



OPEN The impact of ecocentric leadership on organizational green innovation examining the serial mediation of green knowledge sharing and ambidexterity

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Drawing on social exchange theory, this study investigates the serial mediation relationship between ecocentric leadership, green knowledge sharing, green ambidexterity, and organizational green innovation. Additionally, it examines the moderating effects of technological orientation. Data were collected from 623 hotel employees working in the Guangdong-China hospitality industry. The structural model was analyzed using Mplus 8.6 to test the proposed model. The results indicate that ecocentric leadership has a positive influence on organizational green innovation. This relationship is mediated by green knowledge sharing and green ambidexterity, individually and sequentially. Furthermore, the mediated relationship between ecocentric leadership and organizational green innovation, facilitated through green knowledge sharing, is moderated by technological orientation. The findings suggest that fostering ecocentric leadership and enhancing technological orientation for the hospitality sector can significantly boost green innovation. Hospitality organizations should promote green knowledge sharing and ambidexterity to drive sustainable practices and innovations. This study contributes to how ecocentric leadership influences organizational green innovation through green knowledge sharing and ambidexterity. It highlights the importance of technological orientation as a moderating factor, providing valuable insights for hospitality industry practitioners.

Keywords Ecocentric leadership, Organization green innovation, Green knowledge sharing, Green ambidexterity, Technological orientation

Today, organisations are confronted with numerous environmental challenges and pressures. In the hospitality sector, these encompass rising demands for sustainable practices, energy efficiency, and waste reduction¹. Hotels and other hospitality businesses must adapt to regulatory changes, rising consumer expectations for eco-friendly services, and the need to reduce their carbon footprint². Recognizing the importance of proactively addressing environmental challenges is essential for hospitality organizations to ensure long-term sustainability, resilience, and success in a rapidly changing world^{3,4}. By adopting eco-friendly practices, embedding sustainability into operations and supply chains, and fostering a corporate culture that prioritizes environmental stewardship, hospitality organizations can significantly address environmental concerns^{5,6}. The effectiveness of an organization's environmental strategy extends beyond its policies and procedures to influence employees' attitudes and behaviours toward organizational green innovation⁷. However, research suggests that leadership style plays a crucial role in green innovation, in addition to organizational strategy⁸. Thus, fostering a culture of green innovation within an organization, driven by strategic initiatives and leadership practices, can lead to more meaningful and impactful sustainability outcomes^{9,10}.

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The relationship between leadership and green innovation has been widely studied, yet many of these studies exhibit notable shortcomings. Previous studies have enhanced our understanding of the factors that promote green innovation, including transformational leadership Singh et al.¹¹, responsible leadership Liao and Zhang¹², environmentally-specific servant leadership Aboramadan et al.¹³, and green, inclusive leadership¹⁴. There is a significant gap in understanding the influence of additional factors on green innovation. Significantly, research into the connection between ecocentric leadership and employees' green innovation is limited. Hence, this study aims to fill the existing literature gap by investigating the influence of ecocentric leadership on organizational green innovation. Ecocentric leadership embraces a proactive and dedicated approach, prioritizing environmental principles as the cornerstone of a company's values and practices¹⁵. These leadership approaches prioritize environmental considerations, placing ecological responsibility at the forefront. They readily fit in with research on business environmental efficiency, ecological responsibility, and environmentally conscious behavior¹⁶. This choice was appropriate given our research objective of analysing the influence of ecocentric leadership on organisational green innovation.

Another aspect of this gap pertains to the examination of underlying mechanisms. In our study, we incorporated three variables green knowledge sharing, green ambidexterity, and technological orientation to elucidate their role in influencing the relationship between ecocentric leadership and organizational green innovation. Eco-centric leaders emphasize environmental principles and goals to create a culture of sustainability inside the organization¹⁷. This culture encourages employees to share knowledge and information about green practices and initiatives. When employees share knowledge about environmentally sustainable practices and innovations, they explore new green possibilities and improve the organization's capacity to capitalize on its current green skills¹⁵. This knowledge-sharing facilitates the development of green ambidexterity within the organization¹⁸. Green ambidexterity enables an organization to simultaneously optimize its current green initiatives and explore new avenues for green innovation and sustainable outcomes¹⁹. This balanced approach to sustainability fosters a culture of continuous improvement and innovation, ultimately leading to enhanced organizational green innovation²⁰.

Furthermore, this study examines the moderating role of technological orientation—a managerial technique involving technology in all aspects of a company's operations²¹. By emphasizing environmental values and goals¹⁷, eco-centric leaders tend to prioritize the adoption and usage of technology, i.e., technological orientation to support green initiatives within the organization²². The ecocentric leadership visionary approach encourages the integration of technological solutions for environmental sustainability²³. This enhances our understanding of how eco-centric leaders can incentivize employees to engage in environmentally friendly behaviors and share knowledge, ultimately developing successful interventions and regulations to promote green innovation. This study utilized social exchange theory to further our understanding of the study model.

All of the above concepts led us to suggest the following research questions: (1) Does ecocentric leadership promote organizational green innovation? (2) Can employee green knowledge sharing and green ambidexterity serve as an underlying mechanism linking ecocentric leadership to organizational green innovation? (3) Does technological orientation moderate the direct path between ecocentric leadership and employees' green knowledge-sharing? (4) Does technological orientation buffer the mediated path between ecocentric leadership and organizational green innovation via green knowledge sharing?

This study makes several significant contributions to the literature. First, it reveals how ecocentric leadership fosters organisational green innovation through the sequential mediation of green knowledge sharing and green ambidexterity, providing a deeper understanding of the pathways to sustainability. Second, it highlights the crucial moderating role of technological orientation in enhancing the relationship between ecocentric leadership and green innovation, providing new insights into how technology can support eco-friendly practices. Third, it presents actionable strategies for organisations, particularly in the hospitality sector, to promote sustainable innovation by cultivating ecocentric leadership, enhancing knowledge sharing, and leveraging technological advancements. Lastly, by integrating social exchange theory and exploring these interconnected relationships, the study enriches the literature on leadership and sustainability, providing a comprehensive framework for future research, as shown in Fig. 1.

Theoretical foundation and hypotheses development

Social exchange theory

Social exchange theory²⁴ provides an empirical basis for analyzing the dynamics of connections and interactions within organizations and the exchange of resources between leaders and individuals. Ecocentric leadership, which emphasizes environmental values and goals, can be viewed as a form of social exchange in which leaders provide support and incentives for environmentally sustainable behavior among employees²⁵. In return, employees reciprocate by sharing green knowledge and exchanging information and ideas related to sustainable practices within the organization. This knowledge exchange fosters mutual trust and reciprocity among employees and leaders²⁶. Moreover, green knowledge sharing contributes to the development of green ambidexterity within organizations. Employees exchange knowledge, resources, and assistance to utilize current green capabilities while exploring new green prospects^{20,27}. As employees exploit and explore green initiatives, they exchange resources and collaborate to generate innovative solutions to environmental challenges. This collaborative exchange of ideas and efforts enhances an organization's capacity for green innovation²¹.

