innovation because it typically requires cross-functional collaboration, collective learning and the integration of environmentally specialised knowledge (Chen *et al.*, 2023; Ardito *et al.*, 2018). However, prior studies (Chen and Chang, 2013; Begum *et al.*, 2022) continue to treat innovation as an outcome of individual leadership influence rather

than a collective knowledge-development process. This creates an important theoretical gap because leadership behaviours alone may be insufficient to generate green innovation unless employees actively exchange and recombine environmental knowledge.

Green innovation

Environmental sustainability is increasingly viewed as dependent on organisations' ability to develop and implement green innovation practices (Guoyou *et al.*, 2013). Consequently, green innovation has attracted significant scholarly attention as firms seek to respond to growing environmental pressures, regulatory demands and stakeholder expectations (Begum *et al.*, 2022; Sun *et al.*, 2022). Despite this growing body of research, the literature remains theoretically fragmented regarding the drivers, processes and outcomes of green innovation. While many studies identify green innovation as a strategic response to environmental degradation and unsustainable business practices (Dzage *et al.*, 2024; Guo, 2022), there is less consensus regarding the organisational mechanisms through which green innovation is developed and sustained. A dominant stream of literature conceptualises green innovation primarily from a technological and operational perspective, emphasising eco-friendly products, cleaner production processes, energy efficiency and waste reduction (Song *et al.*, 2020; Muisyo and Qin, 2021). From this perspective, green innovation is treated largely as a technical adaptation that enables organisations to comply with environmental regulations and improve operational efficiency. In contrast, another stream of research argues that green innovation should be understood more broadly as a strategic and capability-driven organisational process involving knowledge creation, organisational learning and leadership support (Alshebami, 2023; Begum *et al.*, 2022). These competing perspectives suggest that the literature has yet to fully clarify whether green innovation is primarily a technological outcome or a broader organisational capability.

Furthermore, although scholars generally agree that green innovation contributes to both environmental sustainability and competitive advantage, existing findings remain inconsistent regarding its antecedents. Some studies emphasise external drivers such as environmental regulations, stakeholder pressure and market competition (Porter and van der Linde, 1995; Horbach, 2008), while others highlight internal organisational factors including leadership, culture and knowledge management capabilities (Chen and Chang, 2013; Singh *et al.*, 2020). This inconsistency indicates that green innovation is unlikely to emerge automatically from external environmental pressures alone but may instead depend on internal organisational processes that facilitate the generation and application of environmentally relevant knowledge.

Another important limitation within the literature is the tendency to examine green innovation using direct-effect models that isolate single antecedents while overlooking the interactive organisational processes through which innovation develops. For example, studies frequently examine the independent effects of leadership, green human resource management or environmental orientation on green innovation outcomes (Jia *et al.*, 2018; Begum *et al.*, 2022; Singh *et al.*, 2020). However, such approaches provide a limited explanation of how these organisational factors interact to stimulate innovative environmental practices. As a result, the literature often treats green innovation as a static outcome rather than a socially embedded, knowledge-intensive process that requires collaboration, learning and knowledge exchange among organisational members.

The literature also provides limited insight into the role of knowledge-sharing processes in facilitating green innovation (Abbas and Sağsan, 2019). Green innovation differs from conventional innovation because it often requires integrating specialised environmental knowledge across multiple organisational functions. However, prior studies (Chen and Chang, 2013; Muisyo and Qin, 2021; Begum *et al.*, 2022) continue to conceptualise

innovation primarily as an outcome of managerial or technological capability, with insufficient attention given to how employees collectively exchange and recombine environmental knowledge to generate innovative solutions. This omission is particularly important in emerging economy contexts, where resource constraints may make knowledge mobilisation and collaborative learning even more critical for innovation success. Consequently, existing research provides a limited explanation of how leadership-driven organisational processes facilitate environmentally oriented innovation through knowledge mobilisation and integration.

