Journal of Risk Analysis and Crisis Response, 2025, 15(2), 334-353
https://jracr.com/
ISSN Print: 2210-8491
ISSN Online: 2210-8505

Article

Low-Carbon Transformation in Hospitality: Integrating Green HRM, Sustainable Commitment, and Industry 4.0 for Environmental Resilience

Karam Zaki [1,2,*]

[1] Department of Business Administration, College of Science and Humanities, Shaqra University, Dawadmi (17452), Saudi Arabia
[2] Department of Hotel Studies, Faculty of Tourism and Hotels, Fayoum University, Fayoum (63514), Egypt
* Correspondence: kzaki@su.edu.sa

Received: January 31, 2025; Received in revised form: April 6, 2025; Accepted: May 7, 2025; Available online: June 30, 2025

Abstract: Saudi Arabian hospitality firms are now engaging in a change process, as observed in their environmental activity, suggesting a new, long-term process of sustainability in the workplace. This study aims to promote low-carbon behavior (LB) within the context of green hotels in Saudi Arabia's evolving business landscape by exploring the green human resource management practices (GHRM)–environmental performance (EP) nexus. The study used questionnaires and received 480 responses from the staff sample of the green hotels in Saudi Arabia. The study hypotheses were tested using partial least square structural equation modeling. Key study findings are highlighted: First, GHRM increases the SBC, II, and LB. Secondly, the results of the study demonstrated that an II and SBC were positive to LB. Third, as identified in the study, LB fosters EP. Fourth, this research outcome confirmed that eco-friendly behavior (EB) moderates the relationship between LB and EP. This finding adds to the discussion on GHRM and how to advance LB and EP. This study uniquely explores the interplay of GHRM, SBC, and Industry 4.0 innovations in shaping low-carbon behavior and environmental performance in Saudi Arabia's hospitality sector.

Keywords: Low-Carbon Behavior; Environmental Performance; Green Human Resource Management; Sustainable Business Commitment; Industry 4.0 Innovations

1. Introduction

One major concern that poses a threat to the wellbeing and continued existence of human and non-human resources is undefined as the rates of CO_2 emissions and other greenhouse gases are tending to increase significantly, emissions, all countries have to take into account the economic and environmental issues [1]. Humanity faces urgent challenges, including environmental pollution, which has arisen from the unrestrained pursuit of economic gains at the cost of social and ecological benefits. While the hotel industry contributes to economic growth and job creation, there is an increasing need for new business models and technological advancements. It is essential to explore how hotel enterprises can enhance their environmental performance (EP) [2]. Given that hotels primarily operate within communities, they contribute to environmental pollution.

This research focuses on Saudi Arabia, a nation among the world's most populous and a significant participant in the global economy, particularly in relation to the substantial waste

produced by the hotel sector [3]. The country has implemented various policies and initiatives to support a green transition, actively addressing ecological challenges while committing to sustainable development goals [4]. This paper aims to provide fresh insights into the factors that promote low-carbon behavior (LB) within the context of green hotels in Saudi Arabia's evolving business landscape.

The LB has emerged as a crucial topic in enhancing environmental sustainability in businesses. It can be defined as the deliberate awareness and practices individuals adopt to minimize negative environmental impacts [5]. This behavior encompasses the adoption of eco-friendly and sustainable practices in industrial processes, business operations, and everyday life to combat climate change. It encourages organizations, communities, and individuals to prioritize environmentally responsible actions, energy efficiency, and the use of renewable resources [6]. Understanding the motivations behind hotel staff's LB and its impact on their EP is contentious [7].

Green Human Resource Management (GHRM), as highlighted in previous studies, offers an innovative approach to managing human capital that emphasizes sustainability and ecological responsibility. GHRM incorporates environmental considerations into HR practices, including recruitment, training, performance evaluations, and employee engagement [8]. The primary objective of GHRM is to cultivate a culture of sustainability within the workforce, inspiring employees to adopt environmentally conscious behaviors both professionally and personally [9]. Furthermore, to reduce harmful emissions, green hotels have begun fostering an innovation climate through advanced technologies, such as Industry 4.0 innovations (II), aimed at minimizing environmental impacts throughout their production processes [3]. II emphasizes waste reduction, emission control, and the integration of environmental practices [2].

The relationship between Industry 4.0 innovations and low-carbon behavior in the hotel industry is increasingly significant as digital technologies enhance sustainability efforts [2]. Industry 4.0 encompasses advancements such as *Big Data, IoT, and AI*, which collectively contribute to reducing carbon footprints and promoting eco-friendly practices [10,11].

Eco-friendly behavior (EB) is increasingly acknowledged as a vital internal resource that helps individuals navigate and comprehend the evolving ecological landscape [12]. EB equips businesses with the capability to recognize sustainable initiatives that align with environmental regulations and minimize resource consumption, thereby bolstering the resilience and reputation of the company. Previous literature has indicated that EB plays a significant role in enhancing LB and EP [13]. This research specifically investigates the moderating role of EB within the research framework. EB, in its classical form, refers to factual information concerning ecosystem processes, functions, and structures [3]. This study posits that incorporating EB as a moderator is crucial for understanding its potential to enhance LB and EP. While existing literature has established the direct impact of EB on LB, there remains a theoretical gap regarding EB's moderation in this relationship [14]. This study aims to fill this gap by presenting empirical evidence on EB's influence in the interplay between LB and EP.

The objectives of this research are to explore the influence of GHRM on II, SBC, and LB; to investigate the effects of II and SBC on LB; to analyze the impact of LB on EP; and to evaluate the moderating role of EB in the connection between LB and EP.

This article contributes to the existing body of knowledge in environmental and GHRM literature by examining how GHRM, green innovation climate, environmental knowledge, and low-carbon behavior (LB) collectively enhance environmental performance (EP). It adds depth to the discourse on GHRM's role and highlights mechanisms to foster LB and EP. The paper's novelty lies

in its multi-dimensional framework (Fig.1), which uniquely integrates GHRM, Industry 4.0 innovations (II), and sustainable business commitment (SBC) to promote environmentally conscious practices. It also reveals the moderating role of eco-behavior (EB), emphasizing individual awareness and its impact on the LB–EP link.

Theoretically, the study draws on affect, behavior, and cognition (ABC) model [15] and the resource-based view (RBV) to offer a structured understanding of LB within green hotels. By integrating GHRM, II, and SBC, the model underscores how supportive culture and innovation drive EP. The moderation analysis deepens insight into EB's role in strengthening LB–EP pathways. Thus, this research presents practical implications for scholars, hotel managers, and policymakers aiming to advance sustainable hospitality in Saudi Arabia. Finally, the study applies PLS-SEM, a robust method for evaluating direct, indirect, and moderating effects in complex models.