Key constructs

Ecocentric leadership

Ecocentric leadership is a leadership style that refers to a sustainability-oriented paradigm prioritizing ecological welfare in leadership decisions, emphasizing the balance between human endeavors and the natural environment^{17,26}. In contrast to conventional anthropocentric paradigms, it advocates for environmental

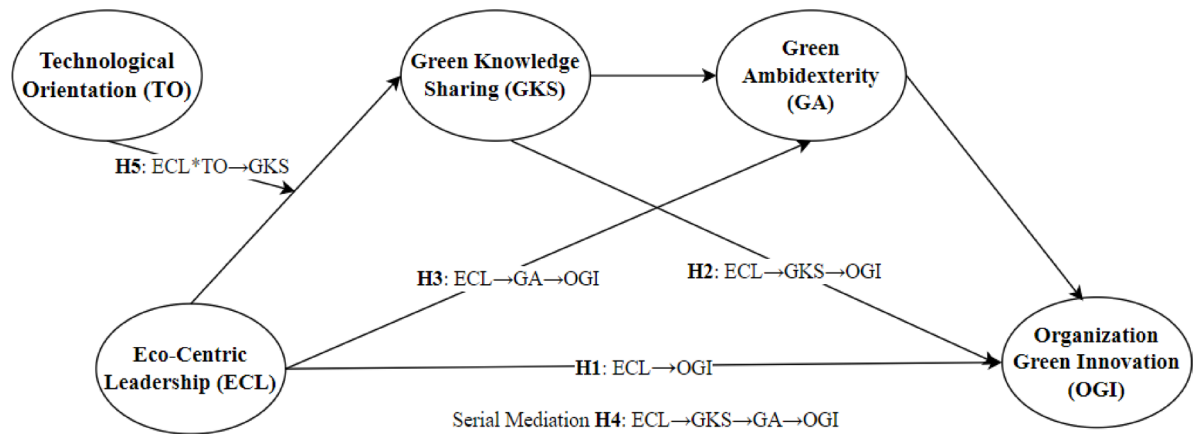


Fig. 1. Theoretical model.

stewardship, long-term sustainability, and ethical accountability in resource utilization^{28,29}. Uddin et al.¹⁷ determined that such leaders frequently exhibit transformational attributes and emphasize ecological principles. Hay²³ underscored the internal integration of employees with environmental learning considerations into corporate activities. Similarly, research on the sustaincentric worldview presents ecocentric perspectives in leadership³⁰. Biswas et al.²⁶ advocated for a shift from ego-centric to eco-centric leadership to achieve sustainability. Literature supported this notion by promoting profound leadership grounded in ecological humility³¹. This leadership approach encourages systemic thinking and a commitment to intergenerational equality. Ecocentric leadership represents a rising demand for responsible and sustainable management within enterprises.

Green knowledge sharing

Green knowledge sharing involves spreading environmentally relevant information, ideas, and practices among employees^{32,33}. It involves sharing information about green technologies, environmental regulations, sustainable practices, and ecological awareness to enhance collective environmental performance. This approach promotes environmental education and innovation through collaboration and a shared commitment to sustainability. Research has confirmed that spreading green knowledge is essential for fostering a culture of sustainability in businesses and enhancing green innovation performance³⁴. It enhances employees' environmental awareness and promotes the integration of sustainable practices into daily routine operations. Shafait and Huang³⁵ argue that the dissemination of green knowledge positively influences green innovation and organizational effectiveness, sustainability. Consequently, green knowledge exchange serves as a strategic tool for organizations aiming to reduce environmental impact, supporting organizational green innovation while maintaining competitiveness in the green economy.

Green ambidexterity

Green ambidexterity refers to an organization's ability to simultaneously engage in two complementary yet distinct green innovation strategies: green exploration (the development of novel, environmentally sustainable products, technologies, or processes) and green exploitation (the enhancement and refinement of existing green practices and resources)^{36,37}. This approach competence enables organizations to balance long-term environmental innovation with short-term efficiency in sustainability initiatives. Green ambidexterity enables organizations to be both adaptive and efficient in addressing environmental concerns, and focuses on the organizational environmental goal³⁸. Research indicates that enterprises exhibiting robust green ambidexterity are better positioned to achieve sustainable competitive advantage and improve environmental outcomes performance³⁶. Shehzad et al.³⁹ suggests that green ambidexterity strengthens green dynamic capabilities and boosts organizational green performance. It combines strategic flexibility with a strong ecological focus, enabling firms to address market and regulatory demands for sustainability.

Technological orientation

Technological orientation refers to an organization's strategic focus on adopting, developing, and integrating advanced technologies to enhance products, services, and processes⁴⁰. It demonstrates a company's commitment to innovation, technical expertise, and continuous improvement through the use of new technology⁴¹. Organizations that have a strong technological orientation actively monitor technological advancements, invest in research and development, and utilize technology to gain a competitive edge⁴². Technical orientation boosts a firm's ability to innovate and adjust to shifting market demands. Companies focused on technology are more likely to adopt digital transformation and sustainable practices⁴⁰. Research conducted by Masadeh et al.⁴² demonstrates that a technological orientation has a positive impact on firm performance, especially in dynamic and competitive environments. A technological orientation is a key driver of innovation, agility, and sustained success in today's enterprises.

Organizational green innovation

Organizational green innovation involves developing and implementing new products, processes, or practices within an organization that aim to reduce environmental impact and promote sustainability³⁴. It encompasses advancements like environmentally sustainable product design, energy-efficient technologies, waste reduction strategies, and sustainable supply chain practices. Green innovation seeks to align environmental performance with economic objectives by integrating environmental considerations into core business strategies⁴³. Chen et al.⁸⁹ assert that green innovation enhances a firm's competitive advantage by improving its reputation, ensuring regulatory compliance, and boosting operational efficiency⁴⁴. Organizations that pursue green innovation often foster a culture of environmental stewardship and continuous improvement⁴⁵. Research has confirmed that green innovation positively impacts both environmental and financial performance⁴⁶. It also promotes long-term sustainability by conserving resources and engaging stakeholders. Organizational green innovation plays a vital role in advancing eco-efficiency and sustainable development within today's environmentally conscious corporate landscape.