The present study addresses these limitations by conceptualising green innovation as not merely a technological or environmental outcome but also a knowledge-driven organisational capability shaped by leadership and knowledge-sharing processes. Specifically, this study proposes that GTL enhances green innovation by influencing green knowledge sharing. By integrating leadership and knowledge-based perspectives, this study moves beyond dominant direct-effect explanations and provides a more process-oriented understanding of how green innovation emerges within organisations. In doing so, this study responds to calls for more theoretically integrated and context-sensitive research on sustainable innovation.

Hypotheses development

Green transformational leadership and green innovation. A leader's green behaviour at work persuades subordinates to imitate it (Sachdeva and Singh, 2024). This implies that leadership actions have a significant impact on employees' behaviour at the workplace. Prior studies into the antecedents of green innovation have yet to yield a consistent conclusion; however, GTL has been recognised as an important driver of green innovation (Begum et al., 2022). GTL articulates the organisation's green vision, constantly discusses green norms and provides resources to its subordinates. This facilitates alignment between employees' green behaviours and the organisation's green vision, thereby increasing the likelihood of innovation. Through their idealised influence attribute, GTL instigates employees to gain new knowledge and keeps them occupied in green products and green process innovation-related activities (Malik et al., 2024). Authors such as Lu et al. (2024) argue that GTL attributes, such as inspirational motivation, intellectual stimulation and individual consideration, are key to promoting green innovation. For example, GTL leaders inspire people to be innovative by articulating a green vision and goals (Begum et al., 2022), adopting green behaviours (Chen et al., 2023) and promoting a green management culture (Begum et al., 2022). Previous research confirms that GTL has a significant impact on green innovation (Begum et al., 2022; Chen et al., 2023; Lu et al., 2024). In light of this, the following hypotheses can be made:

H1. Green transformational leadership positively influences green innovation.

Green transformational leadership and green knowledge sharing. Organisational members are usually unwilling to share their knowledge without strong motivation (Chen et al., 2023). However, transformational leadership can foster creative thinking among employees (Lu et al., 2024). Through idealised influence, transformational leaders can motivate employees to share knowledge for the organisation's benefit. In the context of green management, GTL can foster a green environmental culture (Malik et al., 2024) in which employees engage in knowledge processes and enhance their existing knowledge reservoirs (Lu et al., 2024). According to Chen et al. (2023), GTL facilitates the sharing of green knowledge through behavioural demonstrations and aligns with innovative goals. GTL shares green knowledge with stakeholders and articulates the organisational environmental goals to employees. Through this role modelling, organisational members will also be inclined to share their green

knowledge. GTL also provides training, resources and continuous development opportunities, which are vital for enhancing green knowledge sharing (Lu *et al.*, 2024). Previous research confirms a positive relationship between GTL and green knowledge sharing (Chen *et al.*, 2023; Malik *et al.*, 2024; Lu *et al.*, 2024). It can, therefore, be hypothesised that:

H2. Green transformational leadership positively influences green knowledge sharing.

Green knowledge sharing and green innovation. Knowledge sharing can be a valuable tool for innovation. As Song *et al.* (2020) argue, the success of green innovation lies in firms' acquisition and sharing of knowledge. When shared knowledge is applied in organisational operations, improving problem-solving methods can likely trigger innovations (Ben Arfi *et al.*, 2018). Furthermore, through knowledge sharing, organisational members can connect their skills and knowledge with the complementary competencies of other network members (Zhou *et al.*, 2020) resulting in creativity, a valuable input to innovation. Knowledge sharing also reduces the cost of green innovation failure because idea sharing among organisational members perfects problem-solving solutions. Previous research confirmed that green knowledge sharing positively influences green innovation (Song *et al.*, 2020; Zhou *et al.*, 2020). It can, therefore, be hypothesised that:

H3. Green knowledge sharing positively influences green innovation.