2. Literature Review

2.1. Theoretical Background and Hypotheses Development

The theoretical lenses of this study framework (Figure 1) are based on two primary models. First, we used the ABC model to represent how green human resource management (GHRM) could promote an outcome for a green hotel. Considering GHRM as an antecedent of low-carbon behavior (LB), which, in turn, produces sustainable business provision, we argue that the employee behavior of sustainable business is affected by GHRM practices and Industry 4.0 innovations (II) performance. The ABC model is a popular assessment tool in marketing research contexts [16]. However, it was primarily rooted in medical and social research. The ABC model is a remarkable technique for building individual awareness of the primary triggers and consequences of their attitudes and behaviors. It involves three components of *'affect, behavior, and cognition*, which describe individual behavior based on his feelings about an object, intention to do something, and finally, his beliefs about a thing [15].

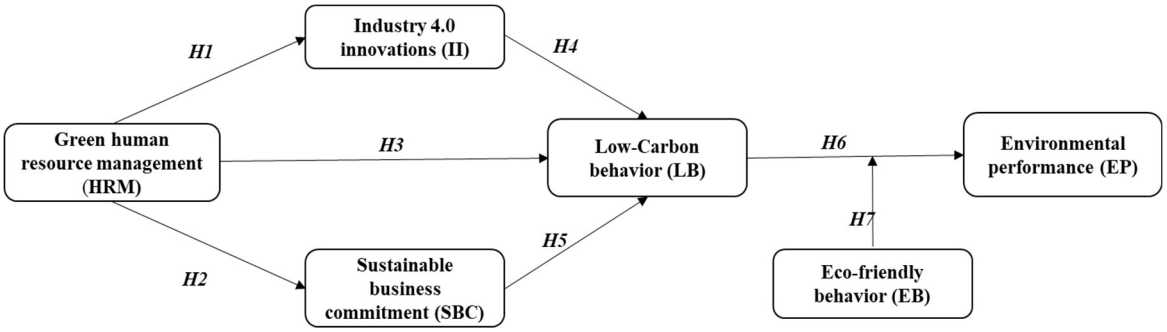

Figure 1. The study model.

Second, this research was underpinned by the theory of resource- based view (RBV) [17], with the assumption that hotel's success or growth was attributed to what the firm possessed, which showed that the absence of adequate resources limited the growth and development of a firm. There is opposition to this theory as it established a firm's competitive advantage based on its internal resources. Internal resources encompass all the possible facilities and assets within a firm that may be useful in increasing the development of firm value co-creation activities.

The RBV framework emphasizes that a company's performance and competitive advantage are influenced by its capacity to effectively utilize strategic internal resources characterized by value, rarity, inimitability, and organizational capability, commonly known as the VRIO framework. Additionally, the effects of green strategies and emerging digital applications have been noted [1]. In this research, the RBV was utilized to analyze the effectiveness of firms, connecting these concepts to the theory, which includes (II, SBC, and EB).

2.2. Link Between GHRM and II

Green HRM practices refer to a comprehensive set of HR activities designed to align human resource management with environmental sustainability. These practices encompass various functions, including sustainable job design, recruitment, training, performance appraisals, rewards, and promotions, all aimed at fostering a sustainability-oriented workforce [9]. The green job design ensures that employees' roles are structured to meet environmental goals while satisfying personal and organizational needs [18]. Recruitment and selection focus on hiring individuals with a strong commitment to sustainability, recognizing that socially responsible employees contribute significantly to a firm's sustainability objectives [19]. Green training and development provide employees with the necessary knowledge and skills to enhance their environmental contributions, thus fostering a culture of sustainability [20]. Performance appraisals integrate sustainability metrics, assessing employees based on their contributions to the company's environmental and social goals [21,22]. Similarly, reward systems in green HRM motivate employees through both financial and non-financial incentives that recognize their efforts towards sustainability [23]. Promotion practices further reinforce these initiatives by offering career growth opportunities that align with sustainable development goals [8]. Ultimately, these interconnected HRM practices work together to create a green organizational culture, leading to improved operational performance, competitiveness, and corporate sustainability.

The integration of GHRM with II in the hotel industry is transforming the way sustainability is achieved. GHRM practices, which focus on enhancing environmental, social, and economic sustainability, align perfectly with the advanced digital technologies of Industry 4.0. These technologies, such as automation, artificial intelligence, and data analytics, streamline HR processes, making the implementation of green initiatives more efficient [24]. This synergy allows hotels to innovate sustainably, improving operational efficiency, reducing environmental impact, and enhancing guest experiences. By leveraging Industry 4.0, hotels can foster a culture of green innovation, where sustainable job design, eco-friendly recruitment, and employee training are enhanced through digital tools. This integration strengthens the hotel industry's ability to meet sustainability goals while maintaining competitiveness in a rapidly evolving market [2]. For example, Indah & Liestyowati [25]. conducted an early study exploring the role of GHRM in fostering green performance and technological competence within the context of Industry 4.0. Their research emphasized that by integrating GHRM with Industry 4.0 technologies, organizations could not only enhance sustainability but also drive innovation, particularly in industrial environments. The findings underscored how digital tools could automate processes and improve HR efficiency, further advancing green initiatives [26].

This understanding extended by focusing on the manufacturing sector, where they demonstrated a strong connection between GHRM and green innovation. Their research emphasized

that environmentally conscious HR practices, when combined with Industry 4.0 advancements, significantly contributed to promoting sustainable development. The study showcased that organizations embracing both GHRM and technological advancements experienced enhanced sustainability performance, particularly in green innovation practices [27]. Subono & Kurnisa [28]. further investigated how GHRM practices align with green product innovations in Industry 4.0 era. They found that companies adopting GHRM policies, such as eco-friendly recruitment and sustainability-oriented training, were more likely to foster green product innovation. Their work demonstrated how HR policies could drive environmental consciousness and sustainability by embedding green management objectives into organizational strategies, particularly in highly digitalized environments. The influence of GHRM on environmental performance in conjunction with Industry 4.0 technologies in the manufacturing sector is explored [29]. They found that both green HR practices and innovation were pivotal in aligning manufacturing operations with sustainability goals. Their study highlighted that organizations leveraging Industry 4.0 for operational efficiency also benefitted from enhanced environmental outcomes, particularly when supported by strong GHRM practices [29]. A comprehensive examination of the relationship between GHRM and Industry 4.0 within the context of sustainable development is provided [30]. Their study found that Industry 4.0 strengthened the link between GHRM and sustainability, enhancing the Triple Bottom Line (environmental, social, and economic) performance of organizations. However, they also warned that the rapid pace of technological advancement might outstrip organizations' ability to adapt their HR practices, potentially leading to a disconnect between innovation and sustainability [31].

To put it briefly, while GHRM practices have been shown to enhance green innovation and environmental performance across sectors [9], there remains a challenge in ensuring that organizations can effectively adapt their HR strategies to keep pace with rapid technological advancements. This calls for a more nuanced approach to integrating green HR practices with the ongoing evolution of Industry 4.0 technologies to maximize their impact on sustainability. The RBV theory interprets the linkage between GHRM and Industry 4.0 innovations as a strategic resource and capability combination that provides firms with a sustainable competitive advantage. GHRM enhances the firm's internal resources, while Industry 4.0 technologies elevate the firm's capabilities, making it uniquely positioned to excel in sustainability, green innovation, and overall performance in a way that competitors may find difficult to replicate. Consequently, drawing from empirical evidence as well as the ABC model and the RBV theory, this study proposes the following hypothesis:

H1: GHRM has a positive and significant impact on II.

