



Green HRM and green innovation: Do environmental strategies and green culture matter?

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ABSTRACT

Literature supports the notion that green human resource management (HRM), an emerging and effective HRM strategy, leads to superior environmental performance. Yet, insufficient attention has been paid to whether green HRM can improve organisations' green innovation, and on the impact that environmental strategies and organisational green culture have on this process. To fill these research gaps, this study aims to examine the relationship between organisations' green HRM and green innovation, utilising the natural resource-based view and ability-motivation-opportunity theories. It also investigates the mediating role of green culture to explore how green HRM relates to green innovation in organisations. Additionally, it examines the moderating role of environmental strategies to determine the boundary condition of the relationship between green HRM and green innovation. In line with its objectives, this study conducted a multisource survey among 250 Australian employees to test its proposed hypotheses. It employed the partial least squares structural equation modelling approach to analyse data and evaluate the hypotheses. Its findings show that organisations' green HRM has a positive influence on green innovation, and environmental strategy acts as a moderator strengthening this relationship. The moderated mediation model also explains that organisations' green HRM indirectly affects green innovation through the intervening mechanism of green culture. This study has important implications for organisations as its findings underscore the need to align green HRM with a supportive green culture to effectively promote their green innovation. It also highlights that environmental strategies are a key driver of green HRM and green innovation, offering essential insights and guidance for organisations looking to remain competitive in the contemporary business world.

Introduction

Currently, sustainability is an integral component of organisational operations, requiring the adoption of practices that reduce environmental effects (Paillé et al., 2020; Pricopoaia et al., 2025). As a response to this motion, green human resource management (HRM) has emerged, which refers to the integration of environmental management principles into human resource (HR) practices, aiming to create a workforce that is environmentally aware, and actively contributes to organisations' sustainability goals (Song et al., 2021). Authors such as Singh et al. (2020) and Niazi et al. (2023) found that when HR practices foster an environmental mindset among employees, they are more likely to make work-related choices and decisions with consideration for environmental outcomes. Likewise, Singh et al. (2020) found that green HRM approaches train and incentivise employees to adopt environmentally friendly practices, thereby enhancing their innovation and willingness to articulate their green innovative ideas. To highlight the importance of

green innovation, Wang (2019) and Niazi et al. (2023) asserted that when employees actively engage in green innovation, they help organisations enhance their competitiveness, strengthen organisational resilience, and meet the rising expectations of environmentally conscious consumers and stakeholders.

Green innovation, which entails developing and applying environmentally friendly processes, products, and practices, requires well-defined environmental strategies to succeed (Aftab et al., 2023). Effective environmental strategies are fundamental for organisations aiming to achieve green innovation and drive sustainable growth (Albino et al., 2009). Environmental strategies serve as roadmaps that integrate sustainability into organisations' core operations and decision-making processes by establishing a clear framework for setting goals, allocating resources, and implementing initiatives for reducing environmental impact, while fostering innovation (Mustafa et al., 2022; O'Regan & Ghobadian, 2005). Without a strategic approach, organisations may struggle to identify opportunities for green innovation or lack

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the coordination necessary to drive impactful changes (Aftab et al., 2023). Thus, effective environmental strategies enhance operational efficiency and resource utilisation, and position organisations as leaders in sustainability, which attracts environmentally conscious customers and investors (Zhao et al., 2020). Moreover, a significant advantage of a robust environmental strategy is its ability to foster a green culture within an organisation, which is a critical driver of green innovation (Mustafa et al., 2022; Wang, 2019).

Green culture enables organisations to align their operations with sustainability goals, while fostering creativity and environmental responsibility (Roscoe et al., 2019). Establishing a green culture within organisations is essential for achieving green objectives, as it cultivates a shared commitment to sustainability among employees, managers, and stakeholders (Wang, 2019). Green culture refers to the values, beliefs, behaviours, and practices within an organisation that prioritise environmental sustainability (Roscoe et al., 2019). It goes beyond formal policies, integrating sustainability into the daily operations and mindset of the workforce. Hooi et al. (2022) asserted that when organisations embrace a green culture, employees feel motivated to contribute to environmental goals through innovative ideas and eco-friendly practices. Furthermore, Rizvi and Garg (2021) found that green culture supports leadership commitment to sustainability, which reinforces employee engagement and ensures consistent progress towards green innovation goals. Thus, businesses can fully realise the potential of green innovation by integrating sustainability into their business culture.

Previous research has emphasised the significance of HRM practices in fostering employee innovative behaviour (Jimenez-Jimenez & Sanz-Valle, 2008; Lin & Sanders, 2017; Wei et al., 2011) and organisational performance (Chowhan, 2016; Mamun, 2022, 2023), but has largely overlooked examining whether green HRM, as a novel and successful HRM strategy can enhance businesses' green innovation. This study aims to extend this line of research, by examining the role of organisations' environmental strategies and green cultures in promoting green innovation, as these aspects have not been concurrently examined in Australia or on a global scale, despite their importance in effectively addressing environmental challenges, and unlocking the potential for sustainable growth and long-term success. This study, thus, proposes the following research questions: (i) What are the relationships amongst green HRM, environmental strategy, green culture, and green innovation? and (ii) What are the moderating and mediating effects, if any, of environmental strategy and green culture on the relationship between green HRM and green innovation?

To address the research questions, this study draws on the natural resource-based view (NRBV) and ability-motivation-opportunity (AMO) theories, and employs a cross-sectional survey of 250 employees from various industries in Australia. The NRBV emphasises leveraging environmental capabilities for strategic advantage (Hart, 1995), while AMO highlights the role played by employees' ability, motivation, and opportunity in achieving organisational goals (Appelbaum et al., 2000). Green HRM supports these frameworks by equipping employees with skills, fostering motivation through incentives, and creating opportunities for green engagement, which drive the implementation of environmental strategies to integrate sustainability into organisational culture and promote green innovation.

