The intersection of ecological leadership and GHRM: A blueprint for a circular economy

Nosheen Qadeer[1], Noureen Fatima[2]

[1] *Tomas Bata University in Zlin, Faculty of Management and Economics, Czech Republic, ORCID: 0009-0000-1394-3196, qadeer@utb.cz;*
[2] *King Faisal University, College of Business Administration, Human Resource Management, Saudi Arabia, nhayat@kfu.edu.sa.*

Abstract: *The circular economy now plays a crucial role in addressing ecological challenges. The exact function of green human management (GHRM) in transitioning to a circular economy has yet to be determined. Manufacturing firms are taking steps to enhance their sustainability practices to support the circular economy. The relationship between organizational green actions and GHRM in the transition to a circular economy remains uncertain. This study intends to discover the relationship among manufacturing firms' ecological leadership, green HR practices, green innovations, and circular economy models to enhance sustainable performance. 234 survey questionnaires from Pakistani small and medium-sized manufacturing industries were evaluated using structural equation modelling with partial least squares. GHRM had a positive and significant impact on circular economy and green innovation actions, as shown by the findings. This framework is specifically designed for manufacturing SMEs in Pakistan. The architecture can be adapted to different industries with minor modifications. The study may be biased due to its reliance on management and specialists. This study's findings will significantly contribute to human resources managers and SME owner-managers by clarifying the significance and interplay of essential green innovation components and GHRM. This will enlighten awareness of ecological leadership, circular economy, and GHRM practices for sustainable performance. The proposed framework simplifies the connection between ecological leadership, GHRM components, and circular economy for practitioners and decision-makers. Environmental leaders effectively encourage businesses to invest in proactive environmental strategies, lower pollution control, and enhance the performance of green innovation, all while promoting a green image and advancing environmental protection practices. This study determines the appropriate relationship between ecological leadership, circular economy, and GHRM components in the limited Pakistani manufacturing SME environment.*

Keywords: *Ecological leadership, green human resource management practices (GHRM), green innovation actions, circular economy, sustainable performance.*

JEL Classification: *D83, E22, L00.*

APA Style Citation: Qadeer, N., Fatima, N (2025). The intersection of ecological leadership and GHRM: A blueprint for a circular economy. *E&M Economics and Management*, *28*(3) 69–86. https://doi.org/10.15240/tul/001/2025-5-019

Early Access Publication Date: *July 10, 2025.*

Introduction

In Pakistan, SMEs make up to 40% of the country's GDP, 25% of its exports, 80% of its workforce, and 35% of its added value in the industrial sector (Khan et al., 2019; Kumar et al., 2013). However, because of their commercial operations, SMEs in the textile, metallurgy, and non-metallurgy sectors have a significant negative influence on the environment (Boiral et al., 2019). Research on ecological management has demonstrated that creating an innovative environment in businesses results in resource management (Awan et al., 2019). Particularly, consumers are putting more and more pressure on businesses to carry out ecological management initiatives to promote green development without negatively impacting the industry's ability to operate sustainably in Pakistan (Iqbal et al., 2023). Increased knowledge is therefore required on which ecological management practices, like resource reutilizing and leftover reduction (Awan et al., 2019), impact the circular economy. Circular economy, which focuses on recycling, repair, reuse, remanufacturing, altering consumption patterns, product sharing, new business systems, and modularization, is the optimal approach for sustainable manufacturing (Khan et al., 2024). The inappropriate usage and disposal of chemicals in manufacturing industries pose significant risks to ecosystems, human health, and environmental stability. Industrial chemicals capable of interacting with the endocrine system are referred to as toxic or those requiring brute force (Cooper et al., 2011). In the production of numerous goods, "monstrous hybrids" and "culture of monoculture," e.g., palm or soya plantations, are also common. For example, an ordinary juice container is constructed of many polymers, cardboard, and glue and lacks easily disassembled elements (Suárez-Eiroa et al., 2019). Ecological leaders aim to establish a production system that is truly good for the environment, as opposed to promoting affluence through the excavation, harvesting, and burning of natural resources as well as the erosion of species diversity and cultural practices (Urbinati et al., 2017). Using the variations in the soil and climate, resources, and local knowledge, ecological leaders would aim to counteract the previous management approaches that promoted such wasteful output (McDonough & Braungart, 2002). Ecological leaders aim to establish a production system that is truly good for the environment, as opposed to promoting affluence through the excavation, harvesting, and burning of natural resources as well as the erosion of species diversity and cultural practices (Moktadir et al., 2020).

The current study addresses the gap in our understanding by examining the mediating role that circular economy and green innovation actions play in the relationship between ecological leadership and sustainable performance. As green innovation actions are the most established concept while introducing ecological leadership will help to improve innovation actions (He et al., 2023; Khanra et al., 2022) in manufacturing firms with the well utilized of resources and minimize waste (RBV). Specifically, it has created new insights by examining the boundary conditions of green HRM and ecological leadership, green innovation actions, circular economy, and sustainable performance linkages. This research has made significant contributions to the academic literature. The study's findings contribute to the global discussion on sustainable development by tackling well-known challenges, including integrating leadership, innovation, and sustainability practices. The global literature is supplemented by providing a model that can be tailored to fit various contexts and sectors.

The research brings together various strands of information, thereby broadening academic knowledge of sustainability frameworks while also offering practical methods for companies to attain their sustainability objectives, thereby making a significant contribution to both theoretical and applied fields. RBV theory has been used for these linkages to explain the best theoretical background and the best usage of organizational resources. Through data collection from Pakistani manufacturing companies, the present study aimed to investigate the following research inquiries: 1) To what extent do green innovation actions and circular economy operate as a mediator in the relationship between ecological leadership and sustainable performance? 2) How far does green HRM highlight the connection between ecological leadership and green innovation actions, and the circular economy? Furthermore, to what degree do green innovation actions and circular economy contribute to long-term sustainable performance? The extremely polluting manufacturing sector, which is the subject

of this research, is responsible for a significant quantity of pollution in Pakistan (Muisyo & Qin, 2021) and is growing annually. According to Hannah et al. (2020), the manufacturing industry generated 55.6 million carbon dioxide (CO_2) emissions in 2018, indicating a decrease from 52.6 million tons and 46.47 million tons in 2017 and 2016, respectively. We believe that this strategy would help minimize the environmental impact that manufacturing organizations create and show the connection between the circular economy, green innovation efforts, sustainable performance, ecological leadership, and green HRM.

The remainder of the work is organized as follows: section 1 presents the derived hypotheses and the literature review. Section 2 covers the research methodology. The results and analysis are shown in section 3. The conclusions, restrictions, and recommendations for further study round up in the last section.