2.3. Link Between GHRM and SBC

There are two stages of business sustainability [32]. The first stage started from the seventies (when governments imposed some environmental regulations) to around 2018, when more sustainable innovations, such as electric vehicles, began to appear in the market in large quantities [33]. At this stage, the market changed to a preference for green products manufactured and marketed in the so-called triple bottom line (TBL) of people, planet, and profit. Business sustainability came from the radical changes in consumer desires growing in TBL and marketing green products of companies that were more attractive and efficient. Many factors have affected the market change, including non-governmental organizations active in the field of environmental conservation, as well

as the maturation of the Internet and social media, which led to increased corporate accountability [34].

As for the second phase, it is from now (and it will increase significantly in the coming years) that companies have used innovative ways to rely on green products with a growing reliance on electric vehicles, solar energy, or wind energy. Customers' support for business sustainability through their purchasing practice could be seen as how they react to businesses' sustainable practices. Precisely, we aimed to understand how customers make decisions about supporting green businesses via sustainable follows. Companies vigorously pursuing sustainable business practices would obtain a further commitment from individuals who respect sustainability pacts (e.g., environment protection, social justice, quality of life). Sustainable business commitment includes responsible practices related to a firm's financial investment to achieve specific sustainable goals that guarantee further protection of the surrounding environment and spreading justice and welfare [32]. We argued that GHRM's program effectiveness depends on better employee awareness of the sustainability dimensions. Insufficient sustainability concept knowledge from organizations and researchers leads to mislaid probabilities of the so-called TBL novelty. Further, the sustainability exertions will likely grow slowly if the employee awareness level of sustainability decreases [35].

The interplay GHRM and SBC is essential for cultivating enduring organizational sustainability. GHRM focuses on environmentally conscious HR practices, which include fostering environmental awareness, attracting eco-friendly talent, and promoting sustainable behaviors. This framework serves as the cornerstone for a company's dedication to sustainability. By integrating green principles into the organizational culture and workforce, GHRM cultivates a sense of accountability among employees that aligns with overarching sustainability objectives. This dynamic creates a cascading influence, where engaged employees bolster the firm's commitment to sustainable practices, thereby enhancing consumer trust and loyalty in green products and services [36]. The synergy between GHRM and SBC not only elevates the organization’s reputation regarding social and environmental accountability but also contributes to the TBL by advancing social, environmental, and economic advantages [37]. In essence, GHRM is pivotal in developing the human capital and organizational infrastructure necessary for companies to realize their SBC aims, thereby fostering ongoing green innovation and ethical business conduct [13]. Thus, it has proposed the following hypothesis:

H2: GHRM has a positive and significant impact on SBC.

2.4. Link Between GHRM and LB

Low-carbon behavior within the hotel industry involves the adoption of strategies designed to minimize carbon emissions and enhance sustainability in hotel operations. This approach includes management practices, engagement with guests, and the conduct of staff, all of which are in harmony with the principles of low-carbon tourism. Key initiatives include the implementation of energy-efficient practices, reduced resource consumption, and the establishment of an environmentally sustainable operational framework within hotels [5,6].

The transition towards low-carbon tourism is vital for tackling global climate issues and aligns with sustainable development objectives, making it a priority for urban tourism hotels [38]. Factors that significantly affect low-carbon behavior encompass managerial actions, strategic focus, social norms, and the perceived control over behaviors by hotel staff [7]. Additionally, the introduction of low-carbon city policies has resulted in notable declines in CO2 emissions within the hotel sector,

highlighting the importance of regulatory frameworks [39]. Despite the growing trend of low-carbon initiatives, the hospitality industry's focus on profitability may impede the comprehensive adoption of sustainable practices, indicating a need for a balanced approach between economic viability and environmental stewardship.

The link between LB and GHRM is multifaceted. GHRM practices foster employee engagement by instilling a sense of ownership and responsibility, motivating employees to adopt low-carbon behaviors. Additionally, a strong green organizational culture created through GHRM can encourage and support sustainable practices across the organization [40,41]. GHRM also equips employees with the knowledge and skills necessary to implement and maintain low-carbon initiatives. Furthermore, GHRM ensures proper resource allocation, providing the budget, time, and personnel needed to support these initiatives. In conclusion, low-carbon behavior and GHRM are interdependent concepts that contribute significantly to the hotel industry's sustainability goals. By implementing effective GHRM practices, hotels can create a work environment that fosters employee engagement in low-carbon initiatives, promoting a more sustainable and environmentally responsible business [42]. Therefore, it has proposed the following hypothesis:

H3: GHRM has a positive and significant impact on LB.

2.5. Link Between II and LB

The relationship between Industry 4.0 innovations and LB in the hotel industry has become increasingly significant as the sector shifts towards sustainable practices. Technologies like Big Data, IoT, and AI are instrumental in optimizing resource use, enhancing operational efficiency, and reducing carbon footprints in hotels [43]. These innovations enable hotels to monitor and manage energy consumption effectively, lowering emissions while aligning with low-carbon tourism objectives, which also improve service quality and customer satisfaction [44]. Moreover, urban hotels are encouraged to adopt strategic management approaches that integrate low-carbon principles, addressing environmental challenges and meeting global sustainability goals [5,45]. Engaging employees by addressing their perceptions of Industry 4.0 technologies can further promote sustainable practices, although challenges such as employee training and technology adoption remain critical barriers to fully realizing the potential of these innovations [46]. Therefore, it has projected the following hypothesis:

H4: II has a positive and significant impact on LB.

2.6. Link Between SBC and LB

The connection between a commitment to sustainable business practices and LB in the hotel sector is becoming increasingly important as the industry embraces eco-friendly initiatives. Corporate social responsibility (CSR) and sustainable marketing strategies are essential factors in promoting low-carbon behaviors. CSR efforts not only improve hotel performance but also encourage environmentally responsible behavior among staff, aiding in the achievement of broader sustainability objectives [12]. Employees who are engaged are more inclined to embrace low-carbon practices, thereby supporting sustainable operations. Hotels that adopt sustainable practices, such as managing waste and water, not only mitigate their environmental footprint but also realize financial gains through cost reductions [47]. These initiatives are particularly successful in areas with favorable policies, as evidenced by the significant decrease in CO2 emissions in hotels [39]. Furthermore, green

marketing strategies are vital in influencing consumer choices, with environmentally friendly hotels attracting guests through sustainability certifications that enhance booking intentions [48]. Nevertheless, despite the growing commitment to sustainability, challenges persist in reconciling operational efficiency with comprehensive environmental strategies. The industry must continue to innovate to satisfy both consumer demands and sustainability objectives [49]. Therefore, it has projected the following hypothesis:

H5: SBC has a positive and significant impact on LB.