This study contributes significantly to both management literature and organisational practices in several ways. First, it enriches the understanding of sustainable business practices by showing how green HRM can drive sustainability into organisational operations, as well as provides empirical evidence on how green HRM, environmental strategy, and green culture lead to organisations' green objectives and green innovation. Second, it provides actionable insights for organisations seeking to achieve their sustainability goals. Organisations can use its findings to design integrated strategies that promote a culture of environmental responsibility, which in turn, promotes green innovation and addresses sustainability challenges. Finally, it underlines the strategic importance of integrating environmental policies with core business

practices, asserting that sustainability extends beyond operational initiatives, and drives green innovation. Thus, it can guide business managers and HR professionals in developing frameworks that effectively address environmental concerns and improve green innovation.

The remainder of the paper proceeds as follows: Section 2 formulates the theoretical background and hypotheses; Section 3 presents the research methodology; Sections 4 and 5 discuss the findings, their implications, and results; and Section 6 offers conclusions, acknowledges limitations, and suggests future research avenues.

Theory and hypotheses

Green HRM and green innovation

Green HRM—the integration of HR and environmental management—plays a transformative role in shaping organisations' approach to sustainability (Paillé et al., 2020). Tahir et al. (2024) conducted a comprehensive bibliometric analysis of 242 top-tier articles on businesses' environmental performance, and suggested that management should embrace green HRM practices for better environmental performance. Hence, by integrating environmental principles into core HR practices—recruitment, training, performance management, and rewards (Renwick et al., 2013)—green HRM enables organisations to cultivate a workforce that is committed to sustainability, aware of environmental issues, and actively engaged in developing innovative solutions to address them (Song et al., 2021). Chen and Chang (2013) and Singh et al. (2020) informed that green HRM predominantly affects green innovation through environmentally aware recruitment and selection procedures. Organisations can build teams of employees who are naturally inclined towards innovative thinking in green domains by hiring individuals with strong environmental consciousness and expertise in sustainable practices (Fu et al., 2015; Pham & Paillé, 2020). Additionally, training and development—critical components of green HRM—significantly impact green innovation (Pinzone et al., 2016). Organisations investing in green training programmes equip employees with the skills and knowledge required to contribute to sustainability initiatives (Renwick et al., 2013). Such training programmes raise awareness, and empower employees to identify and implement innovative solutions that reduce environmental impact (Pinzone et al., 2019, 2016).

Singh et al. (2020) and Niazi et al. (2023) emphasised the importance of performance management, and asserted that performance management systems aligned with environmental goals play a crucial role in driving green innovation. Organisations can encourage employees to prioritise green initiatives by integrating sustainability metrics into performance evaluations (Renwick et al., 2013). When employees know their contributions to environmental objectives are recognised, they are more likely to engage in innovative activities (Singh et al., 2020). In a similar vein, Miao and Cao (2019) and Shafaei and Nejati (2024) noted that recognition and rewards for contributions to environmental goals serve as powerful incentives for employees to engage in innovative thinking.

The relationship between green HRM and green innovation can also be understood through the NRBV and AMO theories. NRBV emphasises the importance of leveraging a firm's natural and organisational resources to gain a sustainable competitive advantage (Hart, 1995). Green HRM practices enhance employees' eco-consciousness and skills, fostering a workforce capable of driving green innovation (Singh et al., 2020). Organisations can effectively develop competencies to create innovative green products, processes, and technologies by adopting environmentally sustainable HRM approaches (Niazi et al., 2023). The AMO framework complements this relationship by explaining how green HRM fosters green innovation through employees. It suggests that organisational performance is enhanced when employees have the ability, motivation, and opportunity to contribute effectively (Appelbaum et al., 2000). Green HRM builds ability by equipping

employees with green skills and knowledge through targeted training and development programmes (Pinzone et al., 2019). Motivation is enhanced by linking green behaviours to rewards, recognition, and career advancement, that encourage employees to actively participate in green initiatives (Miao & Cao, 2019; Shafaei & Nejati, 2024). Additionally, green HRM creates opportunities for employees to engage in sustainable practices (Renwick et al., 2013). Thus, green HRM serves as a critical enabler for green innovation by integrating NRBV's emphasis on sustainable resource utilisation with AMO's focus on individual capabilities and engagement.

With regard to empirical research, several previous studies focusing on HRM found that it had a positive relationship with technological and product innovation (Jimenez-Jimenez & Sanz-Valle, 2008; Lin & Sanders, 2017; Verbarg et al., 2007; Wei et al., 2011), but did not have a significant correlation with administrative and process innovation (Seeck & Diehl, 2017). However, Singh et al. (2020) found a scarcity of research on green HRM and green innovation. Hence, scope exists to extend this line of research, and explore the relationship between green HRM and green innovation. As such, this study conjectures the following hypothesis:

Hypothesis 1. Green HRM is positively related to green innovation.

Moderating roles of environmental strategy

Green HRM has emerged as a critical practice in organisations striving to integrate sustainability into their operations (Renwick et al., 2013). Tian et al. (2023) surveyed a sample of 286 Bangladeshi SME managers and found that green transformational leadership substantially affects organisations' green innovation and environmental performance. Likewise, Mo et al. (2025), who surveyed employees in Chinese and US tourism and hospitality industries found that green HRM and environmentally specific transformational leadership positively interact to shape teams' green behaviour. However, the effectiveness of green HRM in driving green innovation fluctuates across organisations, and depends on the presence of an environmental strategy (Song et al., 2021). The interplay between green HRM, green innovation, and environmental strategies creates a dynamic framework that allows firms to maximise the potential of their sustainability efforts (Aftab et al., 2023; Song et al., 2021).

