

Promoting pro-green behavior towards sustainable excellence: Unveiling the path from strategic Green HRM practices and green innovation to sustainable performance

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ABSTRACT

Over the last few years, sustainable practices have become increasingly important. Green practices must be identified as effective ways to boost sustainability. This study explores the impact of strategic GHRM practices on the sustainable performance of manufacturing firms in Malaysia. In addition, green innovation plays a mediating role between GHRM and sustainable performance. Survey questionnaires were administered to Malaysian manufacturing firms. There were 310 questionnaires completed by respondents, which were deemed suitable for data analysis. SPSS 23 and Smart PLS 4 analyzed the data. This study found that “green” processes within the organization create an environmentally friendly atmosphere. Sustainable performance was positively impacted by green HR practices. Furthermore, the relationship between GHRM and sustainable performance is further mediated by green innovation. This notion can help developing nations’ manufacturing industries create cleaner business processes. In addition to theoretical knowledge, the outcomes may help management achieve their environmental goals while sustaining them.

1. Introduction

With the ever-growing environmental challenges and resource constraints plaguing the world economy, the Asia Pacific region cannot remain an exception (Wu & Lin, 2022). Nevertheless, these challenges have also significantly increased awareness of environmental sustainability, which in turn, has triggered the need for nations to bring out significant reforms in policies to streamline economic growth, sustainably. Green human resource management (GHRM) is becoming a strategic instrument of promoting sustainable performance in manufacturing, where the intensity of resources, regulatory attention, and stakeholder pressure meet. GHRM instills the ability and motivation that transforms environmental intent into actual operation by integrating environmental criteria into staffing, training, performance appraisal, rewards, and participation of employees. It has been demonstrated that GHRM improves sustainability not only directly but also via strong mediating relationships, which are green innovation, green culture, and pro-environmental employee behaviors, that assist companies in cutting emissions, waste, and energy consumption and improving quality and cost performance (Awwad Al-Shammari et al.,

2022; Shahzad et al., 2023). These effects are reinforced by complementary enablers like risk management to align green practices with compliance and resilience to assure that process and product innovations are scaled safely and reliably (Correia et al., 2024).

In addition, the effects of GHRM also depend on people-side factors: the more employees are motivated to be green, the more the translation of HR policies into day-to-day practices is enhanced, and continuous improvement of environmental, social and economic measures is strengthened (Alhashmi et al., 2025). Collectively, the recent research findings are converging to the opinion that GHRM is a form of human-capital-based capability that will contribute to corporate sustainability performance in manufacturing by mobilizing innovation, forming culture and behaviors. Dost et al. (2019) indicated that distributing ‘green ideology’ and sustainable practices cross-functionally across an organization per se, may be helpful to solve several plaguing problems. However, it may be noted that it isn’t easy for an organization to adopt and implement environmental management systems and sustainable practices into its daily operations, while maintaining cultural norms. In fact, the challenge lies in balancing socio-economic and environmental performance (Al-Ghazali & Afsar, 2021). In recent times, there have

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been a lot of discussions about how 'green management' can be applied in two crucial organizational processes: i.e. innovation and human resources (Roscoe et al., 2019).

In general, when talk about the concept of business sustainable performance, we can describe it as the process in which an organization is constantly trying to create value to its shareholders and stakeholders, taking into consideration the environmental requirements (Mousa & Othman, 2020). In connection with that, another argument by Savino and Shafiq (2018) stated that the Resource-Based View (RBV) theory would be incredibly applicable here since it is based on utilizing organizational resources to improve performance. According to Wernerfelt (1984), subsequent development by Barney (1991) and Helfat et al. (2023), the RBV holds that sustainable competitive advantage is enabled by resources and capabilities that are valuable, rare, inimitable, and organized (VRIO). The conceptualization of GHRM practices in this study is as strategic organizational resources that create green knowledge, skills and motivation among employees- hence creating green knowledge management capabilities. The employees who are the main possessors of these capabilities turn out to be the origin of sustained competitive advantage, and the green innovation (GI) is the organizational capability that converts these resources into an enhanced sustainable performance. That is, RBV supports our research model by conceptualizing GHRM as the input resource, green knowledge capability as the enabling mechanism, and GI as the capability output that contributes to long-term performance in accordance with the sustainability objectives. Therefore, organizations are required not only to recruit and retain high environment-skilled employees but also constantly invest in training and development to increase the green innovation capacity (Anwar et al., 2020). In sum, to become sustainable, governments and organizations must reinforce these VRIO-aligned resources and capabilities to minimize the destruction of ecosystems, climate risks, and sustain a long-term competitive advantage (Barbier, 2011; Patwary et al., 2022).

'Sustainability', 'Green Technology' (GT), 'Green HRM' (GHRM) in recent times, owing to their perceived benefits, has thereby gained considerable attention, specifically within the manufacturing industry. In fact, the concept of GHRM has become increasingly popular among academics, corporate leaders, and regulators. Ojo et al. (2022) defined the goal of GHRM as managing the environment by utilizing green technologies. GHRM is defined as the process of ensuring organizational workforce is competent, knowledgeable, and willing to support green practices in the course of achieving the company's sustainable goals in every aspect of HRM (Anwar et al., 2020). For instance, Chuang and Huang (2018) have defined green human resource management as a strategic approach of formulating, implementing and maintaining systems that promote environmental sustainability in people of an organization to create what they term as 'green' human capital.

According to Mousa and Othman (2020), a GHRM system involves all human resource management systems implemented to ensure a balanced approach to environmental sustainability. The goal of GHRM is to improve an organization's performance by strategically using resources, reducing waste, and preventing environmental pollution. Renwick et al. (2013) outlined GHRM as an elaborate eco-policy system that provides employees with more information about environmental activities to reduce an organization's carbon footprint to make it greener. Jabbour and Santos (2008) stated that organizations must reorient their employees and human resource management policies about the environment to effectively implement green practices. Notably, GHRM practices include compensation, recruitment and selection, performance management, training, and development (Saeed et al., 2019).

Beside that Chams and García-Blandón (2019) pointed out the relevance of HR operations in fostering a sustainable culture. They stated that an organization could only be sustainable, when its employees are involved both within the firm and outside of it in the community. Ricardo de Souza Freitas et al. (2011) believed that sustainability is only achieved by adhering to GHRM practices; it enables in developing a

strategy that effectively addresses the socio-economic, as well as the environmental dimensions, and in the process, ensures organizational sustainability. Green human resource management can only be implemented successfully in organizations and within organizational frameworks if and when sustainable performance is achieved (Marrucci et al., 2021; Zaid et al., 2018). In addition, it also supports co-ordination of economic, social and ecological reform hence maintaining a balance in the sustainable development (Bansal, 2005).

Notably, innovation is the key driver of organizational development and competitiveness; not only does it promote the creation of unique value, but it also increases the efficiency of the environment and the development of social capital (Shahzad et al., 2022). However, conventional growth models have been frequently followed by environmental degradation, depletion of resources, and social inequality (Wang, Abbas, et al., 2022; Wang, Wang, & Chang, 2022). These disadvantages reinforce the argument in support of the implementation of Green Innovation (GI), which focuses on environmentally friendly products and processes that provide similar value to consumers with reduced environmental and social impact (Rauter et al., 2019). In addition to environmental benefits, GI can enhance the reputation of firms, access to green markets, and operational efficiency, all of which are directly associated with the financial and non-financial performance (Kraus et al., 2020). Therefore, the theoretical and practical importance of GI to organizational performance in terms of sustainable competitiveness is to understand the GI impact on the organizational performance.

The relationship between Human Resource Management (HRM) and improved employee and organizational outcomes is well-established, whereas the relation to GI is under-researched. The practices of green HRM (GHRM), including environmental training, participation in sustainability activities, and green performance appraisal, are hypothesized to develop environmental awareness and innovative green behaviors among employees, thus, leading to GI (Muisyo et al., 2022; Song et al., 2020). Additionally, the combination of GHRM and GI may result in strategic and competitive benefits as it links human capital development to the environmental goals (Singh et al., 2020). Nevertheless, the GHRM-GI connection has been largely studied in developed economies with very different institutional support, infrastructure and technological maturity compared to those in emerging economies.

The GHRM and GI dynamics can also be quite different in emerging economies, as the pressures of institutions, the lack of green infrastructure, the changing regulatory environment, and the socio-cultural disposition to sustainability can be quite different (Renwick et al., 2013; Dubey et al., 2022; Kim et al., 2019). As an illustration, in the context of Malaysia, India, and China, companies are frequently based in resource-constrained settings whereby employee-based green efforts can be more significant in the outcomes of innovation than capital-intensive technological interventions (Tang et al., 2018; Yong et al., 2022). Furthermore, since these economies are rapidly industrializing and contending with environmental issues, it is imperative to know whether and how GHRM can drive GI under these circumstances- and whether the GI-performance relationship will follow the same pattern as seen in the developed markets or will it be different. This paper addresses these gaps by revisiting the GHRM-GI-SP relationship and examining the connection in particular emerging economies settings therefore addressing the theory and practice of sustainable management.

Despite the obvious link between GHRM and GI as observed from the discussions above; there has been a limited amount of research on this topic. Specifically, to draw the attention towards the fact that only a few studies thus far, have actually explored GHRM practices in environmental management, particularly within the Asian context (Tang et al., 2018). This constitutes a major research gap particularly due to the fact that research in developing and emerging economies (i.e. India, China, Taiwan, and Malaysia) appears to be highly opinionated on the adoption of GHRM practices and GI in order to ensure sustainable growth of the economy. Indeed, some studies have already emphasized the role of GHRM as a sustainability factor in Malaysia in terms of the mediating

factor of GI. Therefore, despite the previous literature providing some insights into the GHRM-GI connection, further studies are necessary since both GHRM and GI are emerging concepts, particularly in the contexts of developing economies (Kim et al., 2019); this thus becomes the research gap that would seek to fill in this study.