The mediating role of green knowledge sharing. Green knowledge sharing is an important explanatory mechanism linking several relationships in the literature. Previous research identified green knowledge sharing as a significant mediating construct in the relationship between socially responsible Human Resources Management (HRM) and environmental performance (Rubel *et al.*, 2020), green inclusive leadership and green innovation (Zhang *et al.*, 2025), Green HRM and green service behaviours (Rubel *et al.*, 2020) and wine tourism and green performance (Martínez-Falcó *et al.*, 2024). Accordingly, this research argues that green knowledge sharing can serve as a mediation mechanism in the relationship between GTL and green innovation. Green transformational leaders are inclusive, accepting diversity and differentiation. Because such leaders can proactively disseminate green knowledge, employees can quickly respond to green innovation challenges by integrating shared knowledge into their practices (Zhang *et al.*, 2025). Previous research confirms a mediating role for green knowledge in the relationship between GTL and green innovation (Chen *et al.*, 2025). It can, therefore, be hypothesised that:

H4. Green knowledge sharing mediates the relationship between green transformational leadership and green innovation.

Methodology

Research paradigm, design and approach. This study adhered to an ontological position of objectivism and an epistemological stance of positivism. These positions advocate the use of scientific approaches that emphasise quantifiable observations amenable to statistical analysis (Wahyuni, 2012). In alignment with this stance, the study used a survey design and a quantitative research approach. The survey design and the quantitative research approach are best suited to testing multiple theoretical relationships, as in this study (Saunders *et al.*, 2009).

Population and sampling. The SME sector in Zimbabwe is experiencing rapid growth. This research targeted 500 managers across ten provinces in Zimbabwe. These participants held managerial roles in their workplaces, and they were deemed to understand the subject

under study. They are also responsible for implementing green business strategies. According to [Israel \(1992\)](#), a sample size of at least 370 participants is considered sufficient at the 5% confidence level for a population of this size. Accordingly, to ensure that each member of the population had an equal chance of being selected ([Saunders et al., 2009](#)), participants in this study were selected using simple random sampling. The simple random sampling used a randomisation method to select 37 participants in each province, ensuring geographic representation while maintaining equal selection probability.

This study adhered to all ethical procedures and guidelines. Furthermore, participants were assured of confidentiality and could choose not to participate in the research at any time without intimidation. A structured questionnaire with an informed consent section was developed and uploaded to the SurveyMonkey platform. The participants' demographics are summarised in [Table 1](#).

Research instrument measures. The research variables were examined using previously validated measurement items in the literature. The structured questionnaire items were piloted with individuals from the research population. A five-point Likert scale was used to measure the constructs, ranging from 1 "strongly disagree" to 5 "strongly agree."

Green transformational leadership. GTL was operationalised with a scale developed by [Tosun et al. \(2022\)](#). A sample item from the scale was: "My leader provides a clear environmental vision for the employees to follow."

Green knowledge sharing. Green knowledge sharing was measured using items adapted from the work of [Makumbe \(2024\)](#). A sample item from the scale was: "I enjoy sharing environmentally friendly knowledge with my colleagues."

Green Innovation. The green innovation scale used in this study was based on the work of [Alshebami \(2023\)](#). A sample item from the scale was: *This organisation has adopted manufacturing processes that allow the reuse of treated waste emissions.*

Reliability and validity. The data were assessed for validity and reliability as discussed below:

Indicator reliability. If a reflective indicator loading is higher than 0.5, then the item is a good measurement of a latent construct ([Hulland, 1999](#)). Accordingly, all the indicator loadings exceeded 0.5 ([Table 2](#)).

Internal consistency reliability. This study assessed internal consistency reliability using Composite Reliability (CR) and Cronbach's alpha. [Gefen et al. \(2000\)](#) state that a CR value of at least 0.7 indicates adequate internal consistency reliability. [Hair et al. \(2012\)](#) suggested

Table 1. Participants' demographics

Factor	No.	%	%
<i>Gender</i>			
Male	177	54	
Female	151		46
<i>Education level</i>			
High school	65	20	
First degree	197	60	
Post graduate degree	66	20	
<i>Organisation tenure</i>			
< 10 Years	98	30	
10 – 15 years	132	40	
>15 years	98	30	