1 Theoretical background

1.1 Resource-based view theory

The pioneers of the resource-based theory (RBV) were Barney (1996) and Barney (1991). It outlined the company's assets, competencies, and connection to competitive advantages. Hart (1995) expounded upon the fundamental idea of this theory, indicating that companies allocate their resources to enhance their capacity to attain a competitive edge. The term resource-based view (RBV) is a strategic management concept that emphasizes the importance of an organization's internal resources in gaining and maintaining a competitive edge. Resources that are rare, precious, unique, and non-substitutable (VRIN) can help businesses outperform their rivals. Together with intangible assets like intellectual property, brand recognition, organizational culture, or specialized skills, these resources might also comprise tangible assets like property or machinery. As per the RBV, companies that efficiently utilize these resources can generate distinctive competencies, hence enabling them to surpass rivals in the long run. According to the concept, which is not all resources result in a competitive advantage; only those that are difficult for rivals to copy or replace offer long-term value. In contrast to Michael Porter's five forces model, which emphasizes external market variables and industry structure, RBV places more emphasis on the internal capabilities of the company, contending that a company's performance is determined by its particular combination of assets and skills. The resource-based view (RBV) theory links green innovation activities by showing how companies can utilise their distinctive resources and skills to develop environmentally friendly innovations, resulting in both environmental and competitive benefits. Manufacturing firms can build distinctive capabilities in resource optimisation, environmental innovation, and the design of sustainable products. These features are in line with industry objectives set by CE and can serve as potential sources of competitive advantage. The current analysis aligns with the resource-based perspective theorem. Similarly, the resources and abilities of the businesses to attain circular economy benefits as a result of sustainable performance are how ecological leadership, green HRM, and GI actions are classified in the current research.

1.2 Hypothesis development

Ecological leadership and sustainable performance

The capacity to persuade people and organize groups to realize a goal of long-term ecological sustainability is known as ecological leadership (Egri & Herman, 2000). In order to address ecological concerns, executives must proactively participate in and modify their strategies, internal practices, and management systems in response to ecological challenges faced by businesses (Boiral, 2009). Considering that senior management plays a critical role in encouraging employees to participate in the company's ecological initiatives without having a detrimental impact on the environment, based on striking a balance between the environment and the economy (Boiral, 2009). Ecological leadership demonstrates a strong commitment to sustainable development and ecological preservation. Firms that exhibit strong ecological leadership are better equipped to handle the challenges posed by external ecological pressures (Afsar et al., 2018), conserve energy and resources, reduce greenhouse gas emissions, and fulfil their social and ethical obligations (Jiang et al., 2020). By doing this, businesses will be better equipped to comprehend and identify opportunities for innovation and development as well as external ecological pressure, leading to the eventual acceleration of low-carbon development to significant levels

(Xu et al., 2018). Moreover, companies can enhance their green innovation skills, integrate low-carbon innovation to strategic heights, and incorporate internal innovation resources with the support of strong top management ecological leadership (Aftab et al., 2023). According to Biedenkopf et al. (2020), innovative ideas, products, and techniques can be developed, implemented, and promoted by companies with strong ecological leadership, thereby strengthening their eco-friendly initiatives. Ecological leaders are dedicated to organisational change, which includes finding eco-friendly production processes, setting up contamination monitoring systems, and improving workers' ecological knowledge. They also better understand the value of ecological management and pay particular attention to stakeholder expectations (Papagiannakis & Lioukas, 2012).

Therefore, we suggest that the presence of ecological leadership has a positive relationship with sustainable performance.

H1: Ecological leadership positively links with sustainable performance.

Green innovation action as a mediator

According to Peterson et al. (2003), the literature on green innovation actions has highlighted the importance of the top management's role in the process of making a strategic decision, which ultimately affects the outcome of the organisation. Lin Moe (2012) states that ecological leadership is a key factor that prevents businesses from implementing management methods. The top managers' environmental consciousness and actions send a strong message to their subordinates that green innovation methods that improve overall organisational performance will be supported. According to Aldieri et al. (2021), implementing green innovations will increase productivity. The goal of green innovation initiatives is to reduce harmful environmental effects such as product dumping, material waste, and air pollution. A well-thought-out plan can help to improve environmental performance, according to an earlier study (Wagner & Schaltegger, 2004). More specifically, a company's environmental image can be established with the aid of green innovation methods, which can improve the company's positive organisational reputation, boost sales, and create a new market for hidden capital (Fraj-Andrés et al., 2009). Green innovation techniques help to increase resource productivity and find new revenue streams by making better use of labour, energy, and raw materials. In addition to achieving higher sustainable performance, it can offset the expense of environmental preservation entirely or in part (Aldieri et al., 2021). Furthermore, taking action in the area of green innovation is crucial for enhancing an organization's reputation. A positive corporate image can boost government funding, increase consumer inclination to buy, increase worker satisfaction, and assist businesses in achieving sustainable performance. Therefore, this research suggests the following hypothesis:

H2: Green innovation actions mediate the relationship between ecological leadership and sustainable performance.

Circular economy as a mediator

Ecological leadership committed to the circular economy establishes metrics to track waste reduction, recycling rates, and resource efficiency, thereby ensuring transparency and accountability. Initiatives focused on a circular economy are being reported on to illustrate a company's commitment and showcase its progress (Irawan & Widodo, 2024; Zhou et al., 2024). To reduce the adverse effects on the environment, ecological leadership involves making tactical, operative, and strategic decisions in all business activities. Businesses have integrated commercial strategies with environmental management techniques (Tiwari et al., 2024). Circular economy decreases the flow of materials at each point of the value chain, prioritising resource and energy efficiency (Aranda-Usón et al., 2020). The circular economy aims to decrease natural resource waste and protect the environment, preserving biodiversity and mitigating climate change (Stewart & Niero, 2018). By reducing the number of resources or using recycled raw materials to maintain a consistent level of production, the circular economy model uses fewer resources (Figge et al., 2018). The principles of reduction, reuse, recycling, refurbishment, remanufacturing, and recovery underpin the circular economy (Pieroni et al., 2019). In order to help companies derive high economic value from their material life cycles, the circular economy is expanding the current ecological leadership management system (Stahel, 2019). In this context, businesses need to produce goods and services that meet the social and environmental requirements of the circular economy. As a result, the circular economy encourages

sustainable management that occurs both within and between organisations (Korhonen et al., 2018). Environmental laws and government incentives have influenced the company's sustainable corporate environmental practices on a micro level (Aranda-Usón et al., 2024). Government-made legislation to the circular economy should, however, endorse design, evaluation, payment, and sorting mechanisms for recyclable goods at each step of the supply chain, in addition to waste disposal and recycling (Jia et al., 2020). Therefore, this research suggests the following hypothesis:

H3: Circular economy mediates the relationship between ecological leadership and sustainable performance.

GHRM as a moderator

According to Muisyo and Qin (2021), a few of the practices covered by GHRM are ecological leadership that creates a beneficial effect on the environment, performance evaluations, instruction, growth, and green hiring. Sustainable product development, process innovation, and environmental effectiveness are together referred to as GI actions. According to Singh et al. (2020), GHRM actively contributes to the creation of a GI action that results in environmental performance that is participatory and preserved. The positive correlation between GHRM and GI action was highlighted by Song et al. (2021), who also explained how GHRM is linked to high company management of environmental problems. The management GHRM exercises in green hiring, training, and development, as well as their impact on GI actions, were highlighted by Sobaih et al. (2020). Additionally, Mishra et al. (2014) emphasised how GHRM has an impact on ecological leadership, and GI actions have a good relationship that has advanced sustainable development in manufacturing firms. Ren et al. (2018) acknowledged that sustainable environmental performance and development are achieved by GHRM, which also develops green exercises and GI actions. Furthermore, it has been suggested by several previous studies (Khan et al., 2024) that companies that use GHRM and GI actions are very successful and respond to customers rapidly. Consequently, the following is the research hypothesis:

H4: GHRM moderates the relationship between ecological leadership and green innovation actions.