The present research explores the effect of Green Human Resource Management (GHRM) practices on sustainable performance with the mediation of Green Innovation (GI). The results also reveal a partial mediating role of GI on the GHRM-sustainable performance relationship. These results also validate the importance of GI as one of the central ways that GHRM practices can optimally contribute towards sustainable performance (Renwick et al., 2013).

2. Hypotheses development

2.1. The resource-based view theory

Firms gain sustained competitive advantage when they have resources that are heterogeneous (differ in nature and quality to competitors) and immobile, that is, they cannot be easily transferred or replicated (as explained in the Resource-Based View or RBV) (Barney, 1991; Wernerfelt, 1984). These resources should also have the VRIO characteristics: Valuable, Rare, Inimitable and Organized to be exploited fully (Barney, 1991; Peteraf, 1993). In the conceptual model of the present study, Green Human Resource Management (GHRM) practices are conceptualized as strategic intangible resources that offer the structural and cultural basis of creating valuable employee capabilities in environmental knowledge, skills, and pro-environmental behaviors (Renwick et al., 2013; Jabbour & de Sousa Jabbour, 2016). The capabilities are represented in the employees and are inherently hard to replicate since they are integrated in the history, culture and social

complexity of the firm (Barney, 1991; Wright et al., 2001).

Green Innovation (GI), in this context, is defined as a dynamic capability (Teece et al., 1997) which is realized through the application of the GHRM-driven competencies in the development of eco-friendly products, services, and processes (Chen et al., 2006; Dangelico & Pujari, 2010). RBV stresses that resources are never enough, but the synergistic, path-dependent relationships between resources (e.g., GHRM) and capabilities (e.g., GI) have the potential to deliver better performance results (Hult & Ketchen, 2001). Without a workforce with special environmental knowledge, motivation, and alignment with sustainability objectives, a firm is unlikely to maximize its GI performance, which is achieved through GHRM and is instilled in an organizational culture that supports it (Singh et al., 2020; Yong et al., 2020). As Sutton and Staw (1995) note, a strong theoretical foundation is critical for connecting constructs in a way that yields testable and meaningful propositions; in this study, RBV serves precisely that role.

Besides, the RBV can be especially applicable in situations when resources are limited, including SMEs or firms in emerging economies, where the HRM system can be optimized to make the best use of limited resources and build employee proactivity and capabilities (Zhang & Edgar, 2022). Based on this, RBV supports our hypotheses by suggesting that: (1) GHRM practices, as VRIO-aligned resources, can generate distinctive green knowledge and skills among workers; (2) these competencies can facilitate GI as a dynamic organizational capability; and (3) the combination of these components can result in high sustainable performance, especially in emerging markets, where environmental pressures and institutional environments contrast with those in developed markets (Hart, 1995; López-Cabrales & Valle-Cabrera, 2020). Fig. 1 shows the current research model explains the resource-capability-performance pathway in our model and validates the strategic significance of aligning HRM systems to innovation-focused

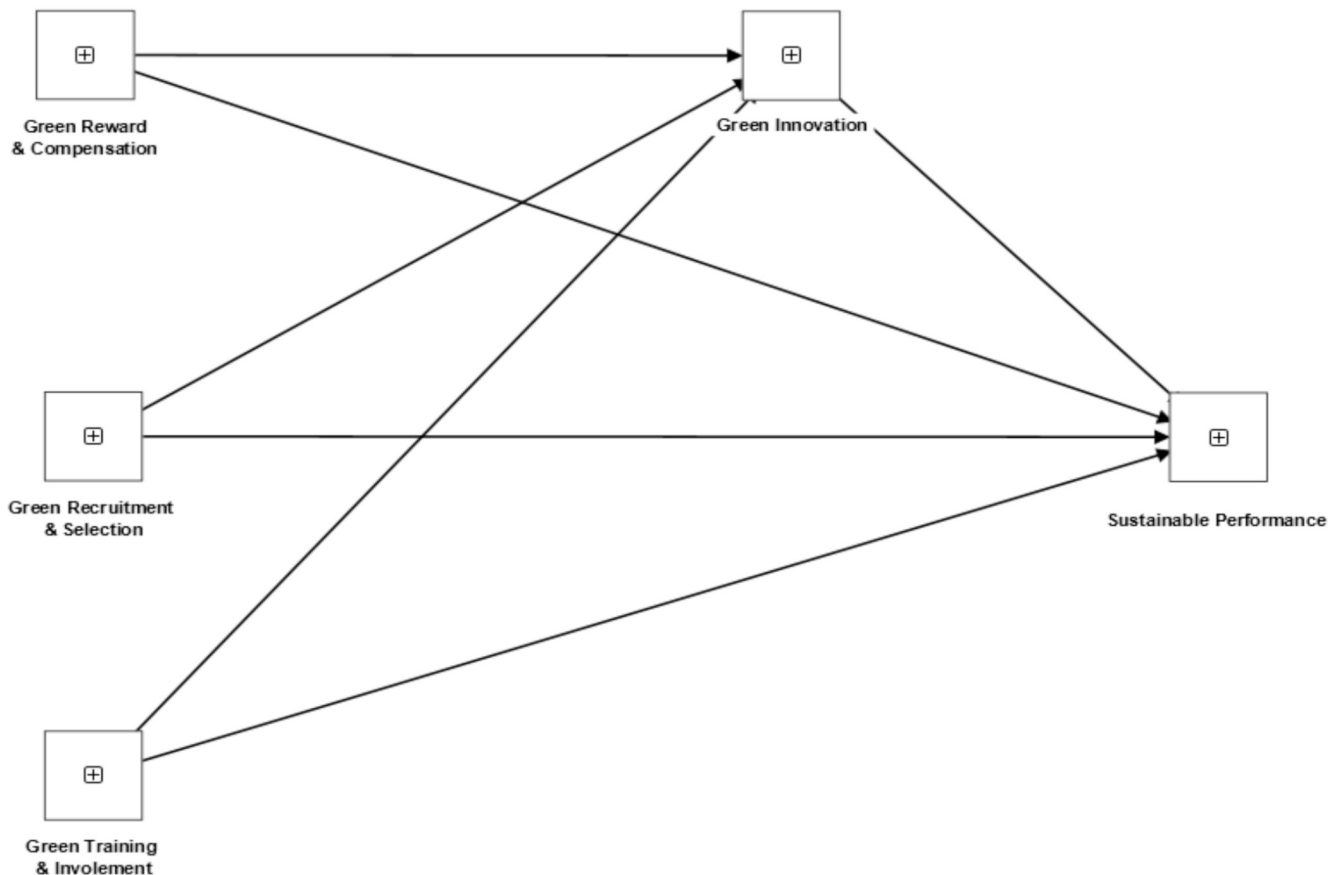


Fig. 1. Research framework.

sustainability strategies.

2.2. Green recruitment and selection towards Sustainable Performance

Green recruitment and selection refer to the process of integrating the environmental factors into the hiring process in such a way that the new employees would have the values, skills, and commitment to help an organization with its sustainability agenda (Renwick et al., 2013). According to the Resource-Based View (RBV), recruitment is a strategic instrument in the acquisition of valuable, rare, inimitable and non-substitutable (VRIN) human capital (Barney, 1991; Wright et al., 2001). By employing people with good environmental knowledge, confirmed problem solving abilities in sustainability settings, and green values, the firms can develop a unique talent pool that facilitates long term competitive advantage (Jabbour et al., 2010; Tang et al., 2018). Such employees will be able to find more eco-efficiency opportunities, promote green innovation, and lead environmental initiatives, all of which directly contribute to sustainable performance (Daily et al., 2009; Guerri et al., 2016).

The Ability Motivation Opportunity (AMO) model offers extra explanatory value to comprehend this connection (Appelbaum et al., 2000; Jiang et al., 2012). The ability is affected by recruitment because it recruits individuals that are already highly skilled in environmental knowledge and sustainability-related problem-solving capacity (Paillé & Boiral, 2013). It also creates motivation as it will attract people whose personal values will resonate with the green aims of the organization, which will make them personally dedicated to the environmental agenda (Dumont et al., 2017; Pham et al., 2019). It strengthens opportunity by positioning such employees in areas and situations where they can use their skills and motivation to support sustainability projects, environmental compliance initiatives, and green innovation projects (Govindarajulu & Daily, 2004; Renwick et al., 2013).

These AMO dimensions are further supported by a powerful green employer brand. Organizations with a visible environmental record will attract high-quality candidates, thus enhancing the quality and cultural fit of new recruits (Pham & Paillé, 2020; Masri & Jaaron, 2017). Sharing green commitments and presenting environmental accomplishments through the recruitment channels, including organizational websites, professional networks, and specialized sustainability platforms, will reflect the organizational priorities in the environment, and it will attract capable and committed candidates (Yong et al., 2020). Cultural congruence is created by the correspondence of the environmental values between the employees and the employers, and it, in turn, promotes cooperation and makes it easier to incorporate sustainability goals into everyday activities (Jabbour & Santos, 2008; Siyambalapitiya et al., 2018).

Such alignment is not a cultural asset alone; it is a strategic asset. Green recruitment under RBV produces an environmentally competent and innovation-driven workforce that offers the capacity of human capital to design and implement green processes, meet emerging environmental standards, and address the market demand on sustainable products and services (Hart, 1995; López-Cabreales & Valle-Cabrera, 2020). With time, this talent pool develops into a path-dependent and socially intricate asset-hard to replicate by competitors-that leads to better sustainability performance. Based on the discussion thus far, we posit:

H1. There is a significant positive relationship between Green recruitment and selection on Sustainable Performance.

2.3. Green training and Involvement towards Sustainable Performance

Green training and involvement (GTI) is a fundamental HRM practice in giving employees the knowledge, skills and the motivation required to meet the organizational sustainability goals. Environmental training improves the capability of employees by raising their awareness

regarding environmental concerns, developing technical skills in the field of energy efficiency, waste management, and sustainable operations, and improving their aptitude to resolve environmental problems (Opatha, 2014; Arulrajah et al., 2016; Masri & Jaaron, 2017). When the training embraces the elements of social sustainability, including occupational health, safety, and community well-being, it will promote a more comprehensive sustainability culture and help the firm build a reputation of a socially responsible organization (Dumont et al., 2017; Macke & Genari, 2019).