Source(s): Created by author

Table 2. Factor scores, mean, average variance extracted (AVE), composite reliability (CR) and variance inflation factor (VIF)

Code	Variable	Factor score	Alpha	AVE	CR	VIF			
<i>Green transformational leadership</i>									
GTL1	The leader of my organisation provides a clear environmental vision for the employees to follow	0.714	0.847	0.568	0.849	1.543			
GTL2	The leader of my organisation gets the employees to work together for the same environmental goals	0.741				1.546			
GTL3	The leader of my organisation encourages the employees to achieve environmental goals	0.742				1.765			
GTL4	The leader of my organisation acts while considering the environmental beliefs of the employees	0.824				1.786			
GTL5	The leader of my organisation stimulates the employees to think about green ideas	0.808				1.765			
GTL6	The leader of my organisation inspires employees with the environmental plans	0.683				1.786			
<i>Green knowledge sharing</i>									
GKS1	I enjoy sharing environmentally friendly knowledge with my colleagues	0.843	0.912	0.740	0.916	1.654			
GKS2	I always share green knowledge obtained from newspapers, magazines, journals, television and other sources	0.906				1.234			
GKS3	In my organisation, people share expertise from work experience with each other	0.849	0.824	0.595	0.844	1.654			
GKS4	Sharing green knowledge with colleagues is pleasurable	0.906				1.876			
GKS5	Organizational members consider that sharing green knowledge can benefit all parties involved	0.790				1.432			
<i>Green innovation</i>									
GI1	This organisation constantly uses technology to enhance the quality of green services	0.601				0.824	0.595	0.844	1.543
GI2	This organisation has adopted manufacturing processes that allow the reuse of treated waste emissions	0.871	1.768						
GI3	This organisation prefers materials that save energy in product design and development	0.830				1.879			
GI4	This organisation has invested in updating procedures with a green focus	0.848				1.879			
GI5	This organisation uses fewer or non-polluting /toxic materials	0.669				1.456			
Source(s): Created by author									

that Cronbach's alpha (α) values greater than 0.60 are widely considered desirable in research to indicate internal consistency reliability. The Cronbach's alpha and composite reliability thresholds were met.

Convergent reliability. Convergent reliability is the extent to which a measure correlates positively with alternative measures of the same construct (Hair *et al.*, 2012). The Average Variance Extracted (AVE) is used to assess convergent reliability and should be greater than 0.5. Table 2 confirms that AVE values are acceptable.

Discriminant validity

According to Hair *et al.* (2012), discriminant validity can be assessed using the Fornell–Larcker criterion. This technique compares the square roots of the AVEs with the correlations of the latent variable with other constructs. The square root of the AVE of each construct should be higher than the correlation with any other construct (Hair *et al.*, 2012), as shown in Table 3.

Empirical results

Common method bias (CMB). We applied the “Harman's one-factor test” (Harman, 1976) and the Variance Inflation Factor (VIF) (Kock, 2015) to analyse common method bias (CMB). The Harman's one-factor test states that a single factor should not account for more than 50% of the variance among the variables, while the VIF values of the indicators should be less than 3.3 (Kock, 2015). The results of this study satisfy both criteria because a single factor was extracting 31.21% of the total variance (Harman, 1976), and VIF values of all items are below 3.3 (Table 2) (Kock, 2015), indicating that CMB was absent in the data set.

Evaluation of the structural model. This study assessed the predictive and explanatory power of the structural model. The predictive power was assessed using the Q^2 values, whereas the explanatory power was assessed using the Coefficient of Determination (R^2) and the Effect Size (F^2) (Rubel *et al.*, 2020).

As previously indicated, the model's predictive accuracy was determined using Q^2 values. In SMART PLS, the Q^2 is calculated using the blindfolding technique. As suggested by Chin (1998), the Q^2 value should be greater than zero (0). The Q^2 values were 0.13 and 0.11 for green innovation and green knowledge sharing, respectively. This implies that the model's predictive accuracy was strong.