In a summary of the circular economy, Marrucci et al. (2023) found a correlation between performance outcomes and GHRM practices. Their results point to the potential for GHRM in high-performing companies to turn into an exclusive practice. The importance of GHRM initiatives and their connection to ecological leadership and circular economy were also proven by the study (Del Giudice et al., 2018; Dibia et al., 2020). Additionally, Popović (2020) went into detail about the connections with sustainable circular economy and the good relationship between green HRM practices and the green environmental approach. According to Sassanelli et al. (2019), these investigations supported the methodical relationship between circular economy, HR practices, and GHRM for firms. D'Adamo (2019), underlined the connection between human practices and the prospects of sustainable performance. As stated by Chau et al. (2024), and other environmentally conscious organisations, the circular economy is actually the closed-loop architecture that manufacturing companies have embraced for the post-consumption phase with GHRM practices. In response to social injustice, climate change, and worldwide limits of natural resources, sustainable development has produced a relationship between GHRM and circular economy (Khan et al., 2024). Green human resource management incorporates environmental principles into human resource practices, promoting a workforce that is environmentally aware and encouraging behaviors that support ecological leaders to promote the circular economy, which are valuable, rare, and unique resource for achieving a sustainable goal, as stated by the resource-based view theory. RBV theory advocates for harmonizing GHRM and circular economy approaches to meet stakeholder requirements, thereby boosting employee well-being, customer retention, and environmentally sustainable practices. Aligning strategies promotes a green work environment, enhances environmental results, and develops robustness within the manufacturing industry (Awan et al., 2023; Elshaer et al., 2024). So GHRM is important for the employees and managers to give them training on recycling and reusing waste while using the resources in a well-mannered way. Therefore, the scientists hypothesize that:

H5: GHRM moderates the relationship between ecological leadership and circular economy.

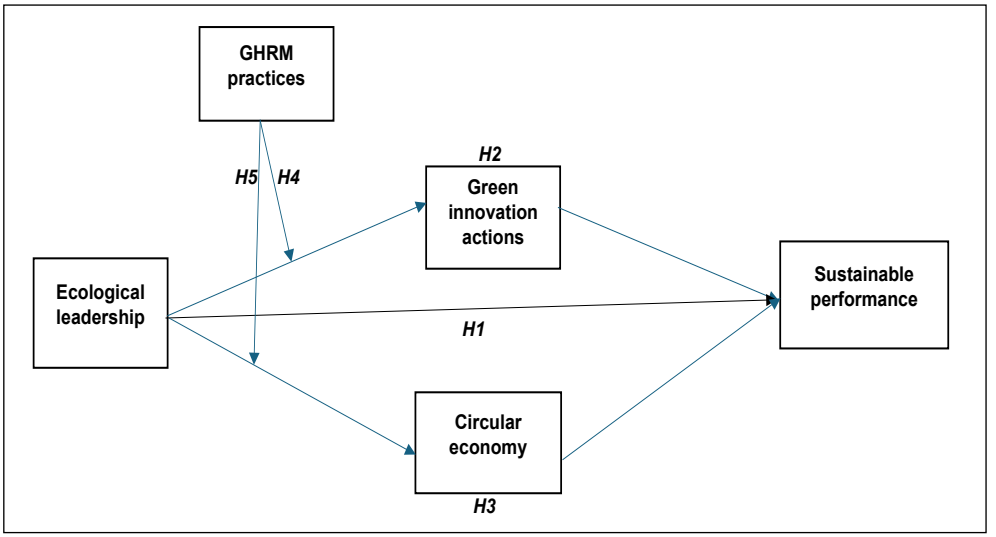

Fig. 1: Theoretical framework

Note: Blue arrows show mediation and moderation effects.

Source: own

Therefore, Fig. 1 serves as the basis for the theoretical framework that follows.

2 Methodology

2.1 Sampling and data collection

Pakistan's industry is particularly sensitive to changes in the internal working environment, making the context of small and medium-sized firms crucial (Awan et al., 2019). According to Dulock (1993), the study's descriptive research plan was centred on outlining and evaluating the hypotheses. Therefore, the present study used primary data for analysis (Hox & Boeije, 2005). In this study, simple probability random sampling technique was used. This makes it possible to choose a sample from any member of the target population (Olken & Rotem, 1995). Data were gathered using the survey questionnaire technique, which included a 7-point Likert scale (Harkness et al., 2004). SMEs in Pakistan's manufacturing industry were, hence, the study's target group. Using a Google form, managers of the SME businesses that served as informants provided the data. A total of 400 questionnaires were distributed and 300 data was collected from medium-sized firms. Ultimately, 234 samples were accepted, and 66 were discarded because of missing data. Data analysis techniques including confirmatory factor analysis, measurement model evaluation, structural model assessment, moderation analysis (interaction terms) and mediation analysis (indifference effect), were performed using Smart PLS software.

2.2 Measures

Every measurement used in the research was modified from earlier research and measure all items on 7-point Likert scale. Ecological leadership has 5-items adapted from Bass (1985). The GHRM consisted of thirteen items, drawn from Renwick et al. (2013) and Sun et al. (2007). In a similar vein, GI actions has 3-items, adapted from Zhang et al. (2015). Ten components that were modified from Zeng et al. (2017) made up the circular economy. Sustainable performance has 6-items adapted from Le et al. (2024). Furthermore, the research employed control variables such as the number of employees, respondent age, company age, management level, and educational attainment. The data was collected from the manufacturing firms having a minimum of 500–1,000 employees. Smaller companies or teams may

exhibit distinct behavior compared to larger ones as a result of limited resources or varying levels of organizational hierarchy. Accounting for these variations guarantees that results are not skewed by the dimensions of the entities being studied. To verify the scale reliability, the survey questionnaires were also pre-tested on a small sample of the intended population before conducting a full-scale study.

3 Results

Ali et al. (2018), recognized as a cutting-edge, versatile, and adaptive measuring tool is partial least squares structural equation modeling (PLS-SEM). Similarly, PLS-SEM was recommended for widespread use in the analysis by Hair et al. (2011) and Ringle et al. (2009). However, when it comes to minimal requirements for data and data normality, PLS-SEM is also quite appropriate (Joseph et al., 2022). For assessment and hypothesis estimation, the study, therefore, used Smart PLS. It is advised to use a two-step approach, which is ideal for social science research, when summarising and emphasising the findings. Convergent validity and discriminant validity evaluation procedures are used in the first phase to deploy measurement model value through confirmatory factor investigation. In the following stage, path analysis (direct relationship), indirect effect analysis (mediation), and interaction term assessment (moderation) are used by the structural model valuation (SEM).