Hypotheses development

Ecocentric leadership and organization green innovation

Ecocentric leadership represents a value-driven leadership style that places sustainability and environmental stewardship on par with traditional business objectives¹⁷. It seeks to promote synergy between human activity and the natural environment, signifying a notable paradigm shift in management towards a more holistic and environmentally conscious approach¹⁵. Prior studies indicate that ecocentric leadership fosters innovation within organizational contexts¹⁶. Biswas et al.²⁶ provided evidence supporting the impact of ecocentric leadership on green innovation by promoting the development of crucial competencies and capabilities through collaborative decision-making processes directed towards collective objectives. Eco-centric leaders are dedicated to ongoing learning and employ a shared vision to raise understanding and appreciation of the organization's purpose and goals among its employees²³. They spearhead innovation efforts within the organization and contribute to the market success of novel products and services through inspiring motivation and intellectual stimulation⁴⁷.

Previous studies indicate that eco-centric leaders prioritizing environmental sustainability tend to shape how employees perceive their roles and engage with environmental issues³¹. This steadfast commitment often inspires employees to reciprocate through proactive participation in green innovation initiatives¹¹. Ecocentric leadership promotes organizational green innovation by strongly emphasizing environmental sustainability as a core value⁸. This focus has the potential to inspire and enable employees to voluntarily adopt environmentally friendly practices, thereby contributing to the organization's overall green initiatives⁴⁸. Research has highlighted the ability of eco-centric leaders to articulate a clear environmental vision and cultivate a supportive, environmentally conscious culture within their organizations. This culture can catalyze driving organizational green innovation⁴⁹. In alignment with social exchange theory, when employees witness their leaders' dedication to environmental sustainability, they are motivated by a moral obligation to participate in the organization's green initiatives⁵⁰. Based on the above arguments, it can be hypothesized that:

Hypothesis 1 Ecocentric leadership will positively influence the organization's green innovation.

Ecocentric leadership predicts organizational green innovation: the mediating role of employee green knowledge sharing

Ecocentric leadership, which prioritizes environmental sustainability and responsibility, has garnered increasing attention in organizational research because of its potential to drive green innovation within organizations²⁶. This concept suggests that leaders who prioritize ecological values are more likely to inspire and motivate their employees to engage in environmentally responsible behaviors and initiatives¹⁵.

One critical pathway through which ecocentric leadership influences organizational green innovation is fostering employee green knowledge sharing⁵¹. Green knowledge sharing encompasses disseminating environmentally relevant information, ideas, and practices among employees^{32,33}. When leaders prioritize environmental sustainability and demonstrate their commitment to green initiatives, they cultivate an environment that inspires and motivates employees to share knowledge and ideas about sustainability efforts^{8,52}. Eco-centric leaders typically exhibit behaviors such as setting clear environmental goals, providing resources for eco-friendly initiatives, and actively participating in sustainability practices^{53,54}. Employees are more inclined to participate in knowledge sharing when they perceive that their contributions are valued and align with the organization's overarching goals and values⁵⁵. These actions tell employees that the organization prioritizes environmental sustainability, increasing their motivation to participate in green innovation efforts^{51,56}.

Furthermore, in line with social exchange theory, ecocentric leadership fosters collaboration and openness, where employees feel empowered to exchange ideas and information related to sustainability initiatives^{57,58}. This collaborative culture facilitates knowledge sharing and enhances creativity and innovation within the organization⁵⁹. Studies have found that organizations with leaders who firmly commit to environmental sustainability tend to exhibit higher levels of employee engagement in green knowledge-sharing activities¹¹. Additionally, these organizations are more likely to develop and implement innovative green initiatives, contributing to their overall environmental performance and competitive advantage¹¹.

We contend that ecocentric leadership is pivotal in advancing organizational green innovation. This is achieved by cultivating a culture of sustainability, motivating employees to participate in sharing green knowledge, and ultimately facilitating the development and implementation of innovative environmental practices. By recognizing the significance of ecocentric leadership and investing in initiatives that promote environmental responsibility, organizations can position themselves as leaders in sustainable business practices. This, in turn, allows them to contribute to a more environmentally sustainable future^{60,61}.

Hypothesis 2 The relationship between ecocentric leadership and organizational green innovation will be mediated by green knowledge-sharing.

Green ambidexterity mediates the relationship between ecocentric leadership and organizational green innovation.

Green ambidexterity describes an organization's capacity to both explore new environmentally sustainable opportunities (green exploration) and exploit existing green initiatives and capabilities (green exploitation)^{36,37}. It involves balancing innovation and efficiency in pursuing environmental sustainability goals^{38,62}. Ecocentric leadership is instrumental in cultivating green ambidexterity by fostering an organizational climate that encourages the simultaneous exploration and exploitation of green opportunities⁶³. Eco-centric leaders promote green ambidexterity by encouraging a culture of experimentation and risk-taking to pursue innovative green solutions (green exploration)⁶⁴. They empower employees with resources, support, and autonomy to innovate new ideas and technologies that promote environmental sustainability^{65,66}. Simultaneously, eco-centric leaders ensure that the organization effectively leverages its existing green initiatives and capabilities by optimizing processes, improving efficiencies, and scaling successful sustainability practices³⁶.

Furthermore, ecocentric leaders guide organizations in adapting to evolving environmental regulations, market trends, and stakeholder expectations by concurrently exploring new avenues for sustainability and leveraging existing green capabilities⁶⁷. Organizations can drive continuous green innovation by balancing exploration and exploitation by effectively managing the trade-offs between immediate benefits and long-term sustainability goals⁶⁸. Ecocentric leaders foster a climate of openness to new ideas, collaboration across functional areas, and continuous learning and improvement. Additionally, eco-centric leaders align organizational goals and incentives with environmental sustainability objectives to prioritize and reward green innovation^{69,70}.

We argue that green ambidexterity serves as an underlying mechanism linking ecocentric leadership to organizational green innovation. Organizations can effectively drive innovation in environmentally sustainable practices by exploring new green opportunities and exploiting existing capabilities^{71,72}.

Hypothesis 3 The path between ecocentric leadership and organizational green innovation will be mediated by green ambidexterity.

Serial mediation

Expanding upon prior literature and theories, this study proposes that green knowledge sharing and green ambidexterity play a chain-mediating role in translating ecocentric leadership into organizational green innovation. Ecocentric leaders set an example by prioritizing environmental concerns and integrating green practices into their organizational culture^{14,73}. This communicates to employees that sustainability is highly regarded, motivating them to participate in environmentally responsible behavior. In return, employees may feel obligated to reciprocate this positive behavior by sharing their knowledge and ideas related to green initiatives^{26,74}. This sharing of knowledge facilitates the development of green ambidexterity within organizations. In addition, ecocentric leaders play a crucial role in promoting this ambidextrous mindset by encouraging employees to continuously improve existing green initiatives while exploring and experimenting with new environmentally sustainable solutions^{33,53}. Organizations can better leverage ecocentric leadership to drive sustainable innovation and competitive advantage by understanding the mediating roles of green knowledge sharing and green ambidexterity.