Coefficient of determination (R^2)

The R^2 was used to evaluate the model's explanatory power, and Table 4 shows the R^2 values.

As shown in Table 4, GTL and green knowledge sharing explained 63.9% of the variance in green innovation. However, green knowledge sharing accounted for a greater explanatory contribution (0.507), whereas GTL accounted for 0.353 of the variance. On the other hand,

Table 3. Discriminant validity values

Variable	Green innovation	Green knowledge sharing	Green transformational leadership
Green innovation	<i>0.771</i>		
Green knowledge sharing	0.761	<i>0.860</i>	
Green transformational leadership	0.718	0.720	<i>0.754</i>

Note(s): The discriminant validity values are shown diagonally in italic

Source(s): Created by author

Table 4. Coefficient of determination (R^2)

Exogenous variable	Endogenous variable	R^2
Green transformational leadership + green knowledge sharing	Green innovation	0.639
Green transformational leadership	Green knowledge sharing	0.519

Source(s): Owner creation

GTL explained 51.9% of the variance in green knowledge sharing. These results indicate a strong explanatory model.

Effect size (F^2)

In complementing the R^2 analysis, the Effect Size was also used in this study, and the results are shown in Table 5.

According to Cohen (1988), f^2 values are interpreted as follows: values close to 0.02 = small, 0.15 = medium and 0.35 = large. Accordingly, GTL had the greatest effect size on green knowledge sharing (0.365) and a medium effect size on green innovation (0.165). Green knowledge sharing had a fairly large effect on green innovation (0.245). These results imply that exogenous variables had an explanatory power on the endogenous variables.

Structural equation modelling

SMART PLS 4 was used to perform the structural equation modelling to test the hypotheses of this study. This is in line with previous research (Begum et al., 2022).

Rationale for using partial least squares-structural equation modelling (PLS-SEM). The use of PLS-SEM is suitable for this study because of its prediction-focused and exploratory nature. The research aims to explain how GTL affects green innovation through the mediating role of green knowledge sharing. Unlike covariance-based SEM, PLS-SEM is especially effective in maximising explained variance and identifying key driver constructs in complex models, aligning well with the study's goal of theory development and mechanism testing. Additionally, the model includes multiple latent constructs and a mediation structure, requiring the simultaneous estimation of both measurement and structural relationships. PLS-SEM enables efficient evaluation of these relationships while accounting for indirect effects via bootstrapping, offering a robust approach to exploring the processes linking leadership and innovation outcomes. The results from the SEM analysis are shown in Figure 1.

Direct effects

Table 6 shows that GTL has a significant impact on green innovation and green knowledge sharing ($\beta = 0.353$, p -value = 0.00; $\beta = 0.720$, p -value = 0.00). Hence, $H1$ and $H2$ were

Table 5. Effect size (F^2)

Exogenous variable	Endogenous variable	F^2
Green transformational leadership	Green innovation	0.165
Green transformational leadership	Green knowledge sharing	0.365
Green knowledge sharing	Green innovation	0.245

Source(s): Owner creation



Hypothesis	Path	Path coefficient	p-value	Decision
H1	Green transformational leadership >>>>>>>green innovation	0.353	0.00	Accepted
H2	Green transformational leadership >>>>green knowledge sharing	0.720	0.00	Accepted
H3	Green knowledge sharing >>>>>green innovation	0.507	0.00	Accepted

Mediation effects of green knowledge sharing. The results showed that green knowledge sharing partially mediated the relationship between GTL and green innovation ($\beta = 0.365$ and $p = 0.00$); hence, $H4$ was accepted.

GTL is increasingly recognised as a critical mechanism through which organisations pursue environmental sustainability and innovation objectives (Lu *et al.*, 2024). While prior studies largely portray GTL as a leadership style that motivates environmentally responsible behaviour (Begum *et al.*, 2022a; Singh *et al.*, 2020), the present findings suggest a broader and more complex role for leadership in sustainability-oriented organisations. Specifically, this study demonstrates that GTL influences green innovation through not only motivational processes but also organisational knowledge mobilisation and capability development. In

doing so, the findings shift the understanding of GTL from a predominantly symbolic or inspirational construct to a strategic organisational capability that shapes how environmental knowledge is generated, exchanged and transformed into innovation outcomes.