3.1 Common method bias

The data used in the research was provided by a few selected SMEs in Pakistan. It is advised to conduct collinearity test in this case to confirm that the dataset's collinearity continues in light of the previously supplied information, as there may be standard method bias. According to Kock (2015), if a score more than 3.3 indicates that there may be collinearity issues with the data. The findings of this study showed that there were no common biasness problems in the dataset, as indicated by the collinearity test score being less than 3.3. Harman's single-factor test was employed to tackle this issue. The KMO was above the accepted value at 0.908, and Bartlett's test of sphericity was also statistically significant (Field, 2013; Kaiser, 1974), indicating the exclusion of common source bias.

3.2 Data normality and descriptive statistics

Generally, PLS-SEM pays less attention to data normality, which is indicative of a non-parametric tool. In order to ensure that the data are normal (Hair et al., 2007), highlighted that only inferential statistical tests should be performed. Many methods, including histogram plots, kurtosis,

Tab. 1: Descriptive statistics and data normality

Sr.	Construct	Mean	SD	SK	KU	1	2	3	4	5	6	7	8	9
1	*EL*	2.870	1.102	0.169	−0.345	1								
2	*GHRM*	3.176	1.020	0.133	−0.148	0.271**	1							
3	*GIA*	2.523	1.150	0.750	0.143	0.359**	0.185**	1						
4	*CE*	2.588	0.909	0.044	−1.197	0.480**	0.246**	0.416**	1					
5	*SP*	3.074	1.181	0.169	−0.784	0.488**	0.475**	0.441**	0.524**	1				
6	*Education*	2.509	0.517	−0.221	−1.518	0.072	0.202**	0.109	0.119	0.203**	1			
7	*Firm size*	1.295	0.465	1.033	−0.591	−0.019	0.052	0.050	0.050	0.100	−0.019	1		
8	*Firm age*	4.295	2.141	0.080	−0.819	0.158*	−0.032	0.142*	0.063	0.032	0.158	−0.032	1	
9	*Team size*	4.556	0.905	−1.819	2.316	−0.010	−0.166*	−0.025	0.051	−0.052	−0.010	−0.166*	−0.025	1

Note: *EL* – ecological leadership; *GHRM* – green human resource management; *GIA* – green innovation actions; *CE* – circular economy; SD – standard deviation; SK – skewness; KU – kurtosis; ** correlation at 0.01 level of significance; * correlation at 0.05 level of significance.

Source: own

and skewness, are used to establish the normality of the data (Munro, 2005). The data in Tab. 1 is considered normal when it meets the data normality criteria, which extends from −2 to +2. Tab. 1 illustrates how the data is consistently dispersed for SMEs. The descriptive statistical analysis for SMEs utilising different averages and the standard deviation is also highlighted in Tab. 1. A correlation analysis was also performed to confirm that the constructs were mutually associated. The findings showed that correlation outcomes are acceptable for SMEs and range from −1 to +1 (Godfrey, 1988). Thus, PLS-SEM was used to perform additional inferential statistics.

3.3 Measurement model assessment

The validity and reliability of the items are confirmed by the measurement model assessment, which is evaluated using convergent and discriminant validity. Factor loading, average variance extracted (AVE), and composite reliability (CR) are assessed in order to demonstrate the convergent validity, which is carried out using a confirmatory factor analysis technique. Factor loading levels are more significant than 0.50 (Tab. 2). According to Hair et al. (2017), the loading values for both SMEs are legitimate and appropriate. However, CR is used to illustrate reliability. According to Hair Jr et al. (2014), the acceptable threshold should be greater than 0.70. According to a method proposed by Hair Jr et al. (2014), items with loadings ranging from 0.40 to 0.70 should be eliminated from evaluation if deleting the observed variable could increase the composite reliability in the reflective scales. As a result, due to the higher AVE values, item CE10 of the circular economy has been abolished. Factor loadings, CR, and AVE computations will be greater than the recommended cut-off values if certain components are removed. CR values are significant and appropriate for SMEs, as Tab. 2 demonstrates. In a similar vein, AVE presents internal validity. Tab. 3 shows that significant or acceptable AVE values for SMEs are larger than 0.50 (Cheung & Wang, 2017).

Tab. 2: Confirmatory factor analysis (convergent validity) – Part 1

Constructs	Items	FL	CR	AVE
Ecological leadership	*EL1*	0.836	0.906	0.659
	EL2	0.855		
	EL3	0.796		
	EL4	0.826		
	EL5	0.741		
Green human resource management practices	*GHRM1*	0.784	0.938	0.539
	GHRM2	0.741		
	GHRM3	0.798		
	GHRM4	0.726		
	GHRM5	0.761		
	GHRM6	0.692		
	GHRM7	0.712		
	GHRM8	0.761		
	GHRM9	0.745		
	GHRM10	0.643		
	GHRM11	0.783		
	GHRM12	0.712		
	GHRM13	0.669		

Tab. 2: Confirmatory factor analysis (convergent validity) – Part 2

Constructs	Items	FL	CR	AVE
Green innovation actions	*GIA1*	0.869	0.908	0.767
	GIA2	0.897		
	GIA3	0.861		
Circular economy	*CE1*	0.762	0.929	0.593
	CE2	0.739		
	CE3	0.754		
	CE4	0.772		
	CE5	0.764		
	CE6	0.829		
	CE7	0.741		
	CE8	0.783		
	CE9	0.781		
Sustainable performance	*SP1*	0.785	0.897	0.594
	SP2	0.723		
	SP3	0.785		
	SP4	0.753		
	SP5	0.816		
	SP6	0.757		

Note: FL – factor loading; CR – composite reliability; AVE – average variance extracted.

Source: own

Additionally, the heterotrait-monotrait criteria (HTMT) are used to emphasise the examination of discriminant validity. According to Kline (2012), construct values less than 0.85 signify that the variables' validity is acceptable. The HTMT requirements for the constructs are less than 0.85 and significant, as Tab. 3 demonstrates.

Tab. 3: HTMT ratio

Constructs	*EL*	*GHRM*	*GIA*	*CE*	*SP*
EL					
GHRM	0.305				
GIA	0.418	0.209			
CE	0.543	0.272	0.475		
SP	0.562	0.527	0.518	0.658	

Note: *EL* – ecological leadership; *GHRM* – green human resource management; *GIA* – green innovation actions; *CE* – circular economy.

Source: own

3.4 Structural model assessment

The structural model (PLS-SEM) assessment includes path analysis, mediation, moderation, and slope analysis. The framework of SP for SMEs (Gudergan et al., 2008) incorporates the validation of models and the verification of hypotheses. Moreover, the validation of β, standard error (SD), and *t*-values reflects the authenticity of the hypothesis. The values of $t > 1.495$ and $p < 0.05$ suggest that the hypotheses are accepted. The relationships between the variables in the hypotheses in the scenarios of direct, indirect, and moderation impact on SP were supported by Tab. 4, Fig. 2. The findings demonstrated that practically every hypothesis has strong support, else one moderation.

Tab. 4: Path analysis (structural equation modelling)

Hypothesis	Relationship	β	SD	*t*	Decision
H1	*EL → SP*	0.262	0.064	4.121	Supported
H2	*EL → GIA → SP*	0.072	0.025	2.812	Supported
H3	*EL → CE → SP*	0.140	0.034	4.130	Supported
H4	*EL * GHRM → GIA*	0.144	0.067	2.154	Supported
H5	*EL * GHRM → CE*	0.101	0.067	1.496	Not Supported

Note: *EL* – ecological leadership; *GHRM* – green human resource management; *GIA* – green innovation actions; *CE* – circular economy.