Green innovation involves both, technological advancements and organisational changes, to achieve sustainability goals (Singh et al., 2020). While green HRM provides the foundation for cultivating an environmentally conscious workforce, green innovation is the outcome of organisational efforts to integrate sustainability into operations (Niazi et al., 2023). Despite the significant potential of green HRM to drive green innovation, its success depends on the organisation's strategic orientation (Aftab et al., 2023). An environmental strategy provides the direction and framework to guide green HRM practices towards meaningful outcomes (Albino et al., 2009). Without a clear strategy, green HRM initiatives may lack coherence and fail to deliver the desired results. An environmental strategy reflects the organisation's commitment to sustainability and ensures that efforts across different functions are aligned with broader environmental objectives (Albino et al., 2009; Bansal & Roth, 2000). Moreover, environmental strategies foster a sense of purpose and direction among employees. Zhao et al. (2020) contended that organisations who adopt proactive environmental strategies create a supportive context for green HRM practices. Mustafa et al. (2022) also argued that when employees perceive their organisations as genuinely committed to environmental sustainability, they are more likely to engage in green behaviours and contribute to innovative solutions. This sense of purpose enhances motivation, and encourages employees to go beyond their formal roles to support their organisations' sustainability agenda. Thus, an environmental strategy acts as a catalyst, amplifying the impact of green HRM on green innovation.

Conversely, the absence of an environmental strategy can undermine

the effectiveness of green HRM. Aftab et al. (2023) studied 410 manufacturing firms, and their results suggested that without a clear strategy, green HRM initiatives are perceived as superficial or disconnected from organisations' core objectives. This lack of alignment can lead to scepticism among employees, reducing their willingness to participate in green initiatives. Furthermore, Mustafa et al. (2022) and Aftab et al. (2023) contended that without strategic guidance, organisations may struggle to measure the impact of green HRM on green innovation, making it difficult to identify areas for improvement. Thus, environmental strategies enhance the coherence, impact, and effectiveness of green HRM practices, fostering a culture of innovation and sustainability.

The NRBV and AMO theories also reveal how environmental strategies act as a key element in maximising green HRM's capacity to foster green innovation. The NRBV (Hart, 1995) emphasises the importance of integrating sustainability into organisational strategies to build capabilities that enhance competitive advantage. Environmental strategies align organisational practices with sustainability goals, ensuring that green HRM efforts are directed towards fostering green innovation (Aftab et al., 2023). Organisations can develop a cohesive framework, through environmental strategies, that leverage internal resources—such as an environmentally conscious workforce—to achieve innovation that reduces environmental impacts (Mustafa et al., 2022). From the AMO perspective, green HRM enhances employees' abilities, motivation, and opportunities to contribute to green innovation. Green recruitment and training improve employees' knowledge and skills (ability); green performance management and rewards boost their intrinsic and extrinsic drive (motivation); and green engagement initiatives provide platforms to act on green innovation (opportunity) (Appelbaum et al., 2000; Rizvi & Garg, 2021; Singh et al., 2020). Therefore, this study formulates the following hypothesis:

Hypothesis 2. Environmental strategies moderate the relationship between green HRM and green innovation.

Green HRM, green culture, and green innovation

Green HRM and green culture

Research supports the notion that green HRM leads to improved environmental performance. For example, Correia et al. (2024) surveyed a sample of 400 respondents from Pakistan's government and non-government hospitals, and their results showed a positive relationship between green HRM practices and sustainable performance. Likewise, Roscoe et al. (2019) surveyed 204 employees at Chinese manufacturing firms, and found that green HRM plays a critical role in fostering and nurturing a green culture within organisations, which ultimately results in enhanced environmental performance. An organisation's green culture is characterised by its members' values, beliefs, and behaviours, that show a deep care for the environment (Roscoe et al., 2019). Values are what organisational members consider moral and ethical for the environment (Harris & Crane, 2002). Beliefs represent organisational members' perceptions of what is deemed right or wrong, as well as considered acceptable or unacceptable in relation to the environment (Roscoe et al., 2019). Chang (2015) asserted that organisational members' shared values and beliefs shape their actions towards the environment. Green HRM helps to align employee behaviours and organisational goals towards a shared commitment to sustainability by integrating environmental sustainability into HR practices (Hooi et al., 2022). This integration enhances environmental outcomes and fosters a culture where eco-consciousness becomes a core organisational value.

Green HRM fundamentally incorporates sustainability into the conventional practices of HRM. Renwick et al. (2013) highlighted that green HRM ensures that environmental considerations are prioritised and aligned with organisational goals right from recruitment to performance management. Furthermore, Pham and Paillé (2020) suggested that the recruiting process can be customised to attract individuals, who

prioritise sustainability and fit with organisations' environmental goals. Training and development are other critical areas where green HRM can influence green culture. Pinzone et al. (2019) pointed out that green HRM empowers individuals to make eco-conscious decisions in their roles by designing programmes that enhance employees' understanding of environmental issues, and equipping them with skills to implement sustainable practices. Renwick et al. (2013) and Pinzone et al. (2019) argued that the focus on training and education fosters a mindset where employees naturally consider environmental impacts in their everyday tasks, strengthening their organisations' green culture.

Performance management systems under green HRM also play a significant role in cultivating a green culture. Harris and Crane (2002) and Roscoe et al. (2019) asserted that organisations can encourage employees to prioritise sustainability by incorporating environmental goals and achievements into performance evaluations, and rewarding them for green initiatives to reinforce the importance of environmental stewardship, and motivate them to innovate and find creative solutions to sustainability challenges. Thus, green HRM creates a workplace where eco-consciousness is deeply integrated into the organisational culture.

Prior research (Amini et al., 2018; Dyllick & Hockerts, 2002; Roscoe et al., 2019) has also found a positive correlation between green HRM and green culture, indicating that organisations with better green HRM can generate a better green culture. The NRBV and AMO theories also provide theoretical frameworks for understanding the relationship between green HRM and green culture. The NRBV highlights leveraging organisational resources for sustainable competitive advantage, which green HRM supports through eco-friendly practices (Hart, 1995; Singh et al., 2020). Green culture complements this by embedding environmental responsibility into organisational values, thereby promoting eco-innovation (Roscoe et al., 2019). The AMO explains how green HRM enhances employees' abilities, motivates sustainable behaviours, and provides opportunities for environmental initiatives (Appelbaum et al., 2000; Rizvi & Garg, 2021). Thus, green HRM and green culture operationalise the NRBV and AMO frameworks, fostering employee alignment with sustainability goals, and driving organisational commitment to environmental stewardship. Therefore, based on the above discussion, this study hypothesises that:

Hypothesis 3. Green HRM positively influences green culture.