Hypothesis 4 Green knowledge sharing and green ambidexterity sequentially mediate the relationship between ecocentric leadership and organizational green innovation.

Moderation and the moderation mediation effect of technological orientation

We argue that ecocentric leadership, characterized by a commitment to environmental sustainability and responsibility, and a technological orientation that emphasizes the strategic use of technology for organizational advancement, can synergistically enhance green knowledge sharing. Technological orientation complements ecocentric leadership by providing the tools and platforms necessary for efficient and effective knowledge-sharing^{21,75}. Technology facilitates the communication, collaboration, and dissemination of information across organizational boundaries. Through technological platforms, such as intranet portals, social media, and knowledge management systems, employees can easily access and share green knowledge, best practices, and innovative ideas related to sustainability initiatives^{11,76}. Ecocentric leaders leverage technology to reinforce green messaging, communicate sustainability goals, and recognize and reward environmentally responsible behaviors²². Meanwhile, technological tools enable leaders to collect data on environmental performance, track progress toward sustainability targets, and disseminate this information transparently to employees, fostering accountability and engagement^{7,77}.

Moreover, technological platforms provide avenues for interactive learning and collaboration⁷⁸, enabling employees to contribute their insights, experiences, and suggestions for improving environmental practices^{79,80}. This democratization of knowledge sharing empowers employees at all levels to participate actively in the organization's sustainability efforts, fostering a sense of ownership and collective responsibility toward environmental stewardship⁸¹. Organizations can create a dynamic ecosystem where ideas can flourish and translate into tangible environmental benefits by linking ecocentric leadership and technology-enabled knowledge sharing to green innovation. This approach drives continuous improvement in sustainability practices and positions the organization as a leader in green innovation, fostering competitiveness and long-term success in an increasingly environmentally conscious marketplace^{82,83}.

Furthermore, social exchange theory explains how ecocentric leadership drives green knowledge sharing by emphasising mutual benefits and reciprocity²⁴. Leaders prioritising sustainability foster a culture where employees share green knowledge, anticipating positive outcomes¹⁵. Technological orientation enhances this by increasing the perceived value of knowledge sharing through advanced tools, making exchanges more efficient and rewarding⁸¹. This strengthens the leader–follower relationship and promotes green innovation. Research highlights that in tech-savvy environments, the benefits of sharing green knowledge are amplified, fostering greater engagement and sustainable innovation⁴. Based on support from literature and theory, we propose the following hypothesis.

Hypothesis 5 Technological orientation moderates the path of ecocentric leadership with green knowledge-sharing behavior, such that this relationship is strong when technological orientation is high.

Hypothesis 6 The indirect mediated path between ecocentric leadership and organization green innovation through green knowledge sharing is moderated by technological orientation, such that this indirect effect is strong with high levels of technological orientation.

Research method

Participants and procedure

The participants in this study were hotel employees from Guangdong Province, China. Guangdong is a highly developed metropolitan area with a robust hospitality sector. The data collection method used in this study was convenience sampling. This approach was selected due to the fast-paced nature of the hospitality industry, characterised by constant customer interactions, dynamic environments, and sufficient staff availability to gather data on the study variables: Ecocentric Leadership, Technological Orientation, Green Knowledge Sharing, Green Ambidexterity, and Organisational Green Innovation. Convenience sampling enables researchers to collect data efficiently without the need for complex sampling frameworks, making it particularly suitable for industries where time and resource constraints are significant. Moreover, while random sampling methods are rigorous, they can be costly and time-consuming. Convenience sampling mitigates these expenses by focusing on readily available participants, making it a practical and attractive option for hospitality businesses with limited budgets. Additionally, implementing structured sampling methods can be logistically challenging in high-traffic and transient environments due to the industry's high volume of staff engagement. Convenience sampling addresses this challenge by allowing researchers to collect insights from employees who are easily accessible and directly involved in daily operations. To ensure ethical standards, supplementary letters were provided to guarantee the confidentiality and privacy of respondents' data. Informed consent was obtained from all participants before their involvement in the study. The research initially targeted 250 hotels in Shenzhen City, focusing on establishments with ratings between 2 and 5 stars. The primary respondents were mid-level employees, often directly involved in implementing green practices and innovation within their organisations. Data collection was conducted in two phases (Time-lagged approach) to address common method bias⁸⁴. Initially, 960 questionnaires were distributed to hospitality organizations, covering demographics, ecocentric leadership, and technological orientation, yielding 773 responses (80.52% response rate). Subsequently, these respondents were re-engaged in collecting data on green knowledge sharing, green ambidexterity, organizational green innovation, and social desirability, resulting in 667 surveys being returned, with 623 deemed valid (64.89% response rate). Seventy-three percent of the respondents had bachelor's degrees, and the majority (68%) claimed having one to five years of experience.

Measurements

The study utilized the six items from the scale developed by Chen and Yan²⁸ to assess ecocentric leadership. The sample item is, "Our leader inspires the employees with the environmental plans." The study used the twelve items of Gatignon and Xuereb⁸⁵ scale to measure technological orientation. Sample item is "our organization is very proactive in developing new technologies". The study employed a five-item scale for green knowledge sharing developed by Wong⁸⁶. A sample item is "I enjoy sharing environment-friendly knowledge with my colleagues." The research employed the eight-item scale measure of green ambidexterity developed by Sheng and Chien⁸⁷ and Chen and Chang⁸⁸. Sample items are "our organization actively improves green products, processes, and services" and "our organization actively adopts new green products, processes, and services." Organizational green innovation was measured using an eight-item instrument developed by Chen et al.⁸⁹. A sample item is "Our organization chooses the materials that produce the least amount of pollution." Following previous research on ecocentric leadership¹⁶. We controlled for firm size as a control variable.

Results

Descriptive statistics

Table 1 shows that all the correlations were in expected directions. Ecocentric leadership is positively correlated with green knowledge sharing $r=0.213$, $p<0.001$, green ambidexterity $r=0.317$, $p<0.001$, technological orientation $r=0.258$, $p<0.001$, and organization green innovation $r=0.368$, $p<0.001$. Green knowledge sharing is positively correlated with green ambidexterity $r=0.401$, $p<0.001$, technological orientation $r=0.351$, $p<0.001$, and organization green innovation $r=0.223$, $p<0.001$. Green ambidexterity is positively correlated with technological orientation $r=0.241$, $p<0.001$ and organization green innovation $r=0.346$, $p<0.001$. Technological orientation positively correlates with organization green innovation $r=0.184$, $p<0.001$.