Source: own

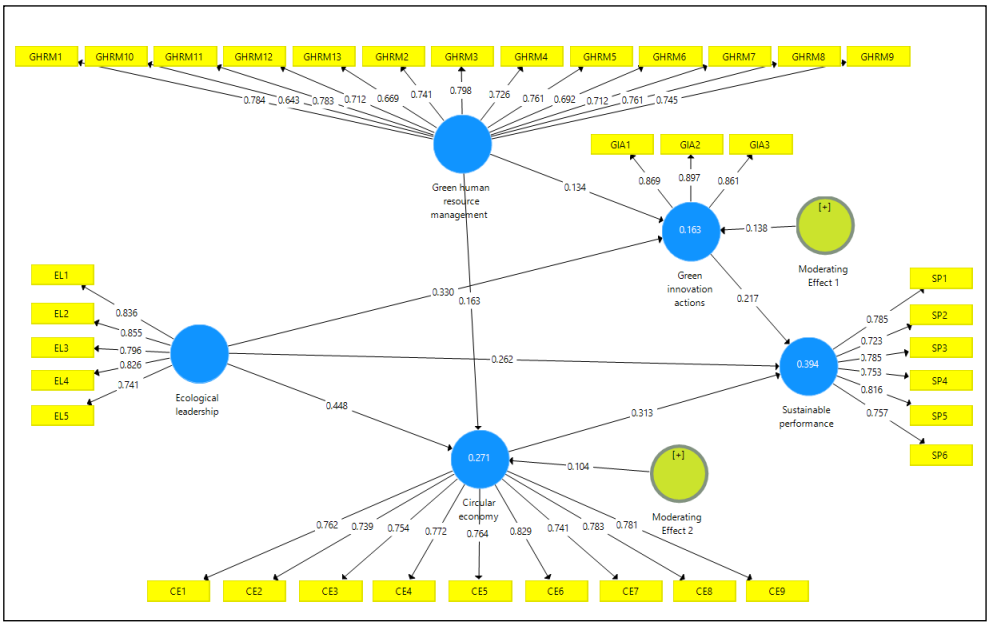

Fig. 2: Structural equation modelling

Source: own

As a result, the findings demonstrated the following relationships: EL with SP for SMEs (β = 0.262; *t* = 4.121), hypothesis *H1* supported and mediation of GIA between EL and SP (β = 0.072; *t* = 2.182), *H2* supported and for second mediation with CE between EL and SP (β = 0.140; *t* = 4.130), *H3* supported. As well as for moderation analysis of GHRM between EL and GIA (β = 0.144; *t* = 2.154), *H4* is supported, and for other moderation analysis of GHRM between EL and CE (β = 0.101; *t* = 1.696), *H5* is not supported as the *t*-value is less than 1.90.

Conclusions and discussion

This study applied the SEM method to explore ecological leadership in circular economy and sustainable manufacturing. This study examined ecological leadership's impact on sustainable performance. The study further examined how green human resources management practices influenced the green innovation and the circular economy on Pakistan's manufacturing sectors' sustainability. Ecological leadership positively impacts sustainable performance. The results showed that all factor loadings, composite reliability (CR), and average variance extracted (AVE) met the required standards, thereby validating the construct's validity and reliability, and the hypothesis testing results also strongly supported the proposed model, which exhibited statistically significant and positive correlations between the variables else one. This discovery adds to the existing research on this connection in other contexts. Top managers who effectively implement environmental practices can successfully balance the demands of other financial stakeholders and environmental protection for sustained economic growth (Kim & Stepchenkova, 2018). Green innovation actions mediate the relationship between ecological leadership and sustainable performance. According to previous findings in manufacturing firms by Aldieri et al. (2019), ecological leadership is positively associated with sustainable performance through making environmental conservation a top priority and business value. The association established by Roh et al. (2021) between green innovation initiatives and a greener organization supports the proposition that adopting eco-friendly practices is promoted by such initiatives. The circular economy's influence on ecological leadership promotes sustainable performance (*H3*). The study's findings provide evidence for the positive association between ecological leadership and sustainable performance (Obeidat et al., 2023). *H4* reveals how GHRM practices contribute to green innovation actions and enhance sustainable performance in manufacturing firms, in alignment with Elsamahy et al. (2023) research. Green human resource management techniques positively reduce the negative effect of environmental management on sustainable performance (O'Donohue & Torugsa, 2016). This finding strengthens the assertions of other researchers (Bhatti et al., 2022) that green HRM practices promote sustainability via green innovation actions and programs. This study introduces a novel link between ecological leadership and circular economy through the moderate role of GHRM practices in hypothesis *H5*. In the manufacturing sector of developing countries, the circular economy is a novel concept. So, the hypothesis was not supported. Our findings are in line with the previous research (Dhir et al., 2021). In several emerging economies, particularly in Pakistan, the circular economy remains a developing concept. Insufficient infrastructure, resources, and government backing may impede its integration, thus lessening the importance of GHRM as a moderator.

Theoretical contribution. This study significantly contributes to the literature and theory. First, by doing extensive data research, this study advances our understanding of green projects. The main focus is that manufacturing companies may fully utilise GI actions and CE by implementing GHRM practices, especially if they depend more on sustainable performance. Second, we propose that company resources, as shown in ecological leadership and GHRM practices, affect firm green innovation actions and circular economy, which in turn affect sustainable performance, based on RBV theory. Likewise, the research has established a unique relationship with the resource-based view theory. Its application gave Pakistani small and medium-sized businesses in the manufacturing industry a competitive edge in the CE framework. The study identifies a moderating role for GHRM practices in the relationship between ecological leadership and GI actions, specifically in the context of small and medium-sized businesses. The study emphasizes the role of GHRM practices in strengthening the relationship between ecological leadership and CE, notably for small and

medium-sized enterprises. In the agenda for improving CE in the 21st century digitalization era. All of the study's constructs are essentially strategic environmental toolkits that provide researchers additional avenues to pursue.

Practical implications. The study has practical ramifications in addition to theoretical ones. This study, focusing on circular economy performance and UN sustainable development goals, particularly benefits small and medium-sized manufacturing enterprises. Ecological leadership and green innovation activities are crucial for achieving sustainable performance. We propose that managers should take into account the impact of integrating green innovation into operations. GHRM produces a fundamental change in GI, which is why managers need to understand that GI includes product sharing, recycling, repairing, reusing, and remanufacturing. Our research suggests that in order to generate GI and CE, practitioners should talk about the operational level responsibilities of environmental leaders and GHRM. The study's application, efficacy, implementation, efficiency, and functionality of CE in the manufacturing sector make it crucial. By developing a strategic environmental toolbox, the study would assist in creating a green HR environment and boost CE. It would also help provide the foundation for policy texts. The study's conclusion, therefore, provides senior management in the textile industry with enlightening guidance on how to deviate from conventional HR practices and emphasize GHRM as a way to advance the interests of the company and the community. The research aims to enable managers of comparable small and medium-sized firms to effectively convey the significance of the circular economy and its environmental conservation implications. This study can enhance the effectiveness, practicality, safety, and productivity of CE programs for SME employees. The current study, due to its emphasis on environmental safety, is suitable for waste recycling, repair, reuse, and remanufacturing.