Organisational green culture and green innovation

Green culture is crucial in driving green innovation, serving as a key element that promotes sustainable practices (Wang, 2019). Organisations' cultural orientation influences how innovation is conceived, developed, and implemented, establishing a framework that makes green innovation a norm rather than an exception (Pellegrini et al., 2018). Roscoe et al. (2019) conducted a large-scale survey of 204 employees at Chinese manufacturing firms, and their findings suggested that green culture promotes the incorporation of environmental factors into all decision-making processes, ranging from individual behaviour to business plans. Likewise, Paillé et al. (2013) found that green culture encourages the adoption of practices that reduce ecological footprints and mitigate environmental degradation. In a similar vein, Temminck et al. (2015) highlighted the significance of green culture, noting its necessity in promoting green innovation as it aligns incentives and motivations towards developing technologies, products, and processes that minimise environmental harm. Moreover, Porter and Van der Linde (1995) and Pellegrini et al. (2018) contended that organisations with a strong green culture are more likely to invest in research and development aimed at creating sustainable solutions, such as energy-efficient manufacturing processes.

O'Regan and Ghobadian (2005) asserted that innovation is driven by a company's culture, leadership, and strategic planning, noting that organisations exhibiting a high degree of innovation have a more clearly defined culture than those with lower levels of innovation. As such,

well-defined environmental culture and policies can facilitate green innovation within an organisation (Porter & Van der Linde, 1995; Wang, 2019). Özsomer et al. (1997) further posited that organisational green culture affects managers' attitudes towards green innovation. Managers in organisations whose culture is aligned with environmental preservation are more likely to implement environmental protection policies, enhancing organisational green innovation. Hence, Özsomer et al. (1997) and Temminck et al. (2015) contended that green culture in organisations fosters a sense of responsibility among employees and managers, encouraging them to engage in innovative thinking around sustainability challenges and green innovation. As such, this study posits:

Hypothesis 4. Organisational green culture positively influences green innovation.

The mediating role of organisational green culture

Organisations worldwide are increasingly integrating sustainable practices into their operations to address environmental challenges, and two significant components of this shift are green HRM and green innovation (Singh et al., 2020). A critical factor connecting these two dimensions is green culture, which ensures the effective translation of green HRM initiatives into impactful green innovations (Hooi et al., 2022; Wang, 2019). Green HRM encompasses various activities to foster sustainability-oriented behaviour among employees. These include: recruiting environmentally conscious individuals, sustainability-focused training, performance appraisals emphasising green goals, and reward systems recognising eco-friendly contributions (Amini et al., 2018; Renwick et al., 2013). However, without a supportive organisational culture, the potential of these green HRM practices might remain unexploited. Green culture shapes how employees perceive environmental issues and respond to organisational initiatives aimed at sustainability (Roscoe et al., 2019). When organisations foster a strong green culture, they create an environment where employees feel motivated and empowered to pursue sustainability-driven ideas (Pellegrini et al., 2018; Temminck et al., 2015). This cultural orientation bridges green HRM practices and green innovation by aligning employees' values with their organisations' environmental goals.

Paillé et al. (2013) and Roscoe et al. (2019) asserted that developing a sense of shared purpose is one of the key ways in which green culture supports the relationship between green HRM and green innovation. Hooi et al. (2022) collected data from 240 firms in Taiwan, and their findings indicated that when employees recognise their organisations' commitment to environmental sustainability, they are more likely to internalise and incorporate environmental sustainability into their daily activities. Likewise, Rizvi and Garg (2021) found that green culture influences employees' intrinsic motivation to engage in sustainable practices. Moreover, Attaiyane (2012), Pellegrini et al. (2018), and Shafaei and Nejati (2024) argued that while green HRM practices can provide external incentives, such as rewards and recognition, a supportive green culture nurtures employees' internal drive to innovate for sustainability.

The NRBV and AMO also explain the role of green culture between green HRM and green innovation. The NRBV highlights the strategic value of organisational resources, particularly those related to sustainability, in attaining a competitive edge, whereas green HRM practices develop HR that align with environmental goals (Hart, 1995; Roscoe et al., 2019). However, these practices achieve their full potential only when supported by a strong green culture (Roscoe et al., 2019). Hence, green culture acts as an intangible resource, integrating shared environmental values and norms into the organisational fabric (Hooi et al., 2022). This cultural orientation ensures that the resources developed through green HRM are directed effectively towards eco-friendly innovation (Hooi et al., 2022; Wang, 2019). The AMO (Appelbaum et al., 2000) complements this by explaining how green culture enhances employees' ability, motivation, and opportunities to innovate. While green HRM equips employees with skills and external incentives, green

culture nurtures intrinsic motivation, and creates opportunities to foster an environment where employees are empowered to apply their abilities to develop innovative and sustainable solutions (Appelbaum et al., 2000; Rizvi & Garg, 2021; Singh et al., 2020). Therefore, this study hypothesises:

Hypothesis 5. Green culture mediates the relationship between green HRM and green innovation.

Fig. 1 presents the hypothesised structural relationships amongst green HRM, green culture, environmental strategy, and green innovation.

Research methodology

Sample and procedure

To test this study's proposed hypotheses, a survey was administered in 2023 among full-time Australian employees using Qualtrics—a renowned third-party web-based survey administration platform—that has experienced an increase in interest and usage owing to its cutting-edge computer technology, and the obvious convenience it offers compared to traditional mail-based surveys (Shafaei & Nejati, 2024; Vlachos et al., 2014). In Qualtrics, a cover letter was included with the survey questions that explained the study's purpose, and assured participants of the anonymity of their responses. The anonymous responses feature of Qualtrics was enabled to distribute surveys anonymously. To mitigate non-response bias, incentives were offered, questions were kept concise, and confidentiality was guaranteed. Thus, a random sample of 250 valid responses from full-time Australian employees was collected through Qualtrics to attain this study's objectives.