2.7. Link Between LB and EP

low-carbon practices and EP in the hotel sector are increasingly acknowledged as essential for achieving sustainable development. Employee participation in these low-carbon initiatives significantly contributes to enhancing the EP of hotels through multiple avenues. The green self-efficacy and environmental consciousness of employees promote low-carbon behaviors, which directly enhance corporate EP [50]. Additionally, pro-environmental actions by staff amplify the positive impact of CSR on hotel performance [12]. Furthermore, the adoption of low-carbon city policies has resulted in a substantial decrease in CO2 emissions within the hotel industry, especially in wealthier areas, highlighting the importance of regulatory measures [39]. There is a positive relationship between employees' green knowledge, their service behaviors, and environmental performance, suggesting that training and awareness programs can lead to improved sustainability results [51]. Lastly, green supply chain management has an indirect effect on hotel competitiveness by enhancing environmental practices, which further underscores the broader significance of environmental performance [52]. Therefore, it has projected the following hypothesis:

H6: LB has a positive and significant impact on EP.

2.8. The Moderating Role of Eco-Friendly Behavior

The hotel industry, a major contributor to global emissions, faces mounting pressure to implement sustainable practices. Integral to this shift is the adoption of low-carbon behaviors, such as minimizing energy use and waste production [39]. The impact of these low-carbon actions on environmental performance can be enhanced by eco-friendly behaviors, which encompass actions beneficial to the environment. When individuals engage in both low-carbon and eco-friendly practices, a synergistic effect is achieved, resulting in a greater overall positive impact on environmental performance [13]. For example, a hotel guest who conserves energy by turning off lights may also recycle, yielding a more substantial environmental benefit than either action would provide independently. Furthermore, participating in eco-friendly behaviors can foster habit formation, making it easier for individuals to adopt and sustain low-carbon practices. Additionally, social influence can motivate others to embrace these behaviors, contributing to the establishment of a favorable social norm [12]. To maximize these advantages, hotel managers should cultivate a culture that supports eco-friendly practices, offer clear guidelines for reducing carbon footprints, provide education and training, and assess the effectiveness of these initiatives to enhance sustainability outcomes continually [3]. Recognizing the supportive role of EB enables the development of more focused strategies aimed at mitigating environmental impact and promoting sustainability within the hotel sector. This study believes that EB moderates the relation between LB and EP to fill this gap.

H7: EB moderates the relation between LB and EP.

3. Methodology

Table 1. Participant's profile.

	No. of respondents=480	Frequency	%
Gender	Female	180	37.5
	Male	300	62.5
Age	Less than 30	240	50
	31-35	120	25
	36 and more	120	25
Education	Intermediate	50	10.4
	2 years college	170	35.4
	University	190	39.6
	Master/PhD	70	14.6
Tenure	≤5 years	240	50
	5-10	100	20.8
	11-15	130	27.1
	≥16 years	10	2.1
Managerial position	Manager	61	13
	Supervisor	69	14
	Line staff	350	73
Department	Reception	60	12.5
	Food production	70	14.6
	Restaurant	150	31.3
	Room service	110	22.9
	Accounting	50	10.4
	Maintenance	40	8.3

This research utilized a quantitative survey methodology to evaluate the proposed research model, employing a 5-point Likert scale to gauge employees' perceptions across six variables: GHRM, II, SBC, LB, EB, and EP, encompassing a total of 41 items. Additionally, demographic factors such as gender, age, education, and gained experience were analyzed. GHRM was regarded as a unidimensional construct, consisting of five essential components: environmentally-focused staffing, training, performance evaluation, reward systems, and employee engagement, corroborated by the findings of [53], [54], and [42]. The measurement of II was based on a 10-item scale from [2], while SBC was assessed using a 5-item scale developed by [55]. LB was evaluated with a 7-item scale from [14], and EB was measured using a 7-item scale from [56]. EP was determined through a 7-question scale inspired by Zaki's methodology, where hotel staff rated their performance relative to competitors on a scale from 1 ('Very poor') to 5 ('Very good'). The study concentrated on 59 eco-friendly hotels in Saudi Arabia, selected from the ETIC Hotels database [57], which included 22 five-star and 37 four-star establishments, primarily situated in the eastern region, particularly Al Khobar. A total of 590 questionnaires were distributed, with each hotel receiving 10 copies. The research garnered 480 valid responses, achieving an 81% response rate. A minimum sample size ratio of 1:10 for variables is suggested [58], making the sample size of 480 adequate given the 41 components analyzed. Data analysis was performed using PLS-SEM, in accordance with [58] methodology, a widely accepted approach in tourism and hospitality research for evaluating measurement models, structural models, and hypothesis testing. This method is particularly suitable for exploratory research with complex models involving multiple constructs and mediation/moderation effects. PLS-SEM is also robust for handling non-normal data and small to medium sample sizes, making it appropriate for studies like this one [58,59]. The summary statistics for the 480 employees are

presented in Table 2. A majority of the participants (62.5%) were male, with the largest age group being those less than 30 years old, comprising 50 % of the total.

4. Results

Structural equation modeling (SEM) is mainly a valuable and well-established technique for data analysis in the field of social sciences [58]. This study employed PLS-SEM using Smart PLS 4 software to assess the proposed hypotheses. The PLS-SEM approach allows researchers to handle Mult construct models that encompass numerous concepts, components, and structural pathways, without the constraints of specific data distribution assumptions. This predictive method of SEM focuses on the estimation process during model evaluation [59].

4.1. The Measurement Model

The evaluation of a measurement's reliability and validity can be conducted by examining internal consistency, convergent validity, and discriminant validity, which are recognized criteria for this assessment [60]. To assess convergent validity, it is essential that the factor loading values exceed 0.7, and the average variance extracted (AVE) should be greater than 0.5. For discriminant validity, the square root of the AVE must be greater than the correlation values among the variables. Regarding reliability, a composite reliability value above 0.7 is considered acceptable. The results illustrated in Table 3 reflect the evaluations of reliability and validity. Reliability testing involved both the outer loading values and the composite reliability (CR) values, while the AVE value was utilized for validity assessments. The findings indicate that all variables achieved outer loading and composite reliability values surpassing 0.7, confirming the reliability of all indicators associated with these variables. Additionally, the analysis of the AVE values shows that each variable exceeds the 0.5 threshold, thereby validating both the variables and their respective indicators.

Table 2. Reliability, validity and factor loadings.