Future direction and limitations. The study includes both theoretical and practical implications, the research has some limitations, and offers of recommendations for the future. Pakistan and other developing economies are the subject of the current study. However, for comparison, future studies need to concentrate on developed economies under CE conditions. The current study, which focuses on SMEs, is significant for businesses in the industry. According to this, future research should be done with a focus on different industrial sectors in different companies in order to achieve more comprehensive results. The current study focused on the moderator roles of GHRM practices and the mediator function of GI actions and CE to emphasise the distinct conceptual structure of ecological leadership about the sustainable performance. As a result, in order to expand on new links, further research should focus on different methodology approaches. should be conducted employing other criteria and different industries, such as moderating major data investment. Future research in GHRM and CE should integrate knowledge management practices. Future research could also examine the mediating influence of pro-environmental consciousness and socially responsible actions in the context of GHRM adoption and sustainable outcomes.

References

Afsar, B., Cheema, S., & Javed, F. (2018). Activating employee's pro-environmental behaviors: The role of CSR, organizational identification, and environmentally specific servant leadership. *Corporate Social Responsibility and Environmental Management*, *25*(5), 904–911. https://doi.org/10.1002/csr.1506

Aftab, J., Sarwar, H., Kiran, A., Qureshi, M. I., Ishaq, M. I., Ambreen, S., & Kayani, A. J. (2023). Ethical leadership, workplace spirituality, and job satisfaction: Moderating role of self-efficacy. *International Journal of Emerging Markets*, *18*(12), 5880–5899. https://doi.org/10.1108/ijoem-07-2021-1121

Aldieri, L., Carlucci, F., Vinci, C. P., & Yigitcanlar, T. (2019). Environmental innovation, knowledge spillovers and policy implications: A systematic review of the economic effects literature. *Journal of Cleaner Production*, *239*, 118051. https://doi.org/10.1016/j.jclepro.2019.118051

Aldieri, L., Kotsemir, M., & Paolo Vinci, C. (2021). Environmental innovations and productivity: Empirical evidence from Russian regions. *Resources Policy*, *74*, 101444. https://doi.org/10.1016/j.resourpol.2019.101444

Ali, F., Rasoolimanesh, S. M., Sarstedt, M., Ringle, C. M., & Ryu, K. (2018). An assessment of the use of partial least squares structural equation modeling (PLS-SEM) in hospitality research. *International Journal of Contemporary*

Hospitality Management, *30*(1), 514–538. https://doi.org/10.1108/ijchm-10-2016-0568

Aranda-Usón, A., Portillo-Tarragona, P., Scarpellini, S., & Llena-Macarulla, F. (2020). The progressive adoption of a circular economy by businesses for cleaner production: An approach from a regional study in Spain. *Journal of Cleaner Production*, *247*, 119648. https://doi.org/10.1016/j.jclepro.2019.119648

Aranda-Usón, A., Scarpellini, S., & Moneva, J. M. (2024). Dynamic capabilities for a "circular accounting" and material flows in a circular economy. *Resources, Conservation and Recycling*, *209*, 107756. https://doi.org/10.1016/j.resconrec.2024.107756

Awan, F. H., Dunnan, L., Jamil, K., & Gul, R. F. (2023). Stimulating environmental performance via green human resource management, green transformational leadership, and green innovation: A mediation-moderation model. *Environmental Science and Pollution Research*, *30*(2), 2958–2976. https://doi.org/10.1007/s11356-022-22424-y

Awan, U., Khattak, A., & Kraslawski, A. (2019). Corporate social responsibility (CSR) priorities in the small and medium enterprises (SMEs) of the industrial sector of Sialkot, Pakistan. In *Corporate social responsibility in the manufacturing and services sectors* (pp. 267–278). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-33851-9_15

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Barney, J. B. (1996). The resource-based theory of the firm. *Organization Science*, *7*(5), 469–469. https://doi.org/10.1287/orsc.7.5.469

Bass, B. M. (1985). Leadership: Good, better, best. *Organizational Dynamics*, *13*(3), 26–40. https://doi.org/10.1016/0090-2616(85)90028-2

Bhatti, S. H., Saleem, F., Murtaza, G., & Haq, T. U. (2022). Exploring the impact of green human resource management on environmental performance: The roles of perceived organizational support and innovative environmental behavior. *International Journal of Manpower*, *43*(3), 742–762. https://doi.org/10.1108/ijm-05-2020-0215

Biedenkopf, K., Eynde, S., & Bachus, K. (2020). Environmental, climate and social leadership of small enterprises: Fairphone's step-by-step approach. In *Pioneers, leaders and followers in multilevel and polycentric climate governance* (pp. 43–63). Routledge.

Boiral, O. (2009). Greening the corporation through organizational citizenship behaviors. *Journal of Business Ethics*, *87*(2), 221–236. https://doi.org/10.1007/s10551-008-9881-2

Boiral, O., Ebrahimi, M., Kuyken, K., & Talbot, D. (2019). Greening remote SMEs: The case of small regional airports. *Journal of Business Ethics*, *154*(3), 813–827. https://doi.org/10.1007/s10551-017-3447-0

Chau, K. Y., Huang, T., Moslehpour, M., Khan, W., Nisar, Q. A., & Haris, M. (2024). Opening a new horizon in green HRM practices with big data analytics and its analogy to circular economy performance: An empirical evidence. *Environment, Development and Sustainability*, *26*(5), 12133–12162. https://doi.org/10.1007/s10668-023-03725-9

Cooper, J. E., Kendig, E. L., & Belcher, S. M. (2011). Assessment of bisphenol A released from reusable plastic, aluminium and stainless steel water bottles. *Chemosphere*, *85*(6), 943–947. https://doi.org/10.1016/j.chemosphere.2011.06.060

Del Giudice, M., Soto-Acosta, P., Carayannis, E., & Scuotto, V. (2018). Emerging perspectives on business process management (BPM): IT-based processes and ambidextrous organizations, theory and practice. *Business Process Management Journal*, *24*(5), 1070–1076. https://doi.org/10.1108/bpmj-09-2018-336

Dhir, A., Koshta, N., Goyal, R. K., Sakashita, M., & Almotairi, M. (2021). Behavioral reasoning theory (BRT) perspectives on e-waste recycling and management. *Journal of Cleaner Production*, *280*, 124269. https://doi.org/10.1016/j.jclepro.2020.124269

Dulock, H. L. (1993). Research design: Descriptive research. *Journal of Pediatric Oncology Nursing*, *10*(4), 154–157. https://doi.org/10.1177/104345429301000406

Egri, C. P., & Herman, S. (2000). Leadership in the North American environmental sector: Values, leadership styles, and contexts of environmental leaders and their organizations. *Academy of Management Journal*, *43*(4), 571–604. https://doi.org/10.2307/1556356

Elsamahy, T., Al-Tohamy, R., Abdelkarim, E. A., Zhu, D., El-Sheekh, M., Sun, J., & Ali, S. S. (2023). Strategies for efficient management of microplastics to achieve life cycle assessment and circular economy. *Environmental Monitoring and Assessment*, *195*(11), 1361. https://doi.org/10.1007/s10661-023-11955-7