The demographic details are shown in Table 1. The respondents included 123 (49.2 %) male and 116 (46.4 %) female employees, with 30.4 % aged between 21 and 30 years. In terms of education, many respondents were well-educated and possessed professional skills; more than half of the respondents had graduate qualifications (Master's: 13.6 %; Bachelor's: 38.4 %). Regarding position and tenure, 57.6 % held non-managerial posts and 56.4 % had more than five years of service with their respective organisations.

To address common method bias, data were collected from multiple sources, including managers and non-managers (Al-Hawari et al., 2021). Additionally, average full collinearity variance inflation factor (AFVIF) was used to test for common method biases (CMB), wherein AFVIF was found to be in the acceptable range (<3.3) (Kock, 2017), indicating that the CMB was not an issue in the dataset.

Measures

The study used a 49-item Likert scale ranging from 1 (strongly

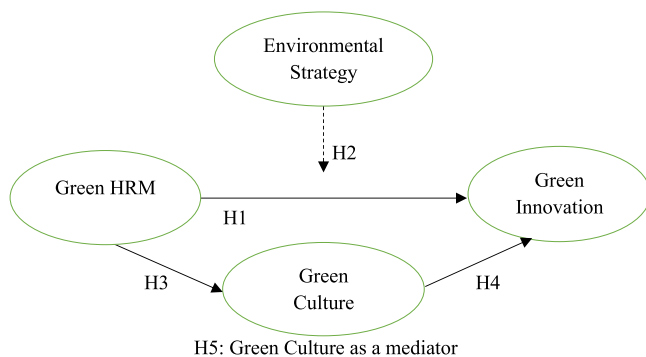


Fig. 1. Hypothesised model.
Source: Author's own work.

Table 1
Demographic data of respondents.

Demographic data (N = 250)	Frequency	Percentage (%)
Sector		
Manufacturing	54	21.6 %
Service	176	70.4 %
Other	20	8.0 %
Gender of respondents		
Male	123	49.2 %
Female	116	46.4 %
Not disclosed/others	11	4.4 %
Age (years)		
Below 20	8	3.2 %
21–30	76	30.4 %
31–40	59	23.6 %
41–50	58	23.2 %
51–60	40	16.0 %
Above 61	9	3.6 %
Education		
Doctoral	6	2.4 %
Master's	34	13.6 %
Bachelor's	96	38.4 %
Graduate certificate or graduate diploma	40	16.0 %
Diploma or associate degree	49	19.6 %
High school or below	22	8.8 %
Others	3	1.2 %
Tenure in the current organisation		
Up to 5 years	109	43.6 %
6–10 years	81	32.4 %
>10 years	60	24.0 %
Current role		
Managerial	106	42.4 %
Non-Managerial	144	57.6 %

Source: Author's own work.

disagree) to 5 (strongly agree) to measure the key concepts of green HRM, environmental strategy, green culture, and green innovation. All items were derived from prior literature, and adjusted to suit the current context, informed by comments from three academics and two HR professionals. The questionnaire underwent pilot testing on a sample of 10 individuals, comprising 5 managers and 5 non-managers, prior to its administration to the respondents.

Green HRM

The 19 items employed to measure green HRM were drawn from existing scales by Pham et al. (2019) and Saeed et al. (2019). While green recruitment (five items) and green rewards (four items) were adapted from Saeed et al. (2019), green performance management (five items) and green training (five items) were adapted from Pham et al. (2019). The sample items include: 'In my organisation, job description specification includes environmental concerns', 'My organisation rewards environmental achievements (leave, gifts, bonuses, cash, premiums, promotion)', 'Every employee has an opportunity to receive environmental training in my organisation', and 'My organisation conveys key environmental performance indicators clearly'. The Cronbach's alpha for green recruitment, green training, green performance management, and green rewards were 0.896, 0.918, 0.946, and 0.862, respectively (Table 2).

Environmental strategy

Seven items from the studies by Banerjee et al. (2003) were adapted to measure environmental strategy. The sample items include: 'Our firm has integrated environmental issues into our strategic planning process' and 'Our firm is engaged in developing products and processes that minimise environmental impact'. The scale's reliability (Cronbach's α) for environmental strategy was 0.824.

Green culture

Green culture was measured using a 16-item scale adapted from Roscoe et al. (2019). Sample items include 'Leaders encourage

Table 2
Measurement model.

Variables	Indicators	Standard factor loading	Cronbach's α
Green HRM			
<u>Green recruitment</u>			0.896
In my organisation, job description specification includes environmental concerns.	GHRM1	0.742	
My organisation selects applicants who are sufficiently aware of greening to fill job vacancies.	GHRM2	0.794	
My organisation includes environmental criteria in the recruitment messages.	GHRM3	0.864	
My organisation considers candidates' environmental concerns and interests as selection criteria.	GHRM4	0.861	
When interviewing candidates or evaluating them for selection, my organisation asks environment-related questions.	GHRM5	0.844	
<u>Green training</u>			0.918
Every employee has an opportunity to receive environmental training in my organisation.	GHRM6	0.834	
My organisation provides environmental training frequently.	GHRM7	0.908	
My organisation offers appropriate environmental training programmes.	GHRM8	0.872	
My organisation evaluates employees' performance after environmental training.	GHRM9	0.894	
My organisation incorporates environmental training programmes in the yearly training calendar.	GHRM10	0.866	
<u>Green performance management</u>			0.946
My organisation conveys key environmental performance indicators clearly.	GHRM11	0.838	
My organisation assesses employees' environmental contributions to the organisation's environmental performance.	GHRM12	0.904	
My organisation provides regular feedback on environmental performance to employees.	GHRM13	0.891	
Environmental performance is one of the criteria in employee performance appraisal.	GHRM14	0.886	
Roles of managers in achieving environmental outcomes are included in performance appraisals	GHRM15	0.892	
<u>Green reward</u>			0.862
My organisation rewards environmental achievements (leave, gifts, bonuses, cash, premiums, promotion.)	GHRM16	0.826	
My organisation recognises green initiatives publicly.	GHRM17	0.747	
My organisation provides incentives to encourage environmentally friendly activities and behaviours (e.g. recycling and waste management).	GHRM18	0.714	
My organisation rewards green skills acquisition	GHRM19	0.871	
Environmental Strategy			0.824
Our firm has integrated environmental issues into our strategic planning process.	ES1	0.826	