Variables	1	2	3	4	5
1. Ecocentric leadership	–				
2. Green knowledge sharing	.213**	–			
3. Green ambidexterity	.317**	.401**	–		
4. Technological orientation	.258**	.351**	.241**	–	
5. Organization green innovation	.368**	.223**	.346**	.184**	–
Mean	3.73	3.64	4.17	3.55	3.87
S. D	0.56	0.61	0.58	0.77	0.66

Table 1. Descriptive statistics and correlation. ** $p < .001$.

Models	Variables	χ^2/df	CFI	TLI	GFI	RMSEA	NNFI
Five-factor model	Ecocentric leadership, Technological orientation, Green knowledge sharing, Green ambidexterity, Organization green innovation	2.96	0.94	0.91	0.90	0.04	0.92
Four-factor model	Ecocentric leadership + Technological orientation, green knowledge sharing, Green Ambidexterity, Organization green innovation	3.06	0.75	0.81	0.71	0.21	0.77
Three-factor model	Ecocentric leadership, Technological orientation, green knowledge sharing	3.22	0.62	0.74	0.63	0.47	0.63
Two-factor model	Ecocentric leadership, Technological orientation, green knowledge sharing, green ambidexterity	3.42	0.49	0.61	0.51	0.59	0.55
One-factor model	Ecocentric leadership + Technological orientation + Green knowledge sharing + Green ambidexterity + Organization green innovation	3.49	0.32	0.53	0.46	0.63	0.32

Table 2. Measurement model results.

Measurement model

Discriminant validity was assessed, and chi-square statistics were compared across the models. Table 2 illustrates that the improvement in the chi-square across the model series was consistently significant. Among the tested models, the five-factor model comprising ecocentric leadership, technological orientation, green knowledge sharing, green ambidexterity, and organizational green innovation) exhibited the optimal fit ($\chi^2/df = 2.96$, CFI = 0.94, TLI = 0.91, GFI = 0.90, RMSEA = 0.04, NNFI = 0.92). We assessed the reliability of the construct indicators using two key metrics: Average Variance Extracted (AVE) and Composite Reliability (CR). The Cronbach's alpha values were more than 0.70 (see Table 3). With CR values ranging from 0.907 to 0.960, all structures showed good dependability across indicators, exceeding 0.70. The AVE values, ranging from 0.588 to 0.669, surpassed the 0.5 threshold, indicating satisfactory convergent validity across all the constructs. Discriminant validity was confirmed by AVE values surpassing the squared correlations between constructs⁹⁰.

Study model analysis

Mplus v.8.6) was used to test the study model. Table 4 and Fig. 2 outline the effects of direct, mediation, and serial mediation. The study results support a direct link between ecocentric leadership and organizational green innovation ($\beta = 0.26$, $p = 0.00$). Additionally, it was found that green knowledge sharing plays a significant mediating role between ecocentric leadership and organizational green innovation ($\beta = 0.31$, $p = 0.00$, CI 0.035; 0.454). Moreover, green ambidexterity was identified as positively mediating the relationship between ecocentric leadership and organizational green innovation, $\beta = 0.12$, $p = 0.00$, CI 0.011; 0.148). Further analysis in Table 3 suggests supportive findings for the serial mediation involving green knowledge sharing and green ambidexterity between ecocentric leadership and organizational green innovation $\beta = 0.04$, $p = 0.00$, CI 0.011; 0.146).

Moderation and moderation mediation effect

To elucidate the moderating effect (see Table 4), the mean of technological orientation was used to estimate slopes ± 1 SD⁹¹. The observed pattern of interactions in Fig. 3 supports this hypothesis. Technological orientation moderates the path between ecocentric leadership and green knowledge sharing ($\beta = 0.13$, SE = 0.051, CI {0.017, 0.102}). The findings showed that the relationship becomes strong when technological orientation is high (simple slope = 0.318, $t = 7.142$, CI 0.015, 0.241) and low, simple slope = 0.052, $t = 1.54$, CI 0.006, – 0.376). The moderating mediation effect was tested using a bootstrap approach Preacher et al. 2007⁹⁴). Under three LMX levels, Ecocentric leadership's indirect effects on organizational green innovation were examined ± 1 SD and Baseline Value. Table 5 presents the moderated mediation results. Green knowledge sharing mediated the relationship between ecocentric leadership and organizational green innovation when technological orientation was high ($\beta = 0.31$, SE = 0.051, 95% CI 0.014, 0.171). When LMX was low, the study found no support for a substantial indirect effect (moderation mediation) from ecocentric leadership on organization green innovation through green knowledge sharing ($\beta = 0.04$, 95% CI [– 0.022, 0.145]). The index of moderation mediation (0.09, SE = 0.017, 95% CI 0.013, 0.163) supports moderation mediation.

Discussion and conclusion

The findings of this study affirm both the direct and indirect impacts of ecocentric leadership on organizational green innovation. The study also supports the sequential mediation path, encompassing ecocentric leadership to

Constructs	Cronbach's alpha	Factor loading	AVE	CR
Ecocentric leadership (EL)	0.817		0.621	0.907
EL1		0.801		
EL2		0.718		
EL3		0.852		
EL4		0.814		
EL5		0.729		
EL6		0.806		
Green knowledge sharing (GKS)	0.905		0.669	0.909
GKS1		0.842		
GKS2		0.805		
GKS3		0.819		
GKS4		0.792		
GKS5		0.831		
Green ambidexterity (GA)	0.824		0.588	0.919
GA1		0.721		
GA2		0.828		
GA3		0.737		
GA4		0.702		
GA5		0.749		
GA6		0.812		
GA7		0.795		
GA8		0.784		
Organization green innovation (OGI)	0.806		0.618	0.928
OGI1		0.836		
OGI2		0.742		
OGI3		0.829		
OGI4		0.717		
OGI5		0.738		
OGI6		0.825		
OGI7		0.843		
OGI8		0.751		
Technological orientation (TO)	0.831		0.667	0.960
TO1		0.813		
TO2		0.828		
TO3		0.805		
TO4		0.819		
TO5		0.796		
TO6		0.834		
TO7		0.822		
TO8		0.811		
TO9		0.798		
TO10		0.772		
TO11		0.863		
TO12		0.841		

Table 3. Convergent validity and internal consistency.

organizational green innovation via green knowledge sharing and green ambidexterity. Moreover, moderation effects were observed, where technological orientation moderated the direct effect between ecocentric leadership and green knowledge sharing and indirectly moderated the path between ecocentric leadership and organizational green innovation via green knowledge sharing.