In terms of the Resource-Based View (RBV) (Barney, 1991; Peteraf, 1993), green training is a strategic investment in creating valuable, rare, inimitable, and non-substitutable (VRIN) human capital. Organizations develop a workforce that is hard to imitate by becoming experts in the peculiar combinations of environmental skills, sustainability-oriented problem-solving skills, and shared green values (Jabbour et al., 2010; Yong et al., 2019). Dynamic capabilities are based on these human capital assets and allow the company to react efficiently to the changing environmental requirements, introduce new green procedures, and obtain better sustainability results (Renwick et al., 2013; Teece et al., 1997).

The Ability-Motivation-Opportunity (AMO) model offers an additional perspective that helps to understand the process by which GTI has an effect on performance outcomes (Appelbaum et al., 2000; Jiang et al., 2012). The process of developing ability happens in a systematic way through environmental education and skill-building programs. Inclusion in the decision-making process regarding sustainability, rewards, and matching the green efforts to their values motivate the employees (Paillé et al., 2014). The creation of opportunity is done through avenues that give employees an opportunity to utilize their green skills like engaging them in eco-efficiency projects, sustainability task forces, and environmental problem-solving activities (Tang et al., 2018).

When the three components of AMO are activated, the likelihood of employees to behave in a proactive manner that promotes environmental and social performance will increase and will eventually lead to positive outcomes in terms of organizational sustainability (Dumont et al., 2017; Guerri et al., 2016). With time GTI has integrated sustainability in the organizational identity forming a socially complex and path-dependent resource that supports the sustained competitive advantage. Thus, green training and participation are not only means of operation HR activities but strategic resource-development processes, which, when designed in the scope of RBV and implemented by means of the AMO framework, directly lead to the long-term sustainable performance. Pursuant to the ongoing discussion, we posit:

H2. There is a significant positive relationship between Green training & Involvement on Sustainable Performance.

2.4. Green reward and compensation towards Sustainable Performance

Green reward and compensations systems have become strategic HRM tools to align the employee behavior according to these sustainability aims (Renwick et al., 2013; Zibarras & Coan, 2015). Such systems include financial and non-financial rewards to attract, retain, and motivate employees to participate in environmental objectives to instill sustainability in the organizational culture (Guerri et al., 2016; Masri & Jaaron, 2017; Saeed et al., 2019).

Through the Resource-Based View (RBV), green rewards and compensation can be used as a tool to improve the value of human capital by strengthening the skills, attitudes, and commitments that are related to sustainability. Employees who are recognized and rewarded when they initiate and maintain green practices (waste minimization, energy savings, environmentally friendly product development and community-based environmental projects) become valuable, rare, inimitable, and non-substitutable (VRIN) resources (Barney, 1991; Hart, 1995; Jabbour et al., 2010). These incentivized behaviors eventually evolve into path-dependent capabilities that become the foundation of

competitive advantage of a firm (López-Cabrales & Valle-Cabrera, 2020; Yong et al., 2020). Rewards based on recognition (e.g., awards, praise in public, symbolic awards) and financial rewards (bonuses, salary increase, carbon credits) indicate the strategic value of sustainability and motivate people to remain engaged (Opatha, 2014; Pham & Paillé, 2020; Rani et al., 2023; Wehrmeyer & Vickerstaff, 2017).

Ability, Motivation, and Opportunity (AMO) model also explains the effect of green rewards on sustainable performance (Appelbaum et al., 2000; Jiang et al., 2012). By making employees willing to learn and use more advanced skills in the environment, rewards enhance ability, and they usually rely on reward systems (Paillé et al., 2014; Dumont et al., 2017). Their motivation comes in the form of rewards and acknowledgment of contributions to sustainability to enhance intrinsic and extrinsic commitment to green goals (Pham et al., 2019; Raineri, 2017). They also increase opportunity by offering the employees resources and platforms to engage in sustainability projects, propose eco-innovations, and be involved in green decision-making processes (Govindarajulu & Daily, 2004; Guerci et al., 2016; Kim et al., 2019).

Green reward and compensation systems are institutionalized when they are incorporated as part of a strategic approach to managing pro-environmental behavior and linking it to organizational performance measures. Non-financial reward, like the awarding of a green champion, eco-certification recognition, or sustainability leader board can be combined with financial incentives (bonuses, pay rise, or subsidies to sustainable commuting). Besides demonstrating the commitment of top management to sustainability, these approaches also create social norms that support the reinforcement of green behavior in the whole organization (Daily et al., 2009; Ojo & Raman, 2019; Zibarras & Coan, 2015). Based on the understanding gained thus far, we hypothesize:

H3. There is a significant positive relationship between Green Reward & Compensation on Sustainable Performance.

2.5. Relationship between Green HRM and Sustainable Performance

GHRM refers to the strategic adjustment of the fundamental HR practices such as green recruitment & selection, green training & involvement, and green & compensation in line with the environmental goals. Through an RBV prism, these practices form organization-specific bundles of human and social capital (employees possessing environmental know-how, common green routines, and norms of stewardship), are valuable, rare, inimitable and non-substitutable. Such people resources are hard to replicate by competitors since they are entrenched in firm-specific histories, routines, and cultures, thus promoting sustainable competitive advantage in environmental efficiency, compliance reliability, reputation, and cost leadership, all of which are reflected in greater sustainable performance across the triple bottom line (Barney, 1991; Renwick et al., 2013). The GHRM literature reviews are always positive in terms of reporting positive correlations between GHRM and sustainability-oriented outcomes (environmental, social, and economic), which confirms the RBV argument that green-oriented HR architectures are strategic resources but not generic and easily replicated practices (Amrutha & Geetha, 2020; Lawter & Labat, 2025; Miah et al., 2024).

The micro-mechanics of this strategic connection is explained in the AMO theory. High-performance HR systems enhance the Abilities of the employees (e.g. green skills due to specific training and hiring standards), enhance Motivation (e.g. appraisals and rewards based on environmental goals), and increase the Opportunities to act (e.g. suggestion schemes, participative teams and job design that incorporate environmental standards). With HR practices planned with direct environmental considerations, the workforce is capable, motivated and free to implement the cleaner processes, less waste, less energy consumption, and maintain the safety and community standards-delivering visible returns in sustainable performance with less structural leverage (Appelbaum et al., 2000; Renwick et al., 2013). Empirical research in

the operations and sustainability journals also suggests that organizations that incorporate such AMO-consistent GHRM practices report better environmental indicators and, in many cases, improved cost and reputational performance, which supports the opinion that AMO-consistent HR systems are an implementation mechanism of sustainability strategies (Amrutha & Geetha, 2020; Lawter & Labat, 2025; Singh et al., 2020).

Stated simply, RBV describes the reasons why GHRM may be a source of lasting advantage- through the construction of green capabilities that are difficult to copy- and AMO describes how coherent HR practices directly translate strategy into everyday practices that increase environmental, social and economic performance metrics. Companies that strategically model their HR systems to these two views have higher chances of achieving long term organization-wide sustainable performance changes. This finding is finding more and more reflection in the recent systematic reviews and field studies in the industries and it is clear that GHRM is a first-order strategic lever and not an HR initiative at the periphery (Amrutha & Geetha, 2020; Lawter & Labat, 2025; Miah et al., 2024). Based on the understanding gained thus far, we hypothesize:

H4. There is a significant positive relationship between Green HRM on Sustainable Performance.

2.6. Mediating role of Green Innovation between Green HRM and Sustainable Performance

Green innovation (GI) is ideally suited as the process that bridges the gap between green human resource management (GHRM) and sustainable performance since it helps to transform people-based capabilities into product and process modifications that bring forth triple bottom-line outcomes (Dubey et al., 2022; Jabbour et al., 2010). Based on a Resource-Based View (RBV), GHRM develops valuable, rare, inimitable, and non-substitutable (VRIN) resources through hiring environmental skills, educating about eco-design and resource efficiency and ensuring the institutionalization of green norms via appraisal and rewarding. The result of these HR practices is firm-specific human and social capital in the form of specialized technical knowledge, common sustainability values, and routines of collaboration, which competitors can hardly replicate, and satisfy the inimitability and embeddedness criteria of RBV (Barney, 1991; Hart, 1995; Renwick et al., 2013; Tang et al., 2018). The micro foundations of this accumulation of resources are the Ability-Motivation-Opportunity (AMO) framework, which suggests that employees' abilities and motivation are increased by recruitment and training, and green performance management and incentives, increasing the opportunities to experiment and implement ideas by participation platforms and job designs (Appelbaum et al., 2000; Renwick et al., 2013; Pham et al., 2020a,b). Combined, RBV and AMO explain how GHRM shapes the inputs and routines that make up GI as a capability of an organization.

After this has been established, GI is being used as a capability that restructures technologies, processes, and organizational practices to lessen environmental harm without compromising or bettering cost or quality-exactly the sort of path-dependent routine that RBV relates to enduring performance benefits (Dangelico & Pujari, 2010; Teece, 2007). The innovations in eco-processes reduce material and energy intensity, emissions, and waste and improve environmental indicators directly; efficiency improvements and eco-product differentiation also favor economic indicators through cost reduction, revenue increase, and reputation. Social benefits also come through cleaner processes and products that are sensitive to the stakeholders because it improves the safety of the workplace, the pride of the employees and the relationships with the community. Simply put, GI is the delivery vehicle on which the VRIN resources developed by GHRM are translated into quantifiable changes with regard to environmental, economic, and social performance (Dangelico & Pujari, 2010; Hart, 1995; Porter & Van der Linde,

1995).