Table 2 (continued)

Variables	Indicators	Standard factor loading	Cronbach's α
In our firm, quality includes reducing the environmental impact of products and processes.	ES2	0.884	
At our firm, we make every effort to link environmental objectives with our other corporate goals.	ES3	0.744	
Our firm is engaged in developing products and processes that minimise environmental impact.	ES4	0.781	
Environmental protection is the driving force behind our firm's strategies.	ES5	0.823	
Environmental issues are always considered when we develop new products.	ES6	0.741	
Our firm develops products and processes that minimise environmental impact.	ES7	0.792	
Green Culture			0.901
Leaders encourage employees to learn green information.	GC1	0.816	
Leaders communicate the green and environmental policies with employees.	GC2	0.782	
Leaders can help me when faced with green problems.	GC3	0.774	
Leaders "walk the talk" on environmental issues and will review the green operations for progress.	GC4	0.718	
The information about environmental knowledge is delivered by respected sources.	GC5	0.744	
It is easy to understand company's green operations.	GC6	0.882	
Communications about green practices appeal to employees personally.	GC7	0.724	
Company has already applied some related green knowledge.	GC8	0.846	
It is easy to share green knowledge with my colleagues.	GC9	0.884	
We have group discussions about green topics routinely.	GC10	0.843	
Employees are encouraged to solve green issues together.	GC11	0.767	
Peers hold one another accountable for green issues.	GC12	0.736	
I clearly know how green operations fit with my daily job.	GC13	0.842	
I feel a shared sense of responsibility for the green issues at work.	GC14	0.743	
I have significant autonomy to make decisions regarding green issues.	GC15	0.721	
I have a voice for green violations.	GC16	0.824	
Green Innovation			0.862
<u>Green product innovation</u>			
Our firm uses materials that produce least pollution.	GI1	0.821	
consume less energy and resources.	GI2	0.802	
to design environment-friendly products.	GI3	0.784	
are easy to recycle, reuse, and decompose.	GI4	0.796	
<u>Green process innovation</u>			0.814
Our firm's business/production process effectively reduces... hazardous substances or waste.	GI5	0.771	
consumption of coal, oil, electricity or water.	GI6	0.804	
use of raw materials.	GI7	0.794	

Source: Author's own work. GHRM: green human resource management; GI: green innovation; GC: green culture; ES: environmental strategy.

employees to learn green information' and 'It is easy to understand the company's green operations'. The Cronbach's α for green culture was 0.901.

Green innovation

Seven items: four for green product innovation and three for green process innovation, were adapted from the studies by [Chen et al. \(2006\)](#) and [Singh et al. \(2020\)](#) to measure green innovation. The sample items include: 'Our firm uses materials that produce least pollution' and 'Our firm uses materials that are easy to recycle, reuse, and decompose'. The Cronbach alpha for green product and green process innovation was 0.862 and 0.814, respectively.

Results

The measurement model

The developed model was tested to determine whether the scales used to measure the multidimensional constructs were adequate. A first-order confirmatory model was assessed for goodness-of-fit, using multiple adjunct fit indices to validate the theoretical dimensions of the constructs. Consistent with the study by [Roscoe et al. \(2019\)](#) and [Awan et al. \(2023\)](#), green HRM and green innovation were conceptualised as one-factor models, and their psychometric properties were assessed by analysing the goodness-of-fit of alternative measurement models. Particularly, four models were constructed and tested: null, one-factor, two-factor, and three-factor. Based on the analysis results, the one-factor model showed the most satisfactory fit with the sampled population.

The standardised regression weights from the measurement models were evaluated for construct validity. The reliability of the variables was assessed using Cronbach's α . The psychometric properties of the first-order confirmatory factor model of green HRM, environmental strategy, green culture, and green innovation confirmed the validity and reliability of the constructs. As shown in [Table 2](#), the standardised regression weights were all higher than 0.5 ([Hair et al., 2019](#)), and Cronbach's α were >0.7 for all variables. [Table 3](#) illustrates Cronbach's α coefficients and the correlations between this study's focal constructs. The results show significant relationships between all the variables ($p < 0.01$).

Partial least squares structural equation modelling (PLS-SEM)

Smart PLS comprises two components: PLS and Consistent PLS (PLSc). The former represents a statistical approach known as PLS-SEM, while the latter refers to a simulated method called covariance-based (CB)-SEM. The two statistical methods are appropriate for different research purposes. The former uses the maximum potential variable to explain the variance, and its research purpose is to predict important target variables and exploratory research. The latter uses the covariance of the potential variable and theoretical model. The matrix's (covariance matrix) study goals include: theoretical testing, confirmation, and

substitution comparison, for which AMOS, EQS, LISREL, and Mplus statistical software are used for CB-SEM ([Hair et al., 2019](#)). Regardless of the statistical tools employed, limitations exist. Based on the aim of the analysis, only the most appropriate statistical tools may be used. Consequently, in accordance with its requirements and objectives, this study employed PLS-SEM in Smart PLS as its statistical analysis instrument.