Dimension	Variables	Loadings	α	AVE	VIF	CR
GHRM	This hotel recruits' individuals who possess eco-friendly values, knowledge, and awareness.	0.85	0.91	0.75	1.129	0.92
Coded from GHRM1 to GHRM6	This hotel offers training programs focused on sustainability to enhance employees' green skills and behaviors.	0.87			1.365	
	Our hotel assesses employees' eco-friendly practices as part of the performance management process.	0.88			1.241	
	Our hotel creates opportunities for employees to engage in sustainable management initiatives.	0.9			1.532	
	This hotel recognizes and rewards staff for demonstrating eco-friendly behaviors.	0.89			1.789	
	Our hotel acknowledges and incentivizes employees for their commitment to sustainable practices.	0.88			1.402	
II (II1- II10)	Industry 4.0 innovations (II) enhance the efficiency of decision-making.	0.89	0.93	0.77	1.841	0.94
	Applications of artificial intelligence mitigate pollution risks.	0.88			2.123	
	Industry 4.0 innovations (II) play a key role in generating extensive amounts of information.	0.91			1.987	
	II facilitate the effective redistribution of operational processes.	0.9			1.703	

	II minimize waste.	0.87			1.639	
	II support the design of sustainable processes.	0.92			2.221	
	II maximize our hotel performance.	0.88			2.345	
	Our current application of II enhance circular economy practices.	0.85			1.512	
	II optimize the usage of resources.	0.89			1.789	
	II provide reliable insights into operational processes.	0.91			1.931	
SBC (SBC1-SBC5)	I consistently respect organizations that implement sustainable business practices.	0.88	0.91	0.74	1.442	0.92
	I endorse companies that are dedicated to sustainability initiatives.	0.87			1.302	
	I choose to work in hotels that prioritize sustainability.	0.89			1.423	
	I advocate for companies that demonstrate a commitment to environmental stewardship.	0.91			1.578	
	I favor working in hotel section devoted to sustainable practices.	0.92			1.622	
LB (LB1- LB7)	I engage in eco-friendly initiatives within the workplace.	0.87	0.92	0.76	1.512	0.93
	I educate and disseminate information regarding environmental issues to my colleagues.	0.89			1.726	
	I develop proposals aimed at enhancing environmental sustainability.	0.91			1.798	
	I consciously ensure that technological devices are turned off to conserve energy.	0.85			1.437	
	I employ environmentally friendly techniques to accomplish tasks.	0.88			1.621	
	I take pleasure in implementing energy-saving practices.	0.9			1.765	
	I value recycling and energy efficiency.	0.91			1.849	
EB (EB1-EB7)	I am eager to optimize electricity consumption.	0.89	0.92	0.78	1.732	0.93
	I ensure that lights are turned off when not in use.	0.88			1.812	
	I am dedicated to recycling efforts.	0.9			1.659	
	I adhere to environmentally friendly standards.	0.87			1.835	
	I repurpose materials for recycling.	0.91			1.759	
	I strive to optimize the use of resources such as water and energy.	0.88			1.512	
	I address water leaks promptly.	0.89			1.698	
EP (EP1-EP7)	Minimizing waste (including food, water, and energy)	0.92	0.93	0.79	2.102	0.94
	Lowering the consumption of energy resources	0.9			1.943	
	Reducing the use of radioactive materials	0.88			1.789	
	Diminishing environmental incidents	0.89			1.742	
	Improving health and safety for customers	0.91			1.989	
	Promoting health and safety for employees	0.9			2.231	
	Supporting the well-being of managers	0.87			1.823	

The measurement model has been conclusively defined and is illustrated in Table 2, summarizing various factors alongside their respective factor loadings. The model's reliability and validity were established through indicators such as factor loadings, composite reliability (CR), and average variance extracted (AVE), all exceeding acceptable thresholds, thereby confirming the robustness of the constructs. Furthermore, the analysis of variance inflation factors (VIF) indicated no significant common method bias, supporting the model's overall validity and reliability [59].

4.2. The Structural Model

Path analysis (Fig. 2) utilizing the PLS-SEM technique was conducted to evaluate the validity of model hypotheses, with confirmatory factor analysis rigorously assessed through path constraints, t-values, and p-values, establishing significant thresholds. The analysis of a sample of 480 participants revealed favorable model fit indices, including a chi-square to degrees of freedom ratio ($\chi 2$ / df = 1.201), RMSEA of 0.060, and various comparative indices, collectively affirming the model's adequacy with an SRMR value of 0.079 [61].

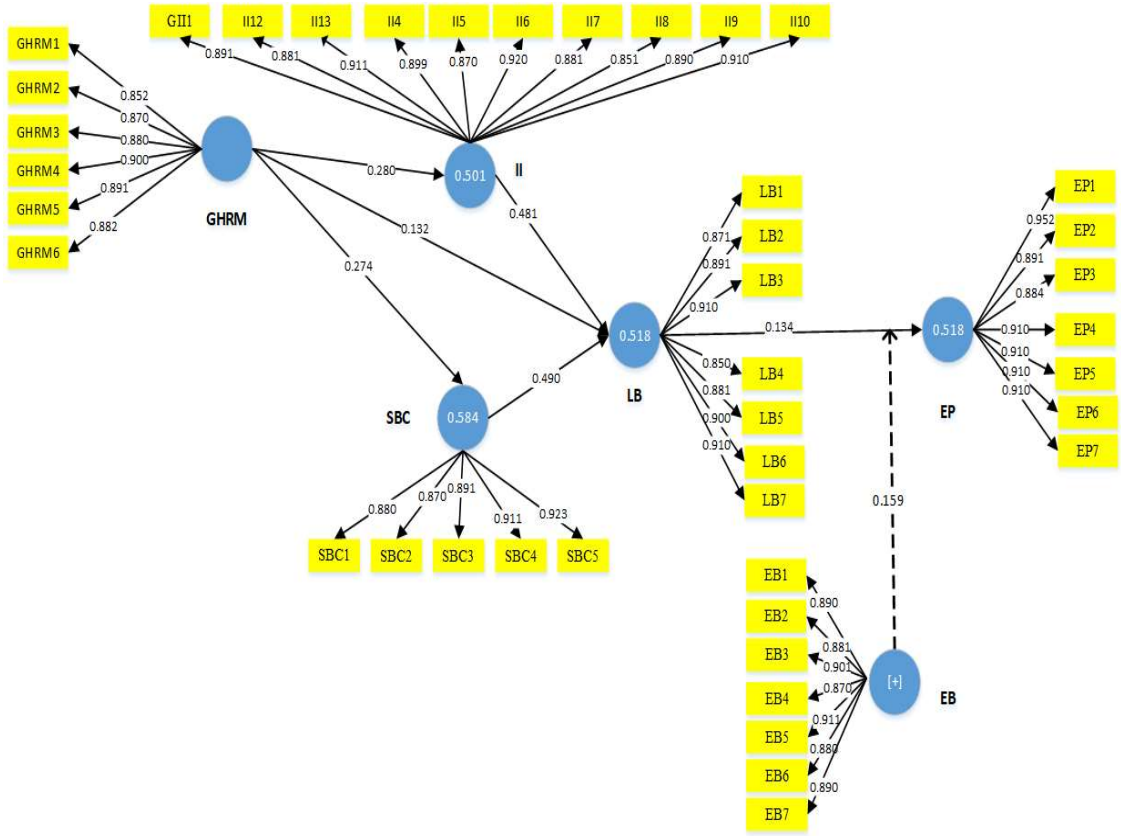

Figure 2. Structural model output.

4.3. Hypotheses Testing

Table 3. Hypotheses breakdown.