Elshaer, I. A., Azazz, A. M. S., Kooli, C., Alqasa, K. M. A., Afaneh, J., Fathy, E. A.,

Fouad, A. M., & Fayyad, S. (2024). Resilience for sustainability: The synergistic role of green human resources management, circular economy, and green organizational culture in the hotel industry. *Administrative Sciences*, *14*(11), 297. https://doi.org/10.3390/admsci14110297

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Figge, F., Thorpe, A. S., Givry, P., Canning, L., & Franklin-Johnson, E. (2018). Longevity and circularity as indicators of eco-efficient resource use in the circular economy. *Ecological Economics*, *150*, 297–306. https://doi.org/10.1016/j.ecolecon.2018.04.030

Fraj-Andrés, E., Martinez-Salinas, E., & Matute-Vallejo, J. (2009). A multidimensional approach to the influence of environmental marketing and orientation on the firm's organizational performance. *Journal of Business Ethics*, *88*(2), 263–286. https://doi.org/10.1007/s10551-008-9962-2

Godfrey, L. G. (1988). *Misspecification tests in econometrics: The Lagrange multiplier principle and other approaches*. Cambridge University Press.

Gudergan, S. P., Ringle, C. M., Wende, S., & Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. *Journal of Business Research*, *61*(12), 1238–1249. https://doi.org/10.1016/j.jbusres.2008.01.012

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017). Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modeling methods. *Journal of the Academy of Marketing Science*, *45*(5), 616–632. https://doi.org/10.1007/s11747-017-0517-x

Hair, J. F., Money, A. H., Samouel, P., & Page, M. (2007). Research methods for business. *Education + Training*, *49*(4), 336–337. https://doi.org/10.1108/et.2007.49.4.336.2

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/mtp1069-6679190202

Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/ebr-10-2013-0128

Hannah, R., Max, R., & Pablo, R. (2020). *CO_2 and greenhouse gas emissions*. Our World in Data.

Harkness, J., Pennell, B., & Schoua-Glusberg, A. (2004). Survey questionnaire translation and assessment. In *Methods for testing and evaluating survey questionnaires* (pp. 453–473). Wiley. https://doi.org/10.1002/0471654728.ch22

Hart, S. L. (1995). A natural-resource-based view of the firm. *The Academy of Management Review*, *20*(4), 986–1014. https://doi.org/10.2307/258963

He, S., Zhao, W., Li, J., Liu, J., & Wei, Y. (2023). How environmental leadership shapes green innovation performance: A resource-based view. *Heliyon*, *9*(7), e17993. https://doi.org/10.1016/j.heliyon.2023.e17993

Hox, J. J., & Boeije, H. R. (2005). Data collection, primary vs. secondary. *Encyclopedia of Social Measurement*, *1*(1), 593–599.

Iqbal, R., Shahzad, K., & Donia, M. B. L. (2023). Environmentally specific transformational leadership and employee green attitude and behavior: An affective events theory perspective. *Journal of Environmental Psychology*, *92*, 102181. https://doi.org/10.1016/j.jenvp.2023.102181

Irawan, N., & Widodo, Z. (2024). Developing the blue and circular economy through visionary eco-leadership in the fish waste processing agro-industry. *IOP Conference Series: Earth and Environmental Science*, *1400*(1), 012001. https://doi.org/10.1088/1755-1315/1400/1/012001

Jia, F., Yin, S., Chen, L., & Chen, X. (2020). The circular economy in the textile and apparel industry: A systematic literature review. *Journal of Cleaner Production*, *259*, 120728. https://doi.org/10.1016/j.jclepro.2020.120728

Jiang, Y., Asante, D., Zhang, J., & Cao, M. (2020). The effects of environmental factors on low-carbon innovation strategy: A study of the executive environmental leadership in China. *Journal of Cleaner Production*, *266*, 121998. https://doi.org/10.1016/j.jclepro.2020.121998

Joseph, F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)*. SAGE Publications.

Kaiser, M. (1974). Kaiser-Meyer-Olkin measure for identity correlation matrix. *Journal of the Royal Statistical Society*, *52*, 296–298.

Khan, R., Shaikh, A. S., & Masood, H. (2019). Impact of Pak-China free trade agreement (FTA) on trade and industry of Pakistan. *Electronic Research Journal of Social Sciences and Humanities*, *1*(4), 1–33.

Khan, W., Nisar, Q. A., Roomi, M. A., Nasir, S., Awan, U., & Rafiq, M. (2024). Green

human resources management, green innovation and circular economy performance: The role of big data analytics and data-driven culture. *Journal of Environmental Planning and Management*, *67*(10), 2356–2381. https://doi.org/10.1080/09640568.2023.2189544

Khanra, S., Kaur, P., Joseph, R. P., Malik, A., & Dhir, A. (2022). A resource-based view of green innovation as a strategic firm resource: Present status and future directions. *Business Strategy and the Environment*, *31*(4), 1395–1413. https://doi.org/10.1002/bse.2961

Kim, M., & Stepchenkova, S. (2018). Does environmental leadership affect market and eco performance? Evidence from Korean franchise firms. *Journal of Business & Industrial Marketing*, *33*(4), 417–428. https://doi.org/10.1108/jbim-02-2017-0046

Kline, R. B. (2012). Assumptions in structural equation modeling. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 111–125). The Guilford Press.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of E-Collaboration (IJEC)*, *11*(4), 1–10. https://doi.org/10.4018/ijec.2015100101

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544–552. https://doi.org/10.1016/j.jclepro.2017.12.111

Kumar, R., Ahmed, J., Shaikh, B. T., Hafeez, R., & Hafeez, A. (2013). Job satisfaction among public health professionals working in public sector: A cross sectional study from Pakistan. *Human Resources for Health*, *11*(1), 1–5. https://doi.org/10.1186/1478-4491-11-2

Le, T. T., Behl, A., & Pereira, V. (2024). Establishing linkages between circular economy practices and sustainable performance: The moderating role of circular economy entrepreneurship. *Management Decision*, *62*(8), 2340–2363.https://doi.org/10.1108/md-02-2022-0150

Lin Moe, T. (2012). Aiming for resilience and adaptation in managing environment: An emerging environmental and emergency leadership in the twenty-first century. *International Journal of Disaster Resilience in the Built Environment*, *3*(1), 42–51. https://doi.org/10.1108/17595901211201123

Marrucci, L., Daddi, T., & Iraldo, F. (2023). Institutional and stakeholder pressures on organisational performance and green human resources management. *Corporate Social Responsibility and Environmental Management*, *30*(1), 324–341. https://doi.org/10.1002/csr.2357

McDonough, W., & Braungart, M. (2002). *Remaking the way we make things: Cradle to cradle*. North Point Press.