As the next step, PLS-SEM was fitted to the data to test the proposed model. This study used the PLS-SEM algorithm in the Smart PLS 3.0 software to test the five hypotheses. PLS-SEM was the preferred technique owing to the limited sample size ($N = 250$). Since all this study's constructs were reflective in nature, consistent PLS was employed as the assessment technique. [Figs. 2a](#) and [2b](#), and [Table 4](#) show the results of the five hypotheses tested using SEM analysis. The process involves analysing the effects of green HRM on green innovation (Hypothesis 1) and green culture (Hypothesis 3); green culture on green innovation (Hypothesis 4); the mediating role of green culture in the green HRM-green innovation relationship (Hypothesis 5); and the moderating effect of environmental strategy on the green HRM-green innovation relationship (Hypothesis 2). The final path model yielded a test statistic of $\chi^2 = 37.604$, $df = 23$ ($p = 0.00$). The root mean square error of approximation index is 0.046 for this model, with a 90 % confidence interval (CI) between 0.044 and 0.074, indicating an acceptable fit of the model to the data. Model fit is confirmed through the root mean square residual, as suggested by [Crespo and Inacio \(2019\)](#). According to [Henseler et al. \(2014\)](#), a model is of good fit if its value is <0.08 . Other indices of fit were also found to be acceptable: NFI = 0.903 ([Ringle et al., 2020](#)). Thus, all the hypotheses were confirmed. The final model is illustrated in [Figs. 2a](#) and [2b](#).

The findings from the path model indicate a clear pattern of direct effects that support this study's hypotheses. As shown in [Figs. 2a](#) and [2b](#), and [Table 4](#), green HRM had a significant positive effect on green innovation (0.662***), which supports Hypothesis 1. Green HRM had a significant positive direct relationship with green culture (0.816***), which supports Hypothesis 3. Green culture had a significant positive effect on green innovation (0.791***), which supports Hypothesis 4.

The moderating effect

A moderated multiple regression analysis was performed to assess the moderating effect of environmental strategy on the relationship between green HRM and green innovation. The results in [Table 4](#) show that adding the interaction terms of green HRM and environmental strategy to the regression increase explained variance significantly. Specifically, the interactive effect of green HRM and environmental strategy on green innovation was significant ($\beta = 0.746$, $p < 0.001$). Thus, Hypothesis 2 was confirmed, indicating that environmental strategy moderated the effect of green HRM on green innovation. [Cohen et al. \(2013\)](#), [Hair et al. \(2019\)](#), and [Hooi et al. \(2022\)](#) underlined that collinearity is less likely to occur when VIF is <10 . Therefore, the VIF values in [Table 4](#) suggest that the variables' collinearity is not an issue.

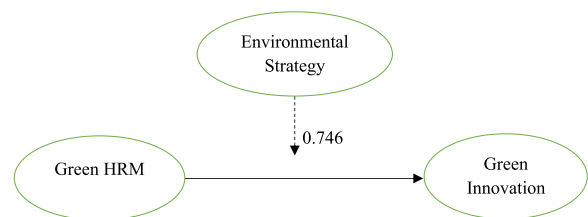


Fig. 2a. Path analysis for the moderating effect of the environmental strategy. **Source:** Author's own work. Note(s): Path coefficients are standardised partial regression coefficients estimated by maximum likelihood. Ellipses represent latent variables. *** $p < 0.001$. HRM: human resource management.

Table 3
Correlations and Cronbach's α of the construct-related variables.

Variables	1	2	3	4
Green values	0.914			
Green HRM	0.782**	0.892		
Environmental performance	0.464**	0.468**	0.773	
Green transformational leadership	0.376**	0.386**	0.639**	0.892

Note(s): $N = 250$. Internal consistency estimates (coefficient alpha) are presented in the diagonal ** $p < 0.01$

Source: Author's own work. HRM: human resource management.

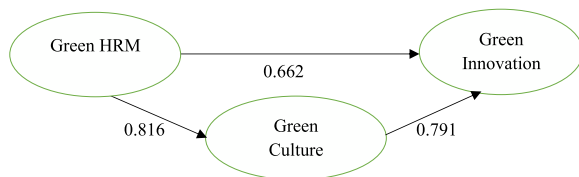


Fig. 2b. Path analysis for the mediating effect of the green culture.

Source: Author's own work. Note(s): Path coefficients are standardised partial regression coefficients estimated by maximum likelihood. Ellipses represent latent variables. *** $p < 0.001$. HRM: human resource management.

The mediating effect – bootstrapping

A mediated bootstrapping analysis was performed to assess the mediating effect of green culture on the relationship between green HRM and green innovation. Results from the bootstrapping analysis support Hypothesis 5. Table 4 illustrates that the indirect effect measures, as per Hooi et al. (2022), demonstrate a mediating effect of green culture on the relationship between green HRM and green innovation, with a 97.5 % CI of [0.714, 0.826]. CI did not contain 0, and CIs showed no overlap. Hence, the mediation through green culture was significant for the relationship between green HRM and green innovation.

Discussion

This study was conducted to investigate the impact of green HRM on green innovation in businesses. The investigation also focused on green culture as an underlying mechanism, and evaluated environmental strategies as a boundary condition. Utilising the theoretical foundations of the NRBV and AMO theories, green culture was hypothesised as a mediating mechanism explaining the impact of green HRM on green innovation, while environmental strategy was posited as a moderating factor that could enhance the effects of green HRM on green innovation. The results of this study substantiate all of the hypothesised relationships.

This study has extended past studies by Aftab et al. (2023), Chen and Chang (2013), Mustafa et al. (2022), Singh et al. (2020), Song et al. (2021), and Zhao et al. (2020) on how green HRM affects green innovation, alongside the moderating role of environmental strategies that increase the effects of green HRM on green innovation. In line with these prior studies, it also suggests that green HRM positively impacts green culture (see examples of Amini et al., 2018; Dyllick & Hockerts, 2002; Roscoe et al., 2019), which in turn, enhances organisations' green innovation (see examples of O'Regan & Ghobadian, 2005; Porter & Van der Linde, 1995; Wang, 2019). Additionally, the results have extended past studies by Hooi et al. (2022), Pellegrini et al. (2018), and Rizvi & Garg (2021), where green culture mediates the effect of green HRM on organisations' green innovation.