The positive relationship between GTL and green innovation confirms previous findings that environmentally oriented leadership enhances innovation outcomes (Begum *et al.*, 2022; Lu *et al.*, 2024). However, the current findings extend this literature by suggesting that the influence of GTL is not limited to encouraging environmentally friendly behaviour but also involves reshaping employees' cognitive orientation toward environmental problem-solving. This implies that GTL creates organisational conditions that legitimise experimentation, collective learning and environmentally oriented risk-taking. From a theoretical perspective, this finding challenges the dominant assumption in prior literature that leadership influences innovation primarily through employee motivation. Instead, the findings indicate that GTL may serve as a capability-building mechanism, enabling organisations to reinterpret environmental challenges as opportunities for innovation and strategic renewal.

The strong effect of GTL on green knowledge sharing further deepens the understanding of how leadership shapes organisational sustainability processes. Existing studies generally argue that transformational leaders create supportive climates for collaboration and information exchange (Chen *et al.*, 2023; Lu *et al.*, 2024). However, the magnitude of the observed relationship suggests that GTL performs a more foundational role by reducing structural and behavioural barriers that often inhibit knowledge exchange, such as low trust, departmental silos and knowledge hoarding. This finding is theoretically important because it positions leadership as an antecedent to organisational knowledge integration rather than merely a facilitator of employee motivation. Consequently, this study contributes to the growing knowledge-based perspective of innovation by demonstrating that environmentally oriented leadership is essential for activating the collective learning processes through which green innovation emerges.

The significant relationship between green knowledge sharing and green innovation also contributes important insights to the innovation literature. While previous studies acknowledge that knowledge sharing supports innovation and problem-solving (Song *et al.*, 2020; Zhou *et al.*, 2020), the present findings suggest that green innovation is fundamentally a socially constructed and knowledge-intensive process. This means that innovation does not emerge solely from individual expertise or technological investment but also from the organisation's capacity to integrate dispersed environmental knowledge across employees and functional units. The findings, therefore, reinforce arguments from the KBV that organisational competitiveness increasingly depends on knowledge integration capabilities rather than the mere possession of knowledge resources. At the same time, the results highlight the importance of tacit knowledge exchange and absorptive capacity, areas that remain comparatively underexplored within green innovation research.

The mediating role of green knowledge sharing provides perhaps the most important theoretical insight of the study. Although previous research has generally examined direct relationships between GTL and green innovation, the present findings demonstrate that leadership influences innovation through interconnected organisational processes. This finding addresses the longstanding "black box" criticism in leadership and innovation research by empirically showing that knowledge-sharing processes constitute a critical transmission mechanism linking leadership capability to innovation outcomes. Importantly, the partial nature of the mediation suggests that GTL operates through multiple complementary pathways, implying that green innovation is unlikely to be explained by a single organisational mechanism. Theoretically, this supports a more process-oriented and integrative understanding of sustainable innovation in which leadership, organisational

learning and knowledge mobilisation interact dynamically to shape environmental outcomes.

Theoretical contribution

One of the major theoretical contributions of this study lies in its integration of the NRBV and the KBV to explain the underlying mechanism through which GTL translates into green innovation. Although prior studies have established positive associations between GTL and green innovation (Chen and Chang, 2013; Singh *et al.*, 2020), the theoretical explanation of how leadership capabilities are translated into organisational green innovation capabilities remains underdeveloped (Zhang *et al.*, 2021; Abbas and Sağsan, 2019). Furthermore, prior research has largely relied on direct-effect models (Jia *et al.*, 2018; Le and Lei, 2019), implicitly assuming that environmentally oriented leadership automatically produces green innovation outcomes. This study challenges that assumption by demonstrating that the relationship is contingent upon the organisation's ability to mobilise, exchange and recombine green knowledge.