This step-by-step logic is in line with empirical findings. Research in emerging-economy contexts demonstrates that companies that engage in better GHRM practices report greater GI, and that GI, in its turn, is linked to better environmental performance; some of the studies go further and include more comprehensive sustainability indicators (Aftab et al., 2022; Fang, Ahmad, & Hassan, 2022; Fang, Shi, et al., 2022; Kanan et al., 2023). Through the RBV-AMO perspective, these findings suggest a resource-accumulation - capability-formation - capability-deployment nexus: GHRM (through AMO) creates VRIN human and relational capital and instills innovation routines; GI then uses those resources to create effects that accrue to the triple bottom line. Thus, the argument that GI moderates the GHRM-sustainable performance relationship is not made but rather based on a logical theoretical chain that is backed by cross-contextual evidence. Based on the discussion, we propose that GI does mediate the impact of GHRM on an organization’s sustainable performance, and posit thereby:

H5. Green Innovation mediates the relationship between Green HRM practices and Sustainable Performance.

3. Research design

3.1. Sample and data collection instrument

This study targeted Malaysian manufacturing firms. According to the Securities & Exchange Commission of Malaysia (SECP) records, there are 1400 manufacturing firms in Malaysia. A questionnaire was distributed to 399 firms using the online survey technique. Covid-19 created a challenging situation in collecting data, which led to the adoption of the convenience sampling technique. Notably, out of the 399 questionnaires being sent, we received 340, yielding thereby a response rate of 77.7 %, which is considered valid and adequate.

3.2. Measurements

In the current study, the dependent variable of sustainable performance includes three dimensions: environmental performance (5 items), social performance (5 items), and economic performance (7 items) based on Zhu et al. (2013). Examples of items include: environmental performance “Our company has reduced the consumption of hazardous/harmful/toxic materials”; social performance “Our company supports local communities through social responsibility activities”; economic performance “Our company has reduced costs associated with energy, water, and waste”.

The green recruitment & selection (5 items) was the first independent variable that was adapted from (Guerci et al., 2016), and the item include “Environmental criteria are considered when selecting candidates”. The green training and involvement (5 items) also adapted by Guerci et al. (2016), such as “We provide employees with training programs on environmental issues”. Green reward & compensation (3 items) is the third independent variable which is again adapted from Guerci et al. (2016) and its item include “Employees are rewarded for achieving environmental goals”. Lastly, the mediator variable, green innovation (8 items), was adapted by Chen et al. (2006), and its item include such as “Our company develops new products that reduce environmental impact”.

3.3. Pilot study

Prior to the main survey, a pilot study was done to provide validity as well as reliability (Kothari, 2004). It was surveyed on 35 manufacturing companies, where 35 usable responses were obtained, which is one response per firm. The questionnaires were filled in by top-level managerial representatives who directly participated in the decision-making process of environmental and human resource management.

In the pilot and the main study, the respondents were mainly HR managers, sustainability/environmental officers and to a lesser extent in some instances, operations managers or CEOs of smaller firms. To obtain content validity of the instruments, the entire questionnaire was given to and discussed with professionals in the area of concern. It is important to note that, content validity is a significant step prior to the final data collection procedure; in this respect, no serious issues have been pointed out in the content validation procedure. In addition to the validity of the survey, we have also analyzed internal reliability of the instrument. Table 1 shows that the internal consistency of all the constructs under-studied is satisfactory.

3.4. Demographic characteristics

Table 2 provides more information on the demographic information of the respondents and their organizations of workplace. This is in terms of the industry sector, gender distribution, age groups, education level of the respondents as well as the years of operation of the organizations in the business sector.

3.5. Common method variance

Common method variance is a term that is used to describe inflation or distortion of relationships among variables in cases where a common set of respondents is used to measure all variables concurrently using the same instrument. The present research incorporated the multi-wave design of data collection, wherein there was a time delay between the waves of measuring data (Conway & Lance, 2010; Podsakoff et al., 2003). The survey has been divided into two parts according to the variables of the study. During the first stage (Wave 1), the results were gathered about one independent variable green recruitment & selection and one dependent variable sustainable performance (environmental, social, and economic aspects). During the second phase (Wave 2), which was four weeks following the first phase, the rest of the independent variables green training & involvement and green reward & compensation and the mediating variable green innovation were to be collected.

The period of four weeks was selected to ensure adequate time lag to ensure that the respondents have minimal capacity to remember and match their previous answers, thus countering consistency motifs and common method bias (Fuller et al., 2016; Ployhart & Vandenberg, 2010). This time is also a compromise between methodological requirement of time lapse and practical limitation of having a reasonable response rate (Lindell & Whitney, 2001). The variable separation over time points and the multi-wave design enhance the temporal integrity of variables and enhance the robustness of causal inferences in the analysis.

Common method variance (CMV), which refers to the variance due to the measurement method rather than the constructs of interest is a major threat for self-reported survey research (Podsakoff et al., 2012). This bias can result in systematic measurement error that can either inflate or deflate observed variable relationships (Chang et al., 2010). To handle this, Exploratory Factor Analysis, based on unrotated Harman’s single-factor test, was conducted using the SPSS. The analysis indicated that none of the factors had a variance of 50 % or more; in fact, the highest variance factor was 23.412 %. These results support the conclusion that common method bias had a minor impact on this study

Table 1
Pilot study results.

	Cronbach Alpha (CA)
Sustainable performance	0.864
Green Innovation	0.875
Green recruitment & selection	0.903
Green training & involvement	0.877
Green reward & compensation	0.856

Table 2
Descriptive analysis of demographic data.

Demographic variables	Category	Frequency	Percentage (%)	Cumulative percentage (%)
Sector	Manufacturing	300	96.7	96.7
	Service	10	3.3	100.0
Gender	Male	223	71.9	71.9
	Female	87	28.1	100.0
Age	20–35 Years	43	13.8	13.8
	36–50 Years	137	44.2	58.0
	Above 50 Years	130	42.0	100.0
Education	Ph.d	43	13.9	13.9
	Masters	165	53.2	67.1
	Bachelors	77	24.8	91.9
	Diploma/ Associate Degree	25	8.1	100.0
No of years in business	1–15 Years	69	22.3	22.3
	16–30 Years	174	56.2	78.5
	Above 30 Years	67	21.5	100.0

(Podsakoff et al., 2012).

4. Analysis and results

Partial least squares structural equation modeling (PLS-SEM) through Smart PLS 4 was used to perform multiple regression analysis. The measurement and the structural models were also tested within this framework. The PLS-SEM was chosen as the analytical approach because of its recent popularity and frequent use in prior studies (Arshad & Arshad, 2019; Sarstedt et al., 2017). This method was particularly appropriate for the study because the research model imposed both reflective and formative constructs. According to the suggestions of the most popular authors (Sarstedt et al., 2017), a bootstrapping procedure using 500 resamples was used to assess the model with a 5 % significance level. Bootstrapping according to Hair et al. (2018) is a powerful statistical tool that uses average of results obtained from a series of small samples to estimate the population parameters. This approach made the results reliable and valid in the framework of the model structure of the studied problem.

4.1. Measurement model assessment

The Smart-PLS model was first examined for its fit, that is, for the validity and reliability of the constructs. In order to determine reliability, Composite Reliability (CR) and Cronbach Alpha (CA) were examined. Sustainable performance has CA and CR values of 0.733 and 0.852, respectively. Green innovation has CA and CR values of 0.734 and 0.860. The CR and CA values of GRS are 0.846 and 0.863, respectively. GTI has CR and CA values of 0.815 and 0.847, respectively. According to GRC, CR and CA values are 0.831 and 0.842, respectively (Table 3 & Fig. 2). Further, it may be noted that the assessment of reliability alone is not sufficient to adequately measure the instrument. The validation of every construct in the theoretical model is also required. In this research, we tested the validity of the construct by examining both convergent and discriminate validity. Convergent

Table 3
Reliability and validity.

	CA	CR	AVE
Sustainable performance	0.733	0.852	0.636
Green Innovation	0.734	0.860	0.677
Green HRM	0.840	0.859	0.610
Green recruitment & selection	0.863	0.846	0.591
Green training & involvement	0.815	0.847	0.583
Green reward & compensation	0.831	0.842	0.612

validity (CV) has been explained by Hair et al. (2018) as “the degree to which a latent construct explains the variance of its indicator.” 50 % of the variance should be achieved by each construct ($AVE \geq 0.50$). A comparison of all the AVE values in Table 1 indicates that they are all greater than the cut-off values, which in turn, indicates that the measurement model is indeed reliable and consistent. AVE values for Sustainable performance (0.636), Green Innovation (0.677), Green recruitment & selection (0.591), Green training & involvement (0.583) and Green Reward & Compensation (0.612).

Discriminant validity (DV) is defined as how much a construct is really different from other constructs that can be measured (Sarstedt et al., 2017, p. 115). It examines the extent to which the indicators discriminate between the constructs, determined by two widely used criteria: the Fornell-Larcker criterion and the HTMT ratio. Discriminant validity, according to Hamid et al. (2017), means that “constructs are different empirically.” In this study discriminant validity was tested using HTMT ratio and Fornell-Larcker criterion was also used. The Fornell-Larcker approach helps to prove that the investigated constructs are indeed distinct from each other since they do not account for phenomena that might be caused by other constructs.

Table 4 postulated the discriminant validity by indicating a correlation greater than AVE squared. According to Sarstedt et al. (2017, p. 115), “the square root of AVE (diagonal) is higher than the correlations (off-diagonal) for all reflective constructs.” We also assessed the HTMT values using the basic criteria expressed by Gold et al. (2001) and Henseler et al. (2015), which are two of the most commonly used criteria, have a cutoff point of HTMT of 0.85 and 0.90, respectively. These criteria indicate that the values in Table 5 have met the above-mentioned standard criteria for the Heterotrait-Monotrait Ratio of Correlation (HTMT) method.