Our first hypothesis asserts that ecocentric leadership is vital in organizational green innovation. Ecocentric leadership emphasizes a deep commitment to environmental sustainability and integrating ecological principles into leadership practices²⁶. Research indicates that leaders embracing an eco-centric approach firmly commit to environmental sustainability. They prioritize ecological considerations in their decision-making processes and encourage organizations to adopt green practices and innovations¹⁷. Eco-centric leaders are acutely aware of the importance of environmental preservation. They understand the potential long-term consequences of unsustainable practices and prioritize protecting natural resources¹⁶. Leaders who uphold eco-centric values

Relationships	β	SE	t-Value	p value	CI 95.0%	Decision
Control variables						
Firm Size $\rightarrow$ Green Knowledge Sharing	-0.05	0.03	1.88	0.11	-0.08; 0.31	Unsupported
Firm Size $\rightarrow$ Green Ambidexterity	-0.01	0.04	1.22	0.07	-0.13; 0.11	Unsupported
Firm Size $\rightarrow$ Organization Green Innovation	0.04	0.05	1.19	0.09	-0.04; 0.17	Unsupported
Direct path's						
EL $\rightarrow$ OGI	0.26	0.03	4.63	$P < 0.001$	0.019; 0.331	Supported
EL $\rightarrow$ GKS	0.23	0.05	6.45	$P < 0.001$	0.070; 0.270	Supported
GKS $\rightarrow$ GA	0.44	0.04	6.12	$P < 0.001$	0.036; 0.524	Supported
GA $\rightarrow$ OGI	0.18	0.06	5.37	$P < 0.001$	0.014; 0.282	Supported
Mediation path's						
EL $\rightarrow$ GKS $\rightarrow$ OGI	0.31	0.04	6.68	$P < 0.001$	0.035; 0.454	Supported
EL $\rightarrow$ GA $\rightarrow$ OGI	0.12	0.05	5.32	$P < 0.001$	0.011; 0.148	Supported
Serial Mediation						
EL $\rightarrow$ GKS $\rightarrow$ GA $\rightarrow$ OGI	0.04	0.05	5.57	$P < 0.001$	0.011; 0.146	Supported

Table 4. Direct, mediation, and serial mediation paths. EL = Ecocentric leadership, GKS = Green Knowledge Sharing, GA = Green Ambidexterity, OGI = Organization green innovation.

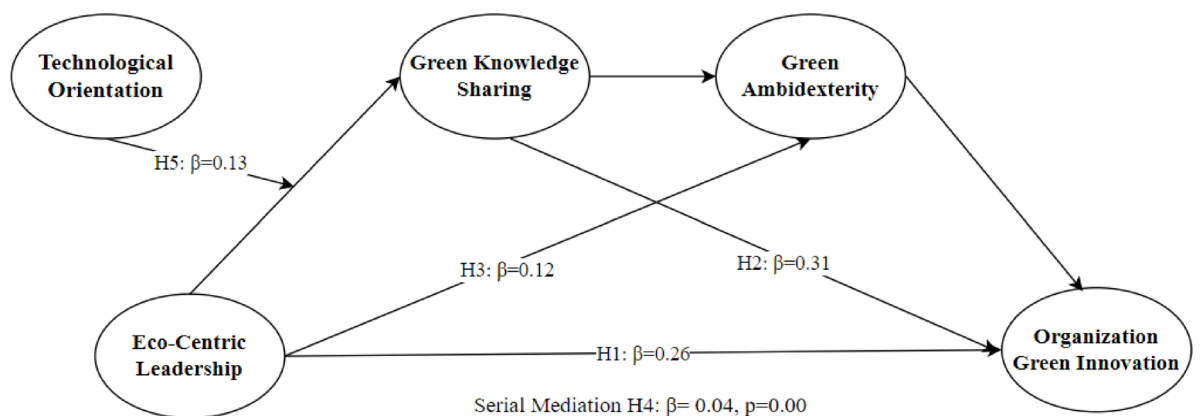


Fig. 2. Structural model.

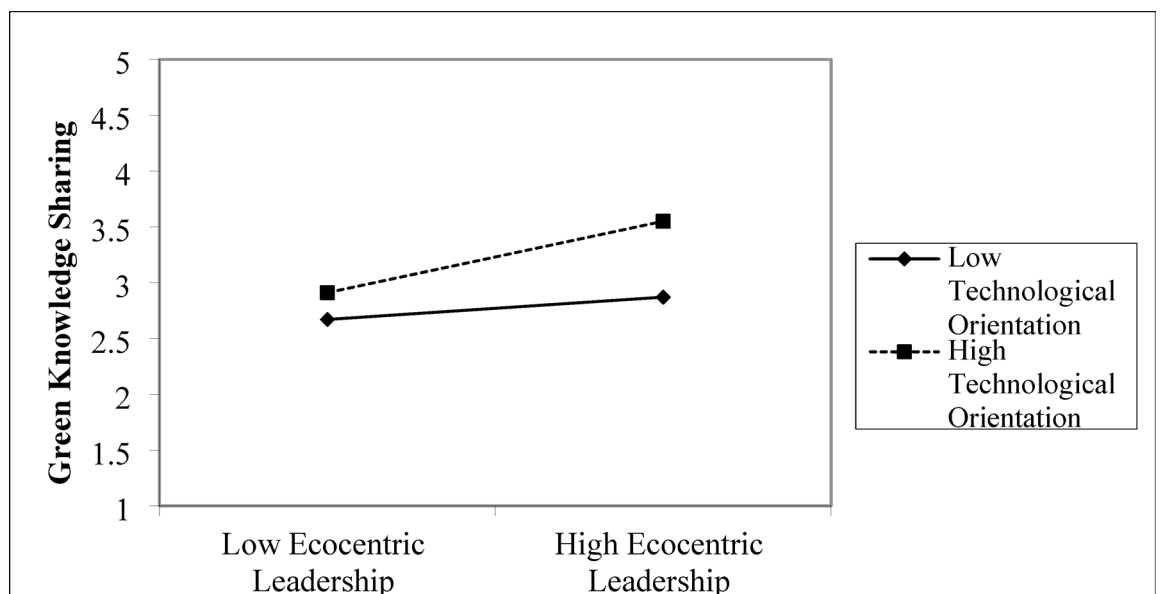


Fig. 3. Moderating role of technological orientation.