From the NRBV perspective, environmentally oriented capabilities are strategic resources that enable firms to achieve sustainable competitive advantage through environmentally responsible practices. However, the NRBV has been criticised for insufficiently explaining the internal organisational processes through which environmental capabilities are transformed into innovation outcomes. This study extends the NRBV by proposing that GTL, while strategically valuable, does not generate green innovation unless it stimulates collective knowledge processes within the organisation. The findings, therefore, reposition green knowledge sharing as a critical organisational capability that converts leadership-driven environmental intent into actionable green innovation outcomes.

This study further advances the KBV by conceptualising green knowledge sharing not merely an information exchange activity but also a strategic mechanism for integrating tacit and explicit environmental knowledge, disseminating it, recombining it and transforming it into innovative green practices, products and processes. While prior KBV research has emphasised knowledge as a source of competitive advantage, this study contributes theoretically by demonstrating that the *circulation* and *collective use* of green knowledge constitute the missing explanatory link between environmental leadership and innovation performance. In this regard, the significant mediating role of green knowledge sharing suggests that organisations derive innovation value from not simply possessing environmental knowledge but also creating organisational conditions that facilitate its continuous exchange and integration.

Another important theoretical contribution is the study's reconceptualisation of GTL as a knowledge-enabling capability rather than merely a motivational leadership style. The strong effect of GTL on green knowledge sharing indicates that transformational green leaders play a central role in shaping the social and cognitive infrastructure necessary for environmental knowledge mobilisation. This shifts the theoretical understanding of GTL beyond its traditional focus on employee inspiration and environmental commitment by demonstrating that leadership also functions as a mechanism for activating organisational learning processes that underpin green innovation.

Furthermore, the finding of partial mediation contributes to theory by suggesting that the relationship between GTL and green innovation is multi-dimensional and operates through interconnected organisational pathways. This moves the literature beyond simplistic linear explanations and supports a more process-oriented understanding of sustainable innovation. This study, therefore, contributes to the growing call for theoretical integration across leadership, environmental management and knowledge management literature by demonstrating that green innovation emerges from not solely leadership behaviours or environmental orientation but also

the interaction between strategic environmental leadership and organisational knowledge processes.

Overall, this study contributes to theory by addressing an important gap in the green innovation literature: the lack of a robust explanatory mechanism linking environmental leadership capabilities to green innovation outcomes. By integrating NRBV and KBV, this study proposes and empirically validates a process-based framework in which green knowledge sharing acts as the capability-building mechanism through which GTL is translated into sustainable innovation outcomes.

Practical implications

The findings of this study provide several practical implications for Zimbabwean manufacturing SMEs seeking to improve their environmental sustainability and innovation performance. First, the significant positive effect of GTL on green innovation ($\beta = 0.353$) suggests that SME owners and managers should move beyond compliance-oriented environmental practices and adopt leadership approaches that actively encourage employee participation in environmental problem-solving. In resource-constrained SME environments such as Zimbabwe, managers often focus primarily on operational survival and short-term financial pressures. However, the findings indicate that leaders who communicate a clear environmental vision, encourage employee participation in sustainability initiatives and support experimentation with environmentally friendly production practices are more likely to stimulate green innovation. Practically, SMEs can operationalise this by incorporating environmental goals into managerial performance targets, conducting regular sustainability-focused team engagements and recognising employees who propose environmentally innovative ideas.

Second, the very strong relationship between GTL and green knowledge sharing ($\beta = 0.720$) demonstrates that leadership is particularly important in creating organisational environments where environmental knowledge can circulate effectively. For Zimbabwean manufacturing SMEs, where formal knowledge management systems may be limited by financial and technological constraints, managers should prioritise low-cost yet interactive knowledge-sharing practices. These may include cross-functional problem-solving meetings, peer-learning sessions, mentorship arrangements and routine discussions on waste reduction and resource efficiency. The findings suggest that employees are more willing to share environmentally relevant knowledge when leaders cultivate trust, openness and collaborative working relationships. Consequently, SME managers should intentionally reduce hierarchical barriers and create safe environments where employees can freely exchange ideas about improving environmental performance.