H	Path direction	β	P-value	*t*-value	F²	R²	Q²	Decision
H1	GHRM -> II	0.280	0.001	4.94	0.132			Support
H2	GHRM -> SBC	0.274	0.000	4.86	0.122			Support
H3	GHRM -> LB	0.132	0.001	5.63	0.112	II=0.501	0.51	Support
H4	II -> LB	0.481	0.001	4.30	0.018	SBC=0.584	0.56	Support
H5	SBC -> LB	0.490	0.003	10.4	0.009	LB=0.511	0.51	Support
H6	LB -> EP	0.134	0.001	9.11	0.010	EP=0.518	0.50	Support
			Moderation					
	LB*EB-> EP							
H7	Low EB	0.10	0.044	2.84				Support
	High EB	0.16	0.000	2.29				Support

The results of the path analysis (Table 3) indicate that GHRM had a significant influence on II ($\beta = 0.280$, $p < 0.01$, $t = 4.94$, $f^2 = 0.132$) and SBC ($\beta = 0.274$, $p < 0.01$, $t = 4.86$, $f^2 = 0.122$), supporting H1 and H2. Similarly, GHRM showed a significant impact on LB ($\beta = 0.132$, $p < 0.01$, $t = 5.63$, $f^2 = 0.112$), while II also had a significant effect on LB ($\beta = 0.481$, $p < 0.01$, $t = 4.30$, $f^2 = 0.018$), thereby supporting H3 and H4. Additionally, SBC demonstrated a substantial influence on LB ($\beta = 0.490$, $p < 0.01$, $t = 10.4$, $f^2 = 0.009$), supporting H5. The results further confirmed that LB positively affected EP ($\beta = 0.134$, $p < 0.01$, $t = 9.11$, $f^2 = 0.010$), supporting H6. Moderation analysis revealed that EB moderated the relationship between LB and EP, with low EB ($\beta = 0.10$, $p < 0.05$, $t = 2.84$) and high EB ($\beta = 0.16$, $p < 0.01$, $t = 2.29$), supporting H7. Overall, the findings suggest that all proposed hypotheses are supported, and the model demonstrates strong predictive relevance with R^2 values for II (0.501), SBC (0.584), LB (0.511), and EP (0.518), providing evidence of a significant pathway across the constructs. Fig. 3 provides evidence of the moderation effect, demonstrating that EB strengthens the positive relationship between LB and EP.

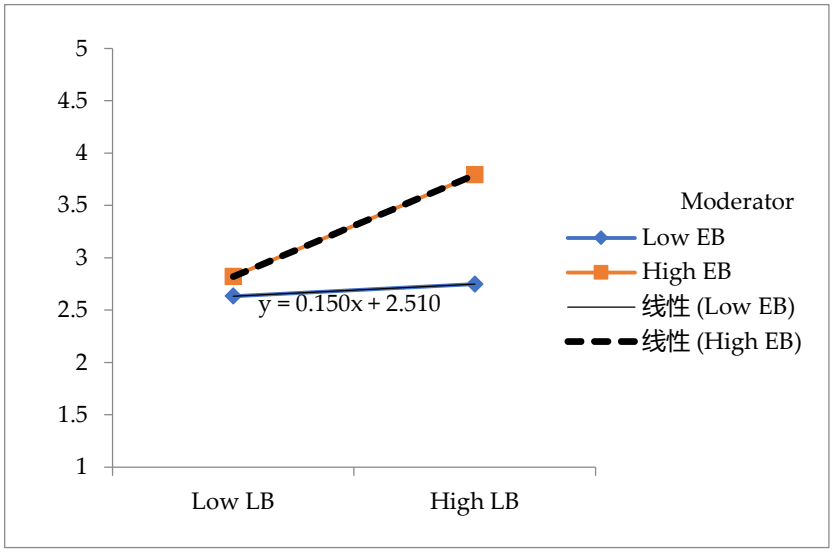

Figure 3. EB moderation effect.

5. Discussions and Conclusions

This study investigates the influence of GHRM on LB and EP in green-certified hotels in Saudi Arabia, with a particular focus on the moderating role of EB. The research tested seven hypotheses, all of which were supported by the findings.

The results revealed that GHRM has a significant positive effect on Innovation Integration (II) (H1). This aligns with previous studies [2,24], which emphasize that GHRM's alignment with Industry 4.0 technologies is revolutionizing the pursuit of sustainability in the hotel industry. By integrating green HR practices—such as green training, performance evaluation, and rewards—with advanced digital technologies, hotels can more efficiently implement green initiatives. From a Resource-Based View (RBV) perspective, this combination of GHRM and Industry 4.0 acts as a strategic resource, providing hotels with a competitive advantage that enhances sustainability, green innovation, and performance. Notably, Industry 4.0 strengthens the link between GHRM and sustainability by improving environmental, social, and economic performance. However, they caution that rapid technological advancements may outpace organizations' ability to adapt, creating potential challenges in aligning HR practices with innovation.

The study also found strong correlations between GHRM and SBC (H2) and between GHRM and LB (H3). This finding is consistent with previous research [36], which highlights GHRM as a key driver of sustainability in organizations. By fostering an environmentally conscious workforce, GHRM not only promotes green values but also cultivates employee accountability toward sustainability objectives. This dynamic reinforces the firm's sustainability reputation, enhancing consumer trust and loyalty. Furthermore, the link between GHRM and LB demonstrates how green HR practices encourage employee engagement in low-carbon behaviors. A well-established green organizational culture, driven by GHRM, motivates employees to adopt sustainable practices, while providing the knowledge, skills, and resources necessary for successful low-carbon initiatives [40,41]. Effective GHRM thus creates a foundation for sustainable practices, encouraging a workforce that actively participates in low-carbon activities, which in turn supports the hotel industry's sustainability goals [42].

The relationship between II and LB (H4) further supports previous findings [5,45], indicating that Industry 4.0 technologies, such as Big Data, IoT, and AI, are critical in optimizing resources and enhancing operational efficiency. These technologies not only streamline operations but also contribute to reducing the carbon footprint of hotels, reinforcing the link between innovation and sustainability. By leveraging such innovations, hotels can more effectively implement low-carbon strategies, fostering a greener and more efficient industry.

The connection between SBC and LB (H5) underscores the increasing importance of corporate CSR and sustainable strategies in promoting environmentally responsible behaviors in the hotel industry [12]. As hotels adopt sustainable practices, such as waste and water management, they not only reduce their environmental impact but also realize financial benefits. Engaged employees, motivated by a commitment to sustainability, are more likely to embrace low-carbon behaviors, further supporting the hotel's operational and environmental goals [47]. In regions with favorable environmental policies, such initiatives have been shown to significantly reduce CO2 emissions, exemplifying the power of a well-integrated sustainability strategy [39].

The study also supports the hypothesis that LB positively affects EP (H6). Employee participation in low-carbon initiatives plays a pivotal role in enhancing EP, as green self-efficacy and environmental consciousness among employees directly translate to improved environmental outcomes [50]. As hotels implement and support these low-carbon behaviors, they can achieve substantial gains in sustainability performance, contributing to the broader goal of sustainable development.