Moderating effect	Moderating coefficient (β)	Standard error (SE)	95% Confidence interval (CI)
Technological orientation on Ecocentric leadership $\rightarrow$ Green knowledge sharing	0.13	0.051	{0.017, 0.102}
Moderated mediation effect	Indirect effect (β)	Standard error (SE)	95% Confidence interval (CI)
High technological orientation	0.31	0.051	{0.014, 0.171}
Low technological orientation	0.04	0.062	{-0.022, 0.145}
Index of moderation mediation	0.09	0.017	{0.013, 0.163}

Table 5. Moderation and moderation mediation analysis.

and prioritize environmental responsibility are instrumental in fostering a culture of sustainability within their organizations. By championing these values, they create an environment where employees are empowered to engage in green initiatives and innovate for sustainability. Ecocentric leadership involves strategically integrating sustainability goals into organizational strategies and operations. Eco-centric leaders who adopt a strategic approach to sustainability are better positioned to drive green innovation by aligning environmental objectives with business objectives, allocating resources to green initiatives, and promoting collaboration across departments e.g.,^{15,47}.

The second underpinning of our research is regarding the underlying mechanism of “green knowledge sharing” between ecocentric leadership and organizational green innovation. Our findings indicate that eco-centric leaders prioritize environmental sustainability and encourage knowledge-sharing related to green practices and innovations. Eco-centric leaders create a supportive environment where employees feel empowered to exchange ideas, best practices, and lessons learned regarding environmental sustainability, thus fostering green knowledge sharing within the organization e.g.,^{53,56}. Eco-centric leaders who promote knowledge sharing contribute to disseminating environmental values, awareness, and expertise throughout the organization, enhancing the organization’s capacity for green innovation⁸². Previous studies have highlighted the importance of knowledge sharing in facilitating innovation. Sharing information, expertise, and experiences related to environmental processes and market trends enables organizations to identify opportunities, overcome challenges, and develop novel solutions for sustainability e.g., Chen et al., (2018). Therefore, organizations with a culture of green knowledge-sharing are more likely to generate innovative ideas and implement environmentally friendly practices.

Our third research inquiry investigated the mediating role of green ambidexterity in the relationship between ecocentric leadership and organizational green innovation. The study results assert that eco-centric leaders will likely foster a strategic orientation toward environmental sustainability within their organizations^{37,63}. They emphasize the importance of integrating ecological principles into an organization’s vision, mission, and strategic goals. This strategic orientation provides a foundation for pursuing green ambidexterity by encouraging the exploration of new green opportunities and exploiting existing green capabilities⁷¹. Previous research has highlighted the positive impact of green ambidexterity on organizational innovation performance⁶⁵. Organizations that adopt a balanced approach of exploring new environmentally sustainable practices while leveraging existing green resources and capabilities are well-positioned to develop innovative solutions to address environmental challenges and effectively meet stakeholder expectations. Green ambidexterity enables organizations to adapt to changing environmental conditions, anticipate market trends, and create value through green innovation⁶⁷. Eco-centric leaders who promote a culture of green ambidexterity encourage employees to balance experimentation with efficiency, risk-taking with stability, and short-term gains with long-term environmental benefits. This balanced approach to innovation enables organizations to effectively translate eco-centric principles into tangible green innovation outcomes³⁷.

The fourth study question concerns the moderating role of technological orientation. Our results show that organizations with high technological orientation prioritize adopting and utilizing technology to drive green innovation. Previous studies indicate that technological orientation encompasses an organization’s readiness to invest in technology, its emphasis on technological development, and its capacity to leverage technology for strategic purposes⁷⁸. Such organizations are more likely to embrace digital platforms, collaborative tools, and knowledge management systems to facilitate knowledge sharing and innovation²¹. Eco-centric leaders recognize the importance of leveraging technology to support environmental sustainability initiatives and advocate the adoption of green technologies, digital platforms, and information systems to enhance the organization’s environmental performance and facilitate green innovation²⁷. They promote a culture of technological readiness, encouraging employees to use digital tools and platforms to share environmental knowledge and best practices. Technological orientation moderates the relationship between ecocentric leadership and green knowledge-sharing behavior by shaping the organizational context in which knowledge-sharing occurs⁵. In organizations with a high technological orientation, the infrastructure and resources necessary for knowledge-sharing are readily available, making it easier for eco-centric leaders to promote and facilitate green knowledge-sharing initiatives⁸¹. Digital platforms, collaboration tools, and information systems enable employees to share real-time environmental insights, expertise, and innovations, fostering a culture of continuous learning and environmental improvement⁷⁹.

In light of the literature and SET, our findings indicate that ecocentric leadership is crucial for promoting organisational green innovation within the hospitality sector. This study conducted a thorough investigation, uncovering a serial mediation pathway that includes green knowledge sharing and green ambidexterity. It clarifies how ecocentric leadership affects proactive cognition and facilitates the spread of green knowledge, ultimately propelling green innovation. Additionally, the study identifies technological orientation as a

moderating factor, suggesting that the connection between ecocentric leadership and organisational green innovation through green knowledge sharing is reinforced when technological orientation is elevated. In the hospitality sector, where sustainability and environmental impact are becoming increasingly significant, such leadership can greatly enhance green practices and innovations, resulting in more sustainable operations and improved environmental performance.

Theoretical implications

Guided by social exchange theory, this study adds many theoretical contributions by integrating ecocentric leadership, green knowledge sharing, green ambidexterity, and technological orientation. This integration sheds light on the mechanisms that drive organizational green innovation. First, it contributes to the burgeoning literature on ecocentric leadership by demonstrating its positive influence on organization-level outcomes, specifically green innovation, within the hospitality sector. By emphasizing values such as environmental stewardship, social responsibility, and long-term sustainability, ecocentric leaders in the hospitality industry create a climate conducive to innovation that aligns with their ecological goals²⁶. This extends prior research on leadership theories, which predominantly focus on traditional performance outcomes, by highlighting the importance of sustainability-oriented leadership in driving environmentally responsible practices within the hospitality sector⁹².

Second, investigating green knowledge sharing as a mediator adds nuance to our understanding of how ecocentric leadership affects organizational outcomes in the hospitality sector. Green knowledge sharing reflects employees' dissemination and integration of environmentally relevant information, ideas, and practices. By fostering a culture of openness, collaboration, and learning, ecocentric leaders in the hospitality industry facilitate the exchange of knowledge essential for identifying and implementing green initiatives¹⁵. This underscores the importance of social exchange processes in promoting sustainability-oriented behavior within organizations. Furthermore, this study extends theoretical insights into green ambidexterity while discussing new opportunities for green innovation. By integrating exploitation and exploration processes within the context of sustainability, this study highlights the dynamic nature of organizational adaptation to environmental challenges⁶⁵. Ecocentric leadership plays a critical role in promoting both exploitation (efficient use of existing resources for sustainability) and exploration (seeking new green opportunities)⁹³, thereby enabling organizations to achieve green ambidexterity and maintain competitiveness in environmentally conscious markets.