4.2. Structural model assessment

In PLS-SEM, interrelationship estimates between independent latent variables and dependent variables are used to evaluate whether the model’s predicted values would accurately predict future sample responses. It must be understood that in the case of structural models, bootstrapping is a non-parametric test of significance, used to test the significance of the t-values of the path coefficients.

After examining the measurement model parameters, the structural model parameters were then determined subsequently. According to Breiman and Friedman (1985), the coefficient of determination (R^2) is the measure of the extent of the endogenous variables’ variance being explained by the independent variable constructs of the model. Chin and Todd (1995) also give an indication of how to assess the R^2 , where values of 0.19, 0.33 and 0.67 signify respectively, weak, moderate and substantial test of the whole model. The present study explains that the calculated value of R^2 is 0.761 (Sustainable performance) and 0.537 (Green Innovation) as shown in Fig. 3, which reaches moderate standard criteria of assessment (Chin & Todd, 1995), which means that independent variables explain 76.1 % and 53.7 % variance, i.e., GI, GRS, GTI, and GRC, towards dependent variable, i.e., Sustainable performance and Green Innovation as shown in Fig. 3.

4.2.1. Testing the direct effect

At a significance level of 5 %, bootstrapping in Smart-PLS was conducted to examine ‘P-values’ and ‘T-values’ hypotheses tests; these are the path coefficients. Specifically, Fig. 3 and Table 6 show the hypotheses results; H1 was found to have a significant positive relationship between green recruitment and selection on sustainable performance ($\beta = 0.132$, T-statistics = 3.767, p -value < 0.01). H2 was found to have a significant positive relationship between green training & involvement in sustainable performance ($\beta = 0.164$, T-statistics = 4.785, p -value < 0.01). H3 was found to have a significant positive relationship between green reward & compensation and sustainable performance ($\beta = 0.189$, T-statistics = 4.506, p -value < 0.01). H4 was also found to have a

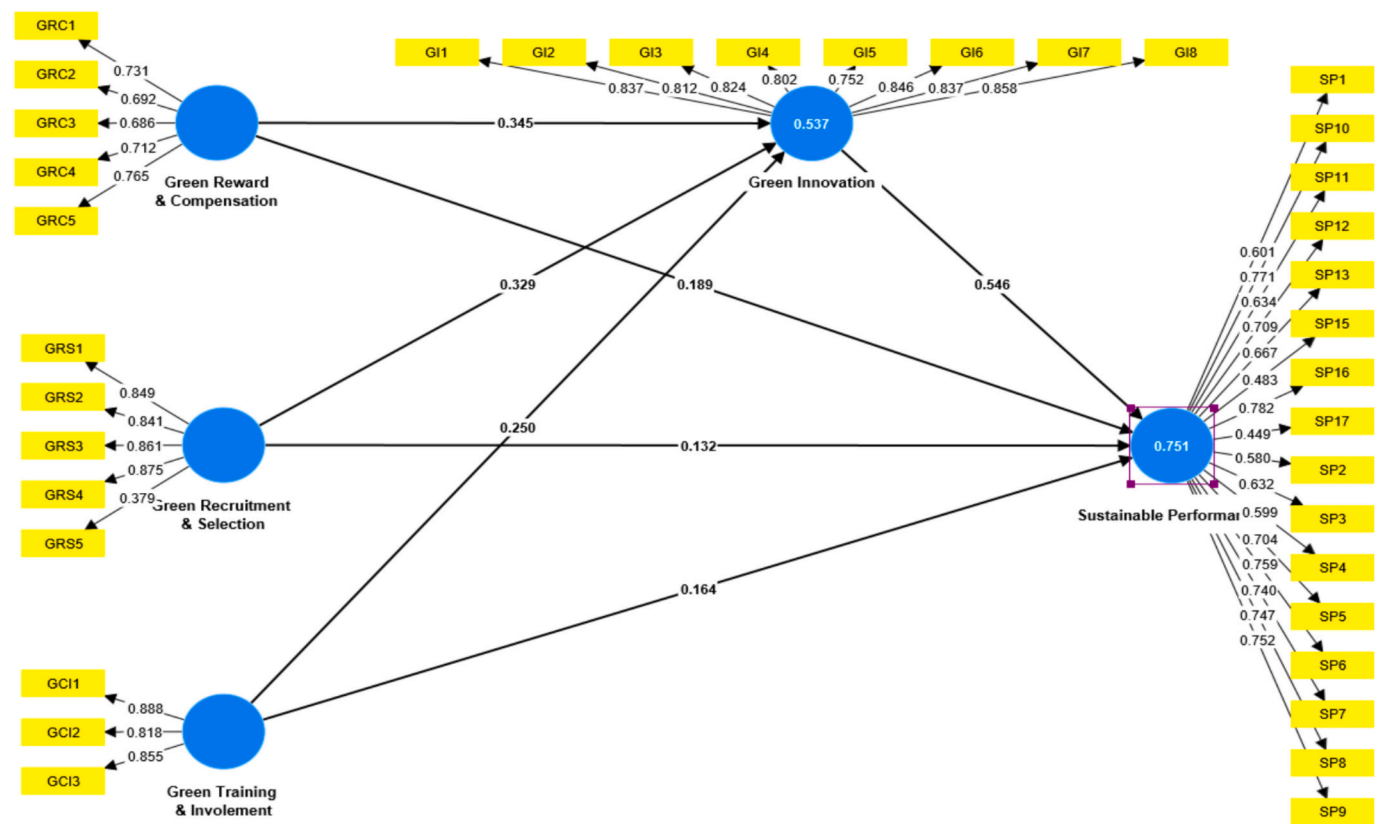


Fig. 2. Measurement model.

Table 4
Fornell-Larcker criterion.

	Sustainable performance	Green Innovation	Green recruitment & selection	Green training & involvement	Green Reward & Compensation
Sustainable performance	0.747				
Green Innovation	0.714	0.824			
Green recruitment & selection	0.529	0.523	0.772		
Green training & involvement	0.656	0.497	0.583	0.673	
Green reward & compensation	0.432	0.577	0.511	0.623	0.721

Table 5
HTMT criterion.

	Sustainable performance	Green recruitment & selection	Green training & involvement	Green Reward & Compensation
Sustainable performance				
Green Innovation	0.799			
Green recruitment & selection	0.749	0.801		
Green training & involvement	0.556	0.773	0.621	
Green reward & compensation	0.652	0.621	0.755	

significant positive relationship between g between Green HRM on Sustainable Performance ($\beta = 0.174$, T-statistics = 4.433, p-value < 0.01). Moreover, statistical analysis found that Green HRM practices, both collectively and individually, correlate positively with environmental performance, confirming the three hypotheses developed. The results, as mentioned earlier, are in congruence with other researchers (Ghouri et al., 2020; Masri & Jaaron, 2017).

As defined by Henseler and Chin (2010), the effect size is calculated as the increase in R2 of the latent variable (LV) to which the path is connected, relative to the LV's proportion of unexplained variance. We calculated the effect size based on the exogenous variables that were omitted from the analysis in order to determine the impact on latent

endogenous variables (Hair et al., 2013) measuring the effect size of a specific model. Further, as Cohen (1992) proposed, the threshold values for small, medium and substantial effects are 0.02, 0.15, and 0.35, respectively. We observed that GRS ($f^2 = 0.043$), GTD ($f^2 = 0.076$) and GRC ($f^2 = 0.077$) have small effect sizes, while Green Innovation ($f^2 = 0.555$) has large effect size.

4.2.2. Testing mediating effect

PLS-SEM has recently become more often used in social science research to conduct indirect impact or mediation analysis. To understand the importance of mediating effects, the researcher needs to assume a sequence of relationships, where an antecedent variable affects a