Finally, the analysis confirmed the moderating role of EB in the relationship between LB and EP (H7). This suggests that employees who possess a deeper understanding of environmental issues are more effective in driving eco-friendly initiatives, thereby amplifying the impact of LB on EP. By fostering environmental knowledge and awareness, hotels can optimize their sustainability efforts, ensuring that employees' actions contribute meaningfully to achieving environmental goals. These finding echoes previous research of [62] and [12], which highlights the importance of educational initiatives and eco-friendly practices—such as energy conservation and waste reduction—in enhancing both operational efficiency and environmental performance. The benefits of these practices, including increased customer satisfaction and reduced costs, further reinforce the link between EB and improved EP [39].

6. Implications

This study offers both theoretical advancements and practical insights into the interplay between GHRM, II, SBC, and LB within the hospitality sector, specifically among green-certified hotels in Saudi Arabia. The findings not only deepen the understanding of GHRM's influence on EP but also inform real-world applications for organizations aiming to strengthen their sustainability practices.

From a theoretical perspective, this research enriches the literature by demonstrating how GHRM serves as a foundational catalyst for cultivating environmentally responsible behavior among employees. By incorporating II and SBC as mediating mechanisms, the study provides a more holistic view of how organizational policies, technological innovation, and employee commitment coalesce to foster LB. This integrated perspective contributes to a more nuanced framework for understanding how sustainability can be embedded within organizational culture.

A key theoretical contribution lies in the application of the ABC model within the context of sustainable hotel management. This framework reveals how LB is shaped by both cognitive understanding—reflected in GHRM practices and environmental behavior—and emotional engagement, as demonstrated through SBC. By extending the ABC model into the hospitality sustainability discourse, the study captures the multi-dimensional nature of employee engagement in green behavior, bridging gaps between individual attitudes and organizational outcomes.

Moreover, the incorporation of Industry 4.0 innovations further enhances the theoretical model, emphasizing the relevance of advanced digital technologies—such as Big Data analytics, the Internet of Things (IoT), and Artificial Intelligence (AI)—in improving sustainability performance. The study supports the growing body of literature suggesting that digital transformation can significantly enhance LB and subsequently contribute to improved EP, especially in high-consumption sectors like hospitality.

The research also addresses a notable gap in the literature by examining the moderating effect of EB on the LB–EP relationship. While prior studies often focus on direct pathways, this study underscores how EB intensifies the influence of LB on EP, highlighting the essential role of employee environmental awareness. This evidence reinforces the argument that environmental knowledge is a critical driver in the effective implementation of sustainable initiatives.

From a practical standpoint, the findings offer several actionable recommendations for hotel managers, practitioners, and policymakers striving to promote sustainability in hospitality operations.

First, the study highlights the strategic value of embedding GHRM practices within human resource systems. Green recruitment, targeted environmental training, and sustainability-focused performance appraisals can reinforce eco-conscious behaviors among employees, positioning HR functions as key enablers of sustainability. For hotels seeking long-term success, GHRM should be viewed not as an auxiliary function but as a central pillar of the organizational strategy.

Second, the integration of Industry 4.0 technologies is shown to be pivotal in enhancing both operational efficiency and environmental outcomes. Hotels can benefit from digital tools that reduce waste, conserve energy, and monitor environmental performance. For instance, automating energy management systems and utilizing predictive analytics to manage resource consumption can generate both ecological and economic value.

Third, fostering a strong SBC among staff is essential. Hotel operators should ensure that sustainability is not only promoted at the leadership level but also cascaded throughout the

organizational hierarchy. Instilling sustainability values into the organizational culture encourages deeper employee involvement, enhancing the effectiveness of green initiatives.

Furthermore, the role of EB points to the need for ongoing education and training that elevate environmental awareness. Hotels should invest in structured learning programs, workshops, and campaigns to develop an environmentally literate workforce capable of making informed, eco-friendly decisions in daily operations.

Finally, recognizing the moderating role of EB calls for a more intentional incorporation of environmental literacy into corporate training agendas. Employees who are well-informed about sustainability issues are more likely to adopt and sustain low-carbon behaviors, making environmental education a cornerstone of long-term green strategy.

In conclusion, the theoretical contributions of this study lie in advancing an integrated framework that combines GHRM, II, SBC, and EB to explain LB and EP, grounded in the ABC model. Practically, the findings offer a roadmap for hotel managers and policymakers to embed sustainability into human resources, technological investments, and employee engagement strategies. As the hospitality sector in Saudi Arabia and globally continues its transition toward low-carbon operations, implementing these strategies will be essential to achieving enduring environmental resilience.

7. Limitations and Future Research

The study presented here, while offering valuable insights, is subject to several limitations. First, its focus on green-certified hotels in Saudi Arabia limits the generalizability of its findings to other industries or regions. Second, the reliance on self-reported data may introduce social desirability bias. Third, the study's focus on specific variables may overlook other influencing factors. Fourth, the cross-sectional design prevents conclusions about causality over time. Finally, while the study examined the moderating effect of eco-friendly behavior, other factors may also influence this relationship. Future research should address these limitations by expanding the scope of investigation to include various industries and regions, employing more objective measurements, considering additional factors, adopting longitudinal designs, and exploring other moderating or mediating variables. This will provide more robust and actionable insights for organizations committed to sustainability.

Supplementary Materials: Data is highlighted in the text, and could be obtained from the corresponding author.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

[1] Bhat, A. A., Mir, A. A., Allie, A. H., Lone, M. A., Al-Adwan, A. S., Jamali, D., & Riyaz, I. (2024). Unlocking corporate social responsibility and environmental performance: Mediating role of green strategy, innovation, and leadership. Innovation and Green Development, 3(2), 100112. https://doi.org/10.1016/j.igd.2023.100112

[2] Zaki, K. (2025). Enabling hotel circularity via Industry 4.0 innovations for enhanced hotel performance: Insights from Saudi Arabia and Egypt. Journal of Hospitality and Tourism Insights, 8(3), 915-936. https://doi.org/10.1108/JHTI-03-2024-0223

[3] Aljoghaiman, A., Hasanein, A. M., Elshaer, I. A., & Sobaih, A. E. E. (2024). Does Environmental Performance Make Any Difference in the Relationship between Green Supply Chain Management and Hotel Competitiveness? Logistics, 8(3), 70. https://doi.org/10.3390/logistics8030070

[4] Mir, M. A., Chang, S. K., & Hefni, D. (2024). A comprehensive review on challenges and choices of food waste in Saudi Arabia: Exploring environmental and economic impacts. Environmental Systems Research, 13(1), 40. https://doi.org/10.1186/s40068-024-00364-5

[5] Zhang, S., Xu, H., Han, B., & Albattat, A. R. (2023). Exploring Urban Tourism Hotel Management Strategies from The Perspective of Low-carbon Tourism. Frontiers in Business, Economics and Management, 8(2), 219–223. https://doi.org/10.54097/fbem.v8i2.7154

[6] Xie, L., & Wang, S. (2023). The New Mode of Hotel Management under the Background of Low-carbon Economy. Academic Journal of Management and Social Sciences, 4(2), 71–72. https://doi.org/10.54097/ajmss.v4i2.12165

[7] Taheri, B., Olya, H., & Batat, W. (2024). Ethical consumption and climate change in hospitality and tourism: Challenges, solutions, and prospects: Guest editorial. International Journal of Contemporary Hospitality Management, 36(5), 1457–1466. https://doi.org/10.1108/IJCHM-05-2024-169

[8] Safavi, H. P., & Karatepe, O. M. (2018). High-performance work practices and hotel employee outcomes: The mediating role of career adaptability. International Journal of Contemporary Hospitality Management, 30(2), 1112–1133.