Third, this study uncovers the sequential chain of causal processes linking ecocentric leadership to organizational green innovation by investigating serial mediation. Specifically, eco-centric leaders foster an environment conducive to employee knowledge sharing, promoting green ambidexterity within the organization¹⁶. This serial mediation framework provides a deeper understanding of the interrelated pathways through which leadership behaviors shape organizational responses to environmental challenges. This highlights the importance of considering direct and indirect effects operating through intermediate processes in the pursuit of sustainability goals. Moreover, incorporating serial mediation into the theoretical framework enriches our understanding of the causal mechanisms underlying the influence of ecocentric leadership on organizational green innovation. By delineating the sequential pathways through which leadership behaviors propagate throughout the organization to drive sustainability-oriented outcomes, this study offers valuable insights for theoretical development and practical implementation in environmental management and sustainable business practices.

Fourth, examining technological orientation as a moderator enriches our understanding of the boundary conditions regarding how ecocentric leadership affects organizational green innovation through green knowledge sharing²¹. Technological orientation reflects the extent to which an organization prioritizes adopting and utilizing technology to support its environmental objectives⁸¹. The findings suggest that organizations with a high technological orientation may leverage digital platforms, tools, and systems to enhance the effectiveness of green knowledge-sharing initiatives initiated by ecocentric leaders. This underscores the interactive effects of leadership behaviors and organizational context in shaping sustainability outcomes. Finally, in contrast to previous research that qualitatively examines the impact of leadership on organizational green innovation, the current study quantitatively investigates how organization green innovation is influenced by eco-centric leadership, considering factors such as green knowledge sharing, green ambidexterity, and technological orientation. This research facilitates an objective analysis of causal effects by employing statistical methods, such as structural equation modeling (SEM) using Mplus, which provides empirical evidence to underpin the hypothesized link between ecocentric leadership, green knowledge sharing, green ambidexterity, technological orientation, and organizational green innovation. Using SEM through Mplus enhances the extrapolative strength of the results. It overcomes the limitations of qualitative approaches that rely on individual perceptions. This guarantees validation based on data and improves the broader applicability of the findings.

Practical implications

Companies are actively aligning their environmental commitments with their leadership roles in the swiftly changing business environment. They are moving towards sustainable, eco-friendly strategies and practices, especially in response to the increasingly strict environmental regulations. Proactive and self-motivated green initiatives undertaken by employees are essential in driving an organisation's sustainable innovation. Thus, this study identifies the primary factors that can inspire and nurture green innovation within organisations. The aim is to ensure that organisations comply with regulatory requirements and leverage the innate motivation of their employees to promote environmental advancements.

Organisations can implement leadership development programmes that emphasise ecocentric leadership competencies. Training sessions, workshops, and coaching programmes can be designed to cultivate leadership behaviours that prioritise environmental stewardship, social responsibility, and long-term sustainability.

Organisations can foster a culture that supports green knowledge-sharing and innovation by equipping leaders with the necessary skills and mindset.

Recognising the pivotal role of green knowledge sharing in facilitating green innovation, organisations can implement initiatives to promote information exchange and collaboration among employees. This may involve creating online platforms, forums, or communities of practice dedicated to sharing best practices, success stories, and lessons learned from environmental sustainability initiatives. Encouraging cross-functional teams and interdepartmental collaboration can also enhance the dissemination of green knowledge across organisations.

Organisations can promote green ambidexterity by balancing the exploitation of existing green practices with the exploration of new, environmentally sustainable opportunities. Managers can encourage experimentation, risk-taking, and innovation in green initiatives while simultaneously optimising the efficiency and effectiveness of current sustainability practices. By fostering a culture that values both continuity and change in environmental management, organisations can adapt to evolving sustainability challenges and seize emerging opportunities.

Furthermore, considering the moderating effect of technological orientation, organisations can utilise technology to enhance ecocentric leadership initiatives and bolster green knowledge-sharing efforts. Investing in digital platforms, collaborative tools, and data analytics systems can facilitate communication, cooperation, and knowledge exchange among employees, particularly in geographically dispersed and remote work environments. By leveraging the potential of technology, organisations can overcome barriers to green innovation and accelerate the implementation of sustainable practices.

Limitations and future research directions

Our research has limitations that present opportunities for future scholars to bridge the gap and enhance the literature. Firstly, a cross-sectional approach was employed to gather the data, making it more challenging to establish a causal relationship between the variables. Future research may employ experimental or longitudinal approaches to gain a deeper understanding of how ecocentric leadership, green information sharing, green ambidexterity, and organizational green innovation interact dynamically over time. Measuring constructs such as ecocentric leadership, green knowledge sharing, and green ambidexterity may be subject to standard methods or self-report biases. Future studies could employ multi-source, multi-method approaches to enhance the validity and reliability of these findings. Second, this study has focused on a specific industry, namely the hospitality sector. Additionally, geographical regions, such as China, may potentially limit the applicability of the findings. Future research could conduct similar investigations in diverse contexts to assess the broader relevance of the relationships across different organizational settings. Third, this study primarily examined the short-term outcomes associated with organizational green innovation. Future research could evaluate the enduring impacts of ecocentric leadership, green knowledge sharing, and green ambidexterity on organizational sustainability performance, competitive advantage, and financial outcomes. Finally, while this study focused on serial mediation and the moderating role of technological orientation, other mediating and moderating variables may also influence the relationships among ecocentric leadership, green knowledge sharing, green ambidexterity, and organizational green innovation. Future investigations may need to explore additional mechanisms, such as organisational culture, top management support, the role of artificial intelligence, environmental factors, and available resources, to provide a deeper understanding of the related processes.

Data availability

Data Availability Statement: Upon publication of this article, the data for this study can be made available based on requests from the corresponding author.

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Author contributions

Conceptualisation: MZ, AA, and NCB; Methodology: AV, MZ, and AA; Software: NCB and AA; Validation: MZ; Formal Analysis: AV and NCB; Investigation: MZ, and AA; Resources: MZ, NCB, and AA; Data Curation: MZ; Writing Original Draft: MZ, NCB, and AA; Preparation: AV, AA, and NCB; Writing Review and Editing: MZ, AA, and NCB; Visualization: AV; Supervision: MZ; Project Administration: MZ. The author has read and agreed to the publication.

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The authors declare no competing interests.

Ethics approval

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