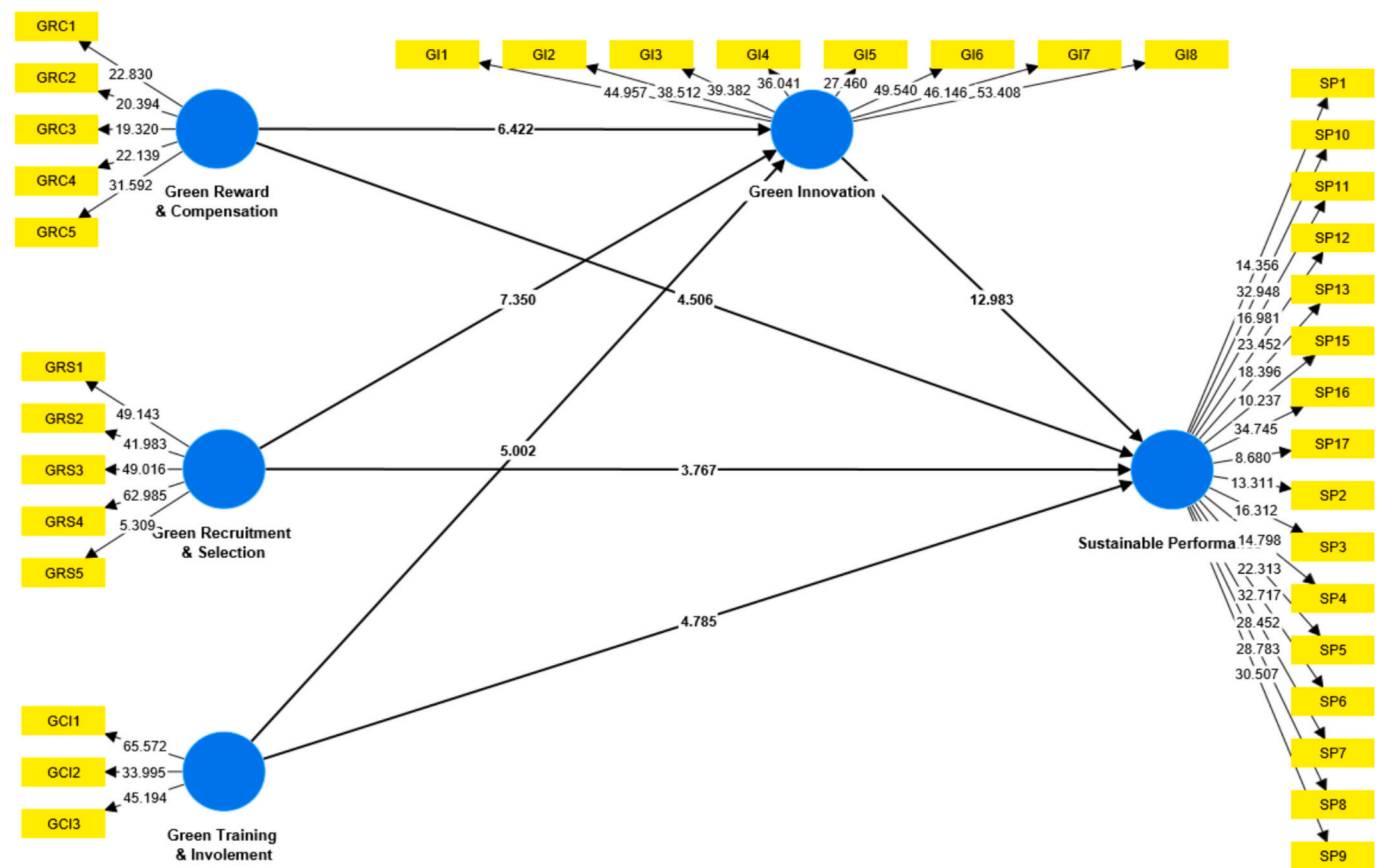


Fig. 3. Structural model.

Table 6
Direct hypothesis testing.

Hypo	Beta	T-value	P-value	Remarks
H ₁ Green recruitment and selection → Sustainable performance	0.132	3.767	0.000*	Supported
H ₂ Green training & development → Sustainable performance	0.164	4.785	0.000*	Supported
H ₃ Green reward & compensation → Sustainable performance	0.189	4.506	0.000*	Supported
H ₄ Green HRM → Sustainable performance	0.174	4.433	0.000*	Supported

Note: level of significance 1 %.

mediating variable, which in turn, affects the dependent variable (Nitzl, Roldan, & Cepeda, 2016).

Earlier, while analyzing the mediating effect, Baron and Kenny (1986) presented the methodology that is most frequently used in social science research. This technique was referred to as Sobel Test. There is an assumption that the sampling distribution of the indirect effect should be normal to apply the Sobel test, which was considered a major flaw in the Sobel test (Hayes, 2009). This new approach, dubbed bootstrapping, was currently used to implement the indirect effect (mediation) (Preacher & Hayes, 2008). The t-values for indirect effects were determined using the bootstrapping technique (500 sub-samples). Preacher and Hayes (2008) earlier showed that bootstrapping, a “non-parametric re-sampling approach,” is effective enough to detect the desired impact. Table 7 displays the findings from testing hypotheses on indirect relationships. It is found that GI mediates the association among GHRM and SP ($\beta = 0.102$, T-statistics = 2.413, p -value < 0.01).

Table 7
Results of the mediating effect hypothesis testing.

Hypo	Beta	T-value	P-value	Remarks
H5 Green HRM → Green Innovation → Sustainable performance	0.428	7.544	0.000*	Supported

Note: level of significance 1 %.

5. Conclusion and discussion

This study combines ideas of innovation management, environmental science and human resource management in a Resource-Based View (RBV) to describe a causal pathway between green human resource management (GHRM) and sustainable performance through green innovation (GI). Notably, we apply the mediation term to refer to a causal relationship- GHRM - GI - sustainable performance- as opposed to integration or interaction. GI is conceptualized as a product of GHRM that consequently spurs environmental, social and economic improvement; it is not a conglomeration of constructs with GHRM. Our three direct hypotheses (GHRM - sustainable performance) are supported empirically, which is reflected in previous studies that have placed GHRM at the heart of the sustainability performance (Chams & García-Blandón, 2019; Marrucci et al., 2021; Zaid et al., 2018). We also have support of our indirect hypothesis, which is in line with evidence that GI transfers the impact of GHRM on performance (Aftab et al., 2022; Fang, Ahmad, & Hassan, 2022; Fang, Shi, et al., 2022).

RBV describes the ability of GHRM to generate GI: through the creation of valuable, rare, inimitable, and non-substitutable (VRIN) human and social capital, in the form of specialized environmental knowledge,

common green norms, and cross-functional routines, which becomes embedded in the firm. The micro foundations of this capability formation are the AMO framework. In particular, GHRM improves the Abilities of employees (e.g., recruitment of environmental expertise; training of eco-design and resource analytics), Motivation (e.g., appraisal and environmental-related rewards), and opportunities to act (e.g., participative suggestions system, process redesign job designs and autonomy) (Appelbaum et al., 2000; Renwick et al., 2013). By this architecture based on AMO, GHRM gathers VRIN assets and institutionalizes search-selection-implementation routines that become GI as a capability in terms of RBV.

GI once formed, uses those RBV assets to rearchitect those products, processes, and organizational practices in a manner that brings triple-bottom-line benefits. Eco-process innovation lowers material and energy intensity, emissions and waste- lifting environmental performance, efficiency improvements and eco-product differentiation enhance cost savings, revenues and reputation- improving economic performance. Safety, employee pride, community relations are also enhanced through cleaner processes and stakeholder-oriented solutions- enhancing social performance. In brief, AMO describes the construction of the inputs and routines of GI (capability formation) and RBV describes the ability of the GI capability (which has already been constructed) to produce long lasting sustainability results (capability deployment). This, along with previous work in manufacturing and other industries, therefore, supports a resource-accumulation - capability-formation - capability-deployment chain instead of an integration of constructs (Aftab et al., 2022; Fang, Ahmad, & Hassan, 2022; Fang, Shi, et al., 2022).

6. Implications

6.1. Theoretical implications

The study has some theoretical contribution in that it helps to further understand how Green Human Resource Management (GHRM) practices can lead to Green Innovation (GI), which in turn promotes Sustainable Performance (SP) in the manufacturing companies. The results are based on the Resource-Based View (RBV) and the Ability-Motivation-Opportunity (AMO) framework and prove that GHRM can be used as a generator of valuable, rare, inimitable, and non-substitutable (VRIN) human capital resources, which are the sources of innovation. In particular, green recruitment, training, involvement, and reward systems are part of the GHRM practices that reinforce the environmental skills, motivation and opportunities of the employees- all these constitute the human and social capital in which the ability of a firm to be GI rests. These findings therefore support the causation pathway (GHRM - GI - SP) as opposed to bi-directional or integrative relationship, which supports the consistency of the conceptualization of the mediation model proposed.

The contribution of the study to the RBV and AMO is not limited to the literature on innovation theory, specifically, the capability-based innovation and eco-innovation management. The argument is substantiated by the evidence that GHRM develops the micro foundations to develop the innovation capability that enables organizations to reorganize resources with respect to sustainability objectives. This research helps in filling the gap between HRM and innovation management literatures by empirically showing that GI is a strategic ability, one that converts human resource-based inputs to process and product innovations that are able to contribute to the environmental, social, and economic value. This way, it puts into the limelight the role of HRM in influencing the dynamics of innovation, which is consistent with the opinion that innovation is not only a result of R&D functions but a product of organization-wide human capital networks that facilitate learning, creativity and problem-solving.

In addition, the study also makes contributions to sustainability theory and organizational theory because it provides empirical evidence based on a developing-country manufacturing setting where the

mediating role of GI between GHRM and SP has not been well studied. These findings substantiate the fact that GHRM is a resource base that develops employee competencies and shared values in the environment, whereas GI is a deployment mechanism of resources that converts the same resources into the competitive sustainability results. This two-theory application (RBV and AMO) therefore enriches our knowledge on how the internal HR systems can create firm-level innovation capabilities which add to sustainable competitive advantage.

6.2. Practical implications

Practically, the results can give a clear direction to HR practitioners, sustainability managers, and policy designers to consider in integrating human resource systems with environmental strategy. To begin with, the HR managers are advised to consider GHRM as a strategic facilitator rather than a compliance instrument by integrating green requirements in the lifecycle of employees. This would include integration of environmental consciousness and competence in the recruitment and selection exercises, develop ongoing green training modules, adopt reward mechanisms that reward environment-related initiatives, and a participatory mechanism through which employees should be allowed to suggest and put into action sustainability initiatives. In so doing, HR departments will set up the conditions of ability-motivation-opportunity that must be in place to allow innovation to thrive.

Second, the managers are to operationalize GI as the application of the resources created by HR. When employees have the right competencies and motivation, companies need to focus their ideas on the structured innovation processes, which may be the green product design, waste reduction programs, energy efficiency programs, and process optimization teams. Such alignment transforms GHRM-based capabilities into the practical results of innovation that increase the efficiency of the environment and economy.

Third, companies, especially those in the manufacturing industry in Malaysia, need to appreciate the fact that environmental management is not a regulatory mandate, but a strategic investment. Innovation that is supported by GHRM can aid in minimizing production wastes, decrease expenses, enhance brand perception and sustainable practices as per the increasing demands of stakeholders and global supply chain partners. Within a very competitive environment in the ASEAN market, GI capability developed via GHRM can help firms to not only comply with global environmental regulations but also differentiate in the long term in line with the Sustainable Development Goals of the United Nations (SDGs).

Lastly, to policy makers and industry associations, the results suggest that HRM-based incentives (e.g. green skill certification, training grant, and innovation award) should be incorporated in national and regional sustainability agendas to motivate firms to institutionalize GHRM and GI together. These would empower the mass of human capital in the manufacturing sector, which would lead to innovation-based sustainability transitions in developing economies.