Implications for managers, theory, and policy

Managerial implications

The positive relationship between green HRM and green innovation emphasises the strategic value of integrating environmental practices

into HRM. For managers, this relationship highlights the importance of cultivating a culture that promotes sustainability through effective recruitment, training, performance management, and rewards. Managers can attract talent with a strong commitment to sustainability by integrating environmental criteria into hiring practices, which lays the foundation for innovative green practices. Green HRM initiatives—such as sustainability-focused training and development programmes—equip employees with the skills and knowledge to develop eco-friendly solutions. Managers play a critical role in designing these programmes and ensuring alignment with organisational goals. Furthermore, incorporating green metrics into performance appraisals and rewards systems motivates employees to actively contribute to green innovation efforts. Thus, the relationship between green HRM and green innovation reminds managers to view sustainability as a core strategic priority, supporting HRM practices with broader environmental objectives to drive long-term success.

The moderating role of environmental strategy between green HRM and green innovation emphasises the critical importance of aligning HRM practices with organisations' strategic commitment to sustainability. For managers, this suggests that a well-defined environmental strategy amplifies the effectiveness of green HRM practices in fostering green innovation. Managers must ensure that environmental objectives are articulated and integrated into their organisation's strategic framework. When environmental strategies serve as a guiding principle, it creates coherence between HRM practices and innovation efforts. Managers can leverage this association to design HRM policies that support sustainability goals, such as recruiting employees with green competencies, offering targeted training programmes, and incentivising eco-friendly behaviours. Thus, a robust environmental strategy provides clarity and direction, ensuring that green HRM initiatives are purpose-driven and contribute directly to innovative outcomes.

The mediating role of green culture between green HRM and green innovation highlights the importance of cultivating an organisational environment where sustainability is deeply integrated into values, norms, and behaviours. For managers, this study's findings suggest that implementing green HRM practices alone may not yield significant green innovation outcomes without fostering a supportive green culture. Green culture acts as a bridge that transforms green HRM initiatives into innovative practices. Managers must promote sustainability as a shared organisational value, and integrate it into everyday operations and decision-making. When employees perceive green practices to align with organisational culture, they are more likely to embrace and contribute to innovative environmental solutions. Thus, managers can facilitate the effective transformation of green HRM practices into sustained green innovation by incorporating green culture into an organisation.

Theoretical implications

The findings provide important theoretical implications to both the NRBV and AMO frameworks. From the perspective of NRBV, the results show that environmental strategy enhances the ability of organisations to convert green HR practices into valuable and rare resources that stimulate green innovation. This highlights the notion that environmental strategies serve as higher-level capabilities, which enable firms to more effectively utilise internal resources in ways that strengthen

Table 4
Path analysis using PLS-SEM (bootstrapping).

Path	Estimates	T statistics	Sig	Standard error	VIF	Confidence Interval 2.5 % 97.5 %	
Green HRM → Green culture	0.816***	38.864	0.000	0.019	4.260	0.824	0.918
Green culture → Green innovation	0.791***	32.642	0.000	0.022	2.884	0.817	0.904
Green HRM → Green innovation	0.662***	26.428	0.000	0.030	2.640	0.714	0.826
Environmental strategy (moderating effect)	0.746***	3.617	0.000	0.038	-	-	-

Note(s): *** $p < 0.001$ R-square: Green culture = 0.662***; Green innovation = 0.624***; Environmental strategy = 0.673***

Source: Author's own work. HRM: human resource management; PLS-SEM: partial least squares structural equation modelling; VIF: variance inflation factor.

their sustainable competitive advantage through innovation. Moreover, the moderating effect of environmental strategy highlights the interdependence between strategic orientation and internal practices, which emphasises the critical importance of alignment between the two for achieving innovation outcomes. From the AMO perspective, this study shows that green HRM has a direct positive impact on employees' abilities, motivation, and opportunities to contribute to green innovation. The mediating effect of green culture emphasises the role of shared values and organisational norms as key mechanisms that convert individual-level contributions into collective innovation outcomes. Thus, the integration of NRBV with AMO shows how green HRM practices, environmental strategy, and organisational green culture work together at different levels to drive green innovation.

Policy implications

The findings suggest policy directions that prioritise fostering green HRM practices to drive green innovation. Policymakers should encourage organisations to embed environmental strategies, as these strategies strengthen the effectiveness of green HRM initiatives. Additionally, promoting the development of strong green cultures can strengthen indirect pathways to innovation. Hence, integrated policies that align green HRM, green culture, and environmental strategy are essential for advancing organisational sustainability and fostering long-term competitive advantage through green innovation.

Conclusions, limitations, and future research directions

Conclusions

This study was conducted to understand the effects of green HRM on green innovation in organisations. It analysed the moderating role of environmental strategy, and mediating effects of green culture on the relationship between green HRM and green innovation. A set of hypotheses was formulated based on the theoretical frameworks of the NRBV and AMO theories with the existing literature, to determine the relationships amongst the model constructs. A multisource survey of Australian employees was employed to assess the proposed hypotheses, and the PLS-SEM approach was used to test the hypotheses. The results inform that environmental strategy serves as a moderator that enhances the effects of green HRM on green innovation, and that green HRM has a significant positive impact on green innovation. They also indicate that via the mediating effects of green culture, green HRM has an indirect positive impact on green innovation. Thus, this study contributes to the existing literature by showing that organisations' green HRM, environmental strategies, and green culture are crucial for fostering green practices and advancing green innovation in organisations.

Limitations and future research directions

This study, like most others, has inherent limitations, and cannot be considered in isolation. It used surveys as its data collection method, but the self-reported responses to the surveys may compromise the reliability of its findings owing to the respondents' various levels of experience and education as managers and non-managers. Therefore, future research could implement a mixed-methods approach incorporating surveys and interviews to provide a comprehensive understanding of the phenomena. Moreover, this study was cross-sectional in nature, as the data were collected at a single point in time. Consequently, a longitudinal study could offer a more comprehensive understanding of the relationships among organisations' green HRM, environmental strategy, green culture, and green innovation. Furthermore, investigating various nations would facilitate the validation of the results, and provide organisations with a strategic roadmap for achieving their sustainability-related goals.

CRedit authorship contribution statement

Mehadi Mamun: Writing – review & editing, Writing – original draft.

Declaration of competing interest

The author declares that he does not have any competing financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jik.2025.100897](https://doi.org/10.1016/j.jik.2025.100897).

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