Third, the significant effect of green knowledge sharing on green innovation ($\beta = 0.507$) indicates that SMEs should treat environmental knowledge as a strategic organisational resource in line with the KBV and the NRBV. The findings imply that green innovation is unlikely to emerge solely from purchasing new technologies or complying with environmental regulations. Instead, innovation depends heavily on the organisation's ability to mobilise employees' tacit environmental knowledge and convert it into practical production improvements. In practice, SMEs should, therefore, invest in mechanisms to capture and retain environmental knowledge, such as documenting environmentally efficient production practices, creating internal knowledge repositories and encouraging experienced employees to transfer knowledge to newer workers. Given the resource limitations commonly faced by Zimbabwean SMEs, internal knowledge mobilisation may represent a more feasible and cost-effective pathway to green innovation than reliance on expensive external technologies.

Finally, the partial mediating role of green knowledge sharing suggests that leadership alone is insufficient to achieve sustained green innovation unless accompanied by supportive organisational processes. This means that Zimbabwean manufacturing SMEs should adopt an integrated approach in which leadership behaviours, organisational culture and employee knowledge processes reinforce one another. For example, managers should align recruitment, training and reward systems with environmental objectives while simultaneously encouraging collaborative learning and innovation. The findings further imply that SMEs should not treat sustainability initiatives as isolated environmental programmes but rather as organisation-wide capability-building processes. By integrating leadership support with continuous knowledge-sharing practices, SMEs can gradually develop valuable, hard-to-imitate organisational capabilities that strengthen both environmental sustainability and long-term competitiveness.

Conclusion

This study examined the relationship between GTL and green innovation, with green knowledge sharing as a mediating mechanism. The findings provide robust empirical support for both the direct and indirect effects of GTL on green innovation, thereby advancing understanding of how leadership contributes to environmental sustainability in organisational contexts. Rather than operating solely as a source of inspiration, GTL emerges as a multi-dimensional driver that shapes employees' cognitive orientations, behavioural engagement and collaborative processes toward environmental goals.

A key contribution of the study is demonstrating that green knowledge sharing is not merely an ancillary organisational practice but also a central explanatory mechanism through which leadership translates into innovation outcomes. The partial mediation effect indicates that, while GTL directly stimulates green innovation, a substantial portion of its impact is transmitted through facilitating knowledge exchange. This finding moves the literature beyond simplistic direct-effect models and provides a more nuanced, process-based understanding of how environmental innovation is generated within organisations.

This study, therefore, underscores that achieving meaningful green innovation requires more than leadership intent; it necessitates the deliberate cultivation of knowledge-sharing processes and organisational conditions that enable employees to translate environmental vision into actionable and innovative outcomes.

Limitations and directions for future studies

This study addresses an important concept in the leadership field, enhancing our understanding of GTL, green knowledge sharing and green innovation. This study was conducted in the Zimbabwean setting, which may affect the generalisability of the findings to other parts of the world. The sample size may be small; however, scholars need to test our conceptual model in a large-sample quantitative study to assess its validity. The use of self-reported measures and the collection of data at a single point in time (a cross-sectional design) might introduce bias in this study. However, despite these limitations, this study has provided practical empirical evidence of the relationships among the variables investigated. Future studies can be replicated in other sectors or in other Sub-Saharan African countries to enhance generalisability. Further, the partial mediation suggests the presence of additional mechanisms, such as organisational culture, employee engagement or institutional pressures, that may further explain the GTL–innovation relationship. Future studies could adopt longitudinal or multi-level approaches to better capture these dynamics and explore contextual contingencies, particularly in emerging economy settings.

Data availability

Data may be available upon reasonable request from the author.

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Declaration of generative AI usage

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Corresponding author

William Makumbe can be contacted at: makumbe.william@gmail.com