7. Limitation and recommendations

There are certain limitations in this study. To begin with, GHRM and GI are still quite new concepts to many HR managers in the developing world and this necessitated further exposition and could restrict generalizability. It is recommended that future research should be conducted to test the proposed framework to increase the external validity in different contexts. Second, the study only addressed the manufacturing industry. This may be extended to other industries which may provide more insights. Third, the research employed only questionnaires; a mixed-method study that would involve surveys and interviews would be more informative. Fourth, the cross-sectional study design is not causal and causes concern regarding common method bias (CMB). The studies should be longitudinal to monitor changes. Fifth, the Malaysian setting of the study can be a limitation to the generalizability

of the research to other cultures; a replication in Western and non-ASEAN countries would permit cross-cultural comparison. Finally, three GHRM practices and mediating role of GI were analyzed. One of the ways to improve the model would be to investigate more practices, mediators, and moderating effects in future.

CRedit authorship contribution statement

Muhammad Zulqarnain Arshad: Writing – review & editing, Writing – original draft, Validation, Supervision, Conceptualization.
Congying Liu: Software, Resources, Investigation, Data curation.

Consent for publication

All of the authors have made a contribution to this research and given their permission for it to be published.

Ethical approval statement

This study received ethical approval from the Ethics Review Committee for Universiti Utara Malaysia, Sintok, Malaysia, (Approval Number: SCRUM-2023-059). All procedures involving human participants were conducted in accordance with the ethical standards of the institution and informed consent was obtained from all participants prior to their involvement in the study.

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Declaration of competing interest

The authors declare no conflicts of interest.

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Data availability

Data will be made available on request.

References

- Aftab, J., Iqbal, R., & Ahmad, N. (2022). Green human resource management and environmental performance: The mediating role of green innovation in Malaysian manufacturing firms. *Journal of Cleaner Production*, 368, Article 133132.
- Al-Ghazali, B. M., & Afsar, B. (2021). Retracted: Green human resource management and employees' green creativity: The roles of green behavioral intention and individual green values. *Corp. Soc. Responsib. Environ. Manag.*, 28(1), 536. <https://doi.org/10.1002/csr.1987>
- Alhashmi, M., Hilmi, M. F., Ahmed, G., & Abudaga, A. (2025). Impact of green HRM on sustainable performance: Moderating role of green employee motivation among the resources industry based public entities in UAE. *Journal of Mines, Metals & Fuels*, 73 (7).
- Amrutha, V. N., & Geetha, S. N. (2020). A systematic review on green human resource management: Implications for social sustainability. *Journal of Cleaner Production*, 247, Article 119131.
- Anwar, N., Nik Mahmood, N. H., Yusliza, M. Y., Ramayah, T., Noor Faezah, J., & Khalid, W. (2020). Green Human Resource Management for organisational citizenship behaviour towards the environment and environmental performance on a university campus. *Journal of Cleaner Production*, 256, Article 120401. <https://doi.org/10.1016/j.jclepro.2020.120401>
- Appelbaum, E., Bailey, T., Berg, P., & Kalleberg, A. L. (2000). *Manufacturing advantage: Why high-performance work systems pay off*. Cornell University Press.
- Arshad, M. Z., & Arshad, D. (2019). Internal capabilities and SMEs performance: A case of textile industry in Pakistan. *Management Science Letters*, 621–628. <https://doi.org/10.5267/j.msl.2019.1.001>
- Arulrajah, A. A., Opatha, H. H. D. N. P., & Nawaratne, N. N. J. (2016). Green human resource management practices: A review. *Sri Lankan Journal of Human Resource Management*, 5(1), 1. <https://doi.org/10.4038/sljhrm.v5i1.5624>
- Awwad Al-Shammari, A. S., Alshammrei, S., Nawaz, N., & Tayyab, M. (2022). Green human resource management and sustainable performance with the mediating role of green innovation: A perspective of new technological era. *Frontiers in Environmental Science*, 10, Article 901235.
- Bansal, P. (2005). Evolving sustainably: A longitudinal study of corporate sustainable development. *Strategic Management Journal*, 26(3), 197–218.
- Barbier, E. (2011, August). The policy challenges for green economy and sustainable economic development. In , Vol. 35, No. 3. *Natural resources forum* (pp. 233–245). Oxford, UK: Blackwell Publishing Ltd.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management* (Vol. 17, Issue 1,, 99–120. <https://doi.org/10.1177/014920639101700108>
- Breiman, L., & Friedman, J. H. (1985). Estimating optimal transformations for multiple regression and correlation. *Journal of the American statistical Association*, 80(391), 580–598.
- Chams, N., & García-Blandón, J. (2019). On the importance of sustainable human resource management for the adoption of sustainable development goals. *Resources, Conservation and Recycling*, 141, 109–122.
- Chang, S. J., Van Wittenloostuijn, A., & Eden, L. (2010). *From the editors: Common method variance in international business research*.
- Chen, Y.-S., Lai, S.-B., & Wen, C.-T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, 67(4), 331–339. <https://doi.org/10.1007/s10551-006-9025-5>
- Chin, W. W., & Todd, P. A. (1995). On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution. *MIS Quarterly*, 237–246. <https://doi.org/10.2307/249690>
- Chuang, S. P., & Huang, S. J. (2018). The effect of environmental corporate social responsibility on environmental performance and business competitiveness: The mediation of green information technology capital. *Journal of Business Ethics*, 150(4), 991–1009.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159. <https://doi.org/10.1037//0033-2909.112.1.155>
- Conway, J. M., & Lance, C. E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology*, 25(3), 325–334.
- Correia, A. B., Farrukh Shahzad, M., Moleiro Martins, J., & Baheer, R. (2024). Impact of green human resource management towards sustainable performance in the healthcare sector: Role of green innovation and risk management. *Cogent Business & Management*, 11(1), Article 2374625.
- Daily, B. F., Bishop, J. W., & Govindarajulu, N. (2009). *A conceptual model for organizational citizenship*.
- Dangelico, R. M., & Pujari, D. (2010). Mainstreaming green product innovation: Why and how companies integrate environmental sustainability. *Journal of Business Ethics*, 95 (3), 471–486.
- Dost, M., Pahi, M. H., Magsi, H. B., & Umrani, W. A. (2019). Effects of sources of knowledge on frugal innovation: Moderating role of environmental turbulence. *Journal of Knowledge Management*, 23(7), 1245–1259.
- Dubey, R., Gunasekaran, A., Childe, S. J., Luo, Z., Wamba, S. F., Roubaud, D., & Giannakis, M. (2022). Green innovation and environmental performance: Developing a theoretical framework for supply chain integration. *Business Strategy and the Environment*, 31(1), 340–356.
- Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behavior: The role of psychological green climate and employee green values. *Human Resource Management*, 56(4), 613–627.
- Fang, L., Shi, S., Gao, J., & Li, X. (2022). The mediating role of green innovation and green culture in the relationship between green human resource management and environmental performance. *Plos One*, 17(9), Article e0274820.
- Fang, Y., Ahmad, N., & Hassan, S. (2022). Green HRM and environmental performance: The role of green innovation. *Sustainability*, 14(10), 6341.
- Fuller, C. M., Simmering, M. J., Atinc, G., Atinc, Y., & Babin, B. J. (2016). Common methods variance detection in business research. *Journal of Business Research*, 69(8), 3192–3198.
- Ghouri, A. M., Mani, V., Khan, M. R., Khan, N. R., & Srivastava, A. P. (2020). Enhancing business performance through green human resource management practices: An empirical evidence from Malaysian manufacturing industry. *International Journal of Productivity and Performance Management*, 69(8), 1585–1607.
- Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, 18(1), 185–214.
- Govindarajulu, N., & Daily, B. F. (2004). Motivating employees for environmental improvement. *Industrial Management & Data Systems*, 104(4), 364–372.
- Guerci, M., Longoni, A., & Luzzini, D. (2016). Translating stakeholder pressures into environmental performance—the mediating role of green HRM practices. *The International Journal of Human Resource Management*, 27(2), 262–289.
- Hair, J. F., Ringle, C. M., Gudergan, S. P., Fischer, A., Nitzl, C., & Menictas, C. (2018). Partial least squares structural equation modeling-based discrete choice modeling:

- An illustration in modeling retailer choice. *Business Research*, 12(1), 115–142. <https://doi.org/10.1007/s40685-018-0072-4>
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Planning*, 46(1–2), 1–12.
- Hamid, S., Ijab, M. T., Sulaiman, H., Md. Anwar, R., & Norman, A. A. (2017). Social media for environmental sustainability awareness in higher education. *International Journal of Sustainability in Higher Education*, 18(4), 474–491.
- Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014.
- Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, 76(4), 408–420.
- Helfat, C. E., Kaul, A., Ketchen, D. J., Jr., Barney, J. B., Chatain, O., & Singh, H. (2023). Renewing the resource-based view: New contexts, new concepts, and new methods. *Strategic Management Journal*, 44(6), 1357–1390.
- Henseler, J., & Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. *Structural Equation Modeling*, 17(1), 82–109.
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43, 115–135.
- Hult, G. T. M., & Ketchen, D. J. (2001). Does market orientation matter?: A test of the relationship between positional advantage and performance. *Strategic Management Journal*, 22(9), 899–906. <https://doi.org/10.1002/smj.197>
- Jabbour, C. J. C., & de Sousa Jabbour, A. B. L. (2016). Green human resource management and green supply chain management: Linking two emerging agendas. *Journal of Cleaner Production*, 112, 1824–1833.
- Jabbour, C. J. C., & Santos, F. C. A. (2008). The central role of human resource management in the search for sustainable organizations. *The International Journal of Human Resource Management*, 19(12), 2133–2154.
- Jabbour, C. J. C., Santos, F. C. A., & Nagano, M. S. (2010). Contributions of HRM throughout the stages of environmental management: Methodological triangulation applied to companies in Brazil. *The International Journal of Human Resource Management*, 21(7), 1049–1089.
- Jiang, K., Lepak, D. P., Hu, J., & Baer, J. C. (2012). How does human resource management influence organizational outcomes? A meta-analytic investigation of mediating mechanisms. *Academy of Management Journal*, 55(6), 1264–1294.
- Kanan, M., Taha, B., Saleh, Y., Alsayed, M., Assaf, R., Ben Hassen, M., ... Tounsi, W. (2023). Green innovation as a mediator between green human resource management practices and sustainable performance in Palestinian manufacturing industries. *Sustainability*, 15(2), 1077.
- Kim, Y. J., Kim, W. G., Choi, H. M., & Phetvaroon, K. (2019). The effect of green human resource management on hotel employees' eco-friendly behavior and environmental performance. *International Journal of Hospitality Management*, 76, 83–93.
- Kraus, S., Rehman, S. U., & García, F. J. S. (2020). Corporate social responsibility and environmental performance: The mediating role of environmental strategy and green innovation. *Technological Forecasting and Social Change*, 160, Article 120262.
- Lawter, L., & Labat, G. (2025). Green human resource management and organizational performance: A systematic literature review. *Sustainability*, 17(7), 3132.
- Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology*, 86(1), 114–121.
- López-Cabral, Á., & Valle-Cabrera, R. (2020). Sustainable HRM strategies and employment relationships as drivers of the triple bottom line. *Human Resource Management Review*, 30(3), Article 100689.
- Macke, J., & Genari, D. (2019). Systematic literature review on sustainable human resource management. *Journal of Cleaner Production*, 208, 806–815.
- Marrucci, L., Daddi, T., & Iraldo, F. (2021). The contribution of green human resource management to the circular economy and performance of environmental certified organisations. *Journal of Cleaner Production*, 319, Article 128859.
- Masri, H. A., & Jaaron, A. A. M. (2017). Assessing green human resources management practices in Palestinian manufacturing context: An empirical study. *Journal of Cleaner Production*, 143, 474–489.
- Miah, M., Arefin, S., & Hoque, R. (2024). A systematic literature review on green human resource management and sustainability. *Cogent Business & Management*, 11(1), Article 2371983.
- Mousa, S. K., & Othman, M. (2020). The impact of green human resource management practices on sustainable performance in healthcare organisations: A conceptual framework. *Journal of Cleaner Production*, 243, Article 118595.
- Muisyo, P. K., Qin, S., Ho, T. H., & Julius, M. M. (2022). The effect of green HRM practices on green competitive advantage of manufacturing firms. *Journal of Manufacturing Technology Management*, 33(1), 22–40.
- Ojo, A. O., & Raman, M. (2019). Role of green HRM practices in employees' pro-environmental behavior: Conceptual and empirical insights. *Journal of Environmental Management*, 237, 849–857.
- Ojo, A. O., Tan, C. N. L., & Alias, M. (2022). Linking green HRM practices to environmental performance through pro-environment behaviour in the information technology sector. *Social Responsibility Journal*, 18(1), 1–18.
- Opatha, H. H. D. N. P. (2014). *Green human resource management: A simplified introduction*. University of Sri Jayewardenepura.
- Paillé, P., & Boiral, O. (2013). Pro-environmental behavior at work: Construct validity and determinants. *Journal of Environmental Psychology*, 36, 118–128.
- Paillé, P., Chen, Y., Boiral, O., & Jin, J. (2014). The impact of human resource management on environmental performance: An employee-level study. *Journal of Business Ethics*, 121(3), 451–466.
- Patwary, A. K., Rasoolimanesh, S. M., Rabiul, M. K., Aziz, R. C., & Hanafiah, M. H. (2022). Linking environmental knowledge, environmental responsibility, altruism, and intention toward green hotels through ecocentric and anthropocentric attitudes. *International Journal of Contemporary Hospitality Management*, 34(12), 4653–4673.
- Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, 14(3), 179–191.
- Pham, D. D. T., & Paillé, P. (2020). Green recruitment and selection: an insight into green patterns. *International Journal of Manpower*, 41(3), 258–272.
- Pham, N. T., Hoang, H. T., & Phan, Q. P. T. (2020a). Green human resource management: A comprehensive review and future research agenda. *International Journal of Manpower*, 41(7), 845–878.
- Pham, N. T., Hoang, H. T., & Phan, Q. P. T. (2020b). Green human resource management: A comprehensive review and future research agenda. *Journal of Cleaner Production*, 277, Article 124020.
- Pham, N. T., Tucková, Z., & Jabbour, C. J. C. (2019). Greening the hospitality industry: How do green human resource management practices influence organizational citizenship behavior in hotels? *Tourism Management*, 72, 386–399.
- Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. *Journal of Management*, 36(1), 94–120.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63, 539–569.
- Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment–competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118.
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40(3), 879–891.
- Raineri, N. (2017). Linking human resources practices with performance: The simultaneous mediation of collective affective commitment and human capital. *International Journal of Human Resource Management*, 28(22), 3149–3178.
- Rani, R., Mishra, R. K., & Singh, S. (2023). Linking green human resource management and environmental performance: Mediating role of green innovation and moderating role of top management commitment. *Journal of Cleaner Production*, 382, Article 135402.
- Rauter, R., Globocnik, D., Perl-Vorbach, E., & Baumgartner, R. J. (2019). Open innovation and its effects on economic and sustainability innovation performance. *Journal of Innovation & Knowledge*, 4(4), 226–233.
- Renwick, D. W. S., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews*, 15(1), 1–14.
- Ricardo de Souza Freitas, W., José Chiappetta Jabbour, C., & César Almada Santos, F. (2011). Continuing the evolution: Towards sustainable HRM and sustainable organizations. *Business Strategy Series*, 12(5), 226–234.
- Roscoe, S., Subramanian, N., Jabbour, C. J., & Chong, T. (2019). Green human resource management and the enablers of green organisational culture: Enhancing a firm's environmental performance for sustainable development. *Business Strategy and the Environment*, 28(5), 737–749.
- Saeed, B. B., Afsar, B., Hafeez, S., Khan, I., Tahir, M., & Afridi, M. A. (2019). Promoting employee's proenvironmental behavior through green human resource management practices. *Corporate Social Responsibility and Environmental Management*, 26(2), 424–438.
- Sarstedt, M., Ringle, C. M., & Hair, J. F. (2017). Partial least squares structural equation modeling. In *Vol. 26. Handbook of market research* (pp. 1–40).
- Savino, M. M., & Shafiq, M. (2018). An extensive study to assess the sustainability drivers of production performances using a resource-based view and contingency analysis. *Journal of Cleaner Production*, 204, 744–752.
- Shahzad, M., Qu, Y., Rehman, S. U., & Zafar, A. U. (2022). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. *Journal of Innovation & Knowledge*, 7(4), Article 100231.
- Shahzad, M. A., Jianguo, D., & Junaid, M. (2023). Impact of green HRM practices on sustainable performance: Mediating role of green innovation, green culture, and green employees' behavior. *Environmental Science and Pollution Research*, 30(38), 88524–88547.
- Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. *Technological Forecasting and Social Change*, 150, Article 119762.
- Siyambalapitiya, J., Zhang, X., & Liu, X. (2018). Green human resource management: A proposed model in the context of Sri Lanka's tourism industry. *Journal of Cleaner Production*, 201, 542–555.
- Song, W., Wang, G. Z., & Ma, X. (2020). Environmental innovation practices and green product innovation performance: A perspective from organizational climate. *Sustainable Development*, 28(1), 224–234.
- Sutton, R. I., & Staw, B. M. (1995). What theory is not. *Administrative Science Quarterly*, 40(3), 371–384.
- Tang, G., Chen, Y., Jiang, Y., Paillé, P., & Jia, J. (2018). Green human resource management practices: Scale development and validity. *Asia Pacific Journal of Human Resources*, 56(1), 31–55.
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319–1350.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533.

- Wang, Q. J., Wang, H. J., & Chang, C. P. (2022). Environmental performance, green finance and green innovation: What's the long-run relationships among variables? *Energy Economics*, 110, Article 106004.
- Wang, S., Abbas, J., Sial, M. S., Álvarez-Otero, S., & Cioca, L. I. (2022). Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture. *Journal of Innovation & Knowledge*, 7(4), Article 100272.
- Wehrmeyer, W., & Vickerstaff, S. (2017). Analysis for environmental training needs. In *Greening people* (pp. 339–356). Routledge. <https://doi.org/10.4324/9781351283045-17>.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5 (2), 171–180. <https://doi.org/10.1002/smj.4250050207>
- Wright, P. M., Dunford, B. B., & Snell, S. A. (2001). Human resources and the resource-based view of the firm. *Journal of Management*, 27(6), 701–721.
- Wu, R., & Lin, B. (2022). Environmental regulation and its influence on energy-environmental performance: Evidence on the Porter Hypothesis from China's iron and steel industry. *Resources, Conservation and Recycling*, 176, Article 105954.
- Yong, J. Y., Yusliza, M. Y., & Ahmad, N. H. (2022). Connecting green human resource management to performance: Pathways toward sustainability. In *Green human resource management research: Issues, trends, and challenges* (pp. 53–78). Cham: Springer International Publishing.
- Yong, J. Y., Yusliza, M. Y., & Fawehinmi, O. (2019). Green human resource management: A systematic literature review from 2007 to 2019. *Benchmarking: An International Journal*, 27(7), 2005–2027.
- Yong, J. Y., Yusliza, M. Y., Jabbour, C. J., & Sehnem, S. (2020). Green human resource management: Aligning sustainability with employee engagement. *Industrial and Commercial Training*, 52(7/8), 351–360.
- Zaid, A. A., Jaaron, A. A., & Bon, A. T. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production*, 204, 965–979.
- Zhang, J. A., & Edgar, F. (2022). HRM systems, employee proactivity and capability in the SME context. *The International Journal of Human Resource Management*, 33(16), 3298–3323.
- Zhu, Q., Sarkis, J., & Lai, K. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management*, 19(2), 106–117.
- Zibarras, L. D., & Coan, P. (2015). HRM practices used to promote pro-environmental behavior: A UK survey. *The International Journal of Human Resource Management*, 26 (16), 2121–2142.