[9] Salama, W., Nor El Deen, M., Albakhit, A., & Zaki, K. (2022). Understanding the Connection between Sustainable Human Resource Management and the Hotel Business Outcomes: Evidence from the Green-Certified Hotels of Egypt. Sustainability, 14(9), 5647. https://doi.org/10.3390/su14095647

[10] Ben Youssef, A., & Zeqiri, A. (2022). Hospitality Industry 4.0 and Climate Change. Circular Economy and Sustainability, 2(3), 1043–1063. https://doi.org/10.1007/s43615-021-00141-x

[11] Zaki, K., Alhomaid, A., & Shared, H. (2025). Leveraging Machine Learning to Analyze Influencer Credibility's Impact on Brand Admiration and Consumer Purchase Intent in Social Media Marketing. Human Behavior and Emerging Technologies, 2025(1), 9959697. https://doi.org/10.1155/hbe2/9959697

[12] Dung, P. T. H., Hoang, H. T., & Son, N. P. (2024). Unlocking sustainable success: The transformative impact of CSR on hotel performance. Cogent Social Sciences, 10(1), 2392025. https://doi.org/10.1080/23311886.2024.2392025

[13] Rana, G., & Arya, V. (2024). Green human resource management and environmental performance: Mediating role of green innovation–a study from an emerging country. Foresight, 26(1), 35–58. https://doi.org/10.1108/FS-04-2021-0094

[14] Sampene, A. K., Li, C., & Agyeiwaa, O. E. (2024). Green human resource to stimulate low carbon behaviour through the mediation role of innovation practices and organizational commitment. International Journal of Innovation Studies, 8(4), 364-380. https://doi.org/10.1016/j.ijis.2024.09.001

[15] Solomon, M., Bamossy, G., Askegaard, S., & Hogg, M. K. (2016). Consumer Behaviour: A European Perspective (6th ed.). Pearson Education.

[16] Solomon, M., White, K., & Dahl, D. W. (2013). Consumer Behaviour: Buying, Having, and Being (6th ed.). Pearson Education.

[17] Barney, J. B. (1986). Organizational Culture: Can It Be a Source of Sustained Competitive Advantage? The Academy of Management Review, 11(3), 656. https://doi.org/10.2307/258317

[18] Yong, J. Y., Yusliza, M.-Y., Ramayah, T., Chiappetta Jabbour, C. J., Sehnem, S., & Mani, V. (2020). Pathways towards sustainability in manufacturing organizations: Empirical evidence on the role of green human resource management. Business Strategy and the Environment, 29(1), 212–228.

[19] Tang, G., Chen, Y., Jiang, Y., Paille, P., & Jia, J. (2018). Green human resource management practices: Scale development and validity. Asia Pacific Journal of Human Resources, 56(1), 31–55.

[20] 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.

[21] Haddock-Millar, J., & O'Donohue, W. (2021). Green Human Resource Management and Talent Management. In Contemporary Talent Management (pp. 315–333). Routledge.

[22] Zaki, K. G. (2019). Using the mixed methods research to model the hotel performance measurement in Egypt: An example from a hotel chain. Journal of Global Business Insights, 4(1), 18–33. https://doi.org/10.5038/2640-6489.4.1.1054

[23] Mathews, J. (2018). Implementing Green Management in Business Organizations. IUP Journal of Business Strategy, 15(2).

[24] Shahzad, M. A., Du, J., Junaid, M., & Shahzad, F. (2024). From green HRM practices to green innovation performance: A mediation-moderation model. Journal of Environmental Planning and Management, 68(5), 1187-1212. https://doi.org/10.1080/09640568.2023.2284656

[25] Indah, D. Y., & Liestyowati, D. (2023). Green Performance and Technological Competence of Human Resources Based on Industrial Revolution 4.0. Sustainable Business and Society in Emerging Economies, 5(2), 87–96. https://doi.org/10.26710/sbsee.v5i2.2665

[26] Shah, N., & Soomro, B. A. (2023). Effects of green human resource management practices on green innovation and behavior. Management Decision, 61(1), 290–312. https://doi.org/10.1108/MD-07-2021-0869

[27] Ogiemwonyi, O., Alam, M. N., & Alotaibi, H. S. (2023). Pathways toward environmental performance: Link between green human resource management, green innovation, and green behavior at work in manufacturing companies. Journal of Cleaner Production, 425, 138949. https://doi.org/10.1016/j.jclepro.2023.138949

[28] Subono, A., & Kurnisa, U. (2024). Green Business: A Review based Green HRM. KnE Social Sciences, 2024, 9(17), 401–411. https://doi.org/10.18502/kss.v9i17.16375

[29] Ud Din, A., Yang, Y., Yan, R., Wei, A., & Ali, M. (2024). Growing success with sustainability: The influence of green HRM, innovation, and competitive advantage on environmental performance in the manufacturing industry. Heliyon, 10(10). https://doi.org/10.1016/j.heliyon.2024.e30855

[30] Zafar, A., & Khan, A. A. (2024). Harmonizing Growth: The Nexus of Green HRM and Triple Bottom Line Perspective of Sustainable Development in Industry 4.0 Era. Journal of Excellence in Management Sciences, 3(2), 115–129. https://doi.org/10.69565/jems.v3i2.260

[31] Raslan, A., Morsy, M., Fayed, H., & Saad, H. (2024). Developing Best Practices to Achieve Sustainable Development in Hotels. Sustainable Business and Society in Emerging Economies, 6(3), 431–444. https://doi.org/10.26710/sbsee.v6i3.3131

[32] Hoffman, A. J. (2018). The next phase of business sustainability. Stanford Social Innovation Review, 16(2), 34–39. http://ssrn.com/abstract=3191035

[33] Peterson, M., Minton, E. A., Liu, R. L., & Bartholomew, D. E. (2021). Sustainable Marketing and Consumer Support for Sustainable Businesses. Sustainable Production and Consumption, 27, 157–168. https://doi.org/10.1016/j.spc.2020.10.018

[34] Elg, U., & Welinder, A. (2022). Sustainability and retail marketing: Corporate, product and store perspectives. Journal of Retailing and Consumer Services, 64, 102810. https://doi.org/10.1016/j.jretconser.2