Mishra, R. K., Sarkar, S., & Kiranmai, J. (2014). Green HRM: Innovative approach in Indian public enterprises. *World Review of Science, Technology and Sustainable Development*, *11*(1), 26–42. https://doi.org/10.1504/wrstsd.2014.062374

Moktadir, Md. A., Ahmadi, H. B., Sultana, R., Zohra, F.-T., Liou, J. J., & Rezaei, J. (2020). Circular economy practices in the leather industry: A practical step towards sustainable development. *Journal of Cleaner Production*, *251*, 119737. https://doi.org/10.1016/j.jclepro.2019.119737

Muisyo, P. K., & Qin, S. (2021). Enhancing the FIRM'S green performance through green HRM: The moderating role of green innovation culture. *Journal of Cleaner Production*, *289*, 125720. https://doi.org/10.1016/j.jclepro.2020.125720

Munro, B. H. (2005). *Statistical methods for health care research* (Vol. 1). Lippincott Williams & Wilkins.

Obeidat, S. M., Abdalla, S., & Al Bakri, A. A. K. (2023). Integrating green human resource management and circular economy to enhance sustainable performance: An empirical study from the Qatari service sector. *Employee Relations: The International Journal*, *45*(2), 535–563. https://doi.org/10.1108/er-01-2022-0041

O'Donohue, W., & Torugsa, N. (2016). The moderating effect of "Green" HRM on the association between proactive environmental management and financial performance in small firms. *The International Journal of Human Resource Management*, *27*(2), 239–261. https://doi.org/10.1080/09585192.2015.1063078

Olken, F., & Rotem, D. (1995). Random sampling from databases: A survey. *Statistics and Computing*, *5*(1), 25–42. https://doi.org/10.1007/bf00140664

Papagiannakis, G., & Lioukas, S. (2012). Values, attitudes and perceptions of managers as predictors of corporate environmental responsiveness. *Journal of Environmental Management*, *100*, 41–51. https://doi.org/10.1016/j.jenvman.2012.01.023

Peterson, A. T. (2003). Predicting the geography of species' invasions via ecological niche modeling. *The Quarterly Review of Biology*, *78*(4), 419–433. https://doi.org/10.1086/378926

Pieroni, M. P. P., McAloone, T. C., & Pigosso, D. C. A. (2019). Business model innovation for circular economy and sustainability: A review of approaches. *Journal of Cleaner Production*, *215*, 198–216. https://doi.org/10.1016/j.jclepro.2019.01.036

Popović, S. (2020). *Green economy – A HRM perspective*. EUROBIT Publishing House.

Ren, S., Tang, G., & E. Jackson, S. (2018). Green human resource management research in emergence: A review and future directions. *Asia Pacific Journal of Management*, *35*(3), 769–803. https://doi.org/10.1007/s10490-017-9532-1

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. https://doi.org/10.1111/j.1468-2370.2011.00328.x

Ringle, C. M., Wende, S., & Will, A. (2009). The finite mixture partial least squares approach: Methodology and application. In *Handbook of partial least squares: Concepts, methods, and applications*. Springer.

Roh, T., Lee, K., & Yang, J. Y. (2021). How do intellectual property rights and government support drive a firm's green innovation? The mediating role of open innovation. *Journal of Cleaner Production*, *317*, 128422. https://doi.org/10.1016/j.jclepro.2021.128422

Sassanelli, C., Rosa, P., Rocca, R., & Terzi, S. (2019). Circular economy performance assessment methods: A systematic literature review. *Journal of Cleaner Production*, *229*, 440–453. https://doi.org/10.1016/j.jclepro.2019.05.019

Singh, S. K., Giudice, M. D., 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*, 119762. https://doi.org/10.1016/j.techfore.2019.119762

Sobaih, A. E. E., Hasanein, A., & Elshaer, I. (2020). Influences of green human resources management on environmental performance in small lodging enterprises: The role of green innovation. *Sustainability*, *12*(24), 10371. https://doi.org/10.3390/su122410371

Song, W., Yu, H., & Xu, H. (2021). Effects of green human resource management and managerial environmental concern on green innovation. *European Journal of Innovation Management*, *24*(3), 951–967. https://doi.org/10.1108/ejim-11-2019-0315

Stahel, W. R. (2019). Innovation in the circular and the performance economy. In *Handbook of sustainable innovation* (pp. 38–58). Edward Elgar Publishing.

Stewart, R., & Niero, M. (2018). Circular economy in corporate sustainability strategies: A review of corporate sustainability reports in the fast-moving consumer goods sector. *Business Strategy and the Environment*, *27*(7), 1005–1022. https://doi.org/10.1002/bse.2048

Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G., & Soto-Oñate, D. (2019). Operational principles of circular economy for sustainable development: Linking theory and practice. *Journal of Cleaner Production*, *214*, 952–961. https://doi.org/10.1016/j.jclepro.2018.12.271

Sun, L.-Y., Aryee, S., & Law, K. S. (2007). High-performance human resource practices, citizenship behavior, and organizational performance: A relational perspective. *Academy of Management Journal*, *50*(3), 558–577. https://doi.org/10.5465/amj.2007.25525821

Tiwari, S., Si Mohammed, K., Mentel, G., Majewski, S., & Shahzadi, I. (2024). Role of circular economy, energy transition, environmental policy stringency, and supply chain pressure on CO_2 emissions in emerging economies. *Geoscience Frontiers*, *15*(3), 101682. https://doi.org/10.1016/j.gsf.2023.101682

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*, 487–498. https://doi.org/10.1016/j.jclepro.2017.09.047

Wagner, M., & Schaltegger, S. (2004). The effect of corporate environmental strategy choice and environmental performance on competitiveness and economic performance: An empirical study of EU manufacturing. *European Management Journal*, *22*(5), 557–572. https://doi.org/10.1016/j.emj.2004.09.013

Xu, X., Zeng, S., & Chen, H. (2018). Signaling good by doing good: How does environmental corporate social responsibility affect international expansion? *Business Strategy and the Environment*, *27*(7), 946–959. https://doi.org/10.1002/bse.2044

Zeng, H., Chen, X., Xiao, X., & Zhou, Z. (2017). Institutional pressures, sustainable supply chain management, and circular economy capability: Empirical evidence from Chinese eco-industrial park firms. *Journal of Cleaner Production*, *155*, 54–65. https://doi.org/10.1016/j.jclepro.2016.10.093

Zhang, B., Wang, Z., & Lai, K. (2015). Mediating effect of managers' environmental concern: Bridge between external pressures and firms' practices of energy conservation in China. *Journal of Environmental Psychology*, *43*, 203–215. https://doi.org/10.1016/j.jenvp.2015.07.002

Zhou, G., Fei, Y., & Feng, C. (2024). The nexus between logistics competitiveness, logistics carbon emission efficiency and industrial structure upgrading: Evidence from China. *E&M Economics and Management*, *27*(3), 36–52. https://doi.org/10.15240/tul/001/2024-5-014

Appendix

Discriminant validity – Fornell-Larcker criterion

Tab. A1: Fornell-Larcker criterion

Constructs	*EL*	*GHRM*	*GIA*	*CE*	*SP*
EL	0.819				
GHRM	0.496	0.778			
GIA	0.302	0.271	0.701		
CE	0.496	0.499	0.509	0.752	
SP	0.354	0.435	0.253	0.472	0.836

Note: *EL* – ecological leadership; *GHRM* – green human resource management; *GIA* – green innovation actions; – circular economy.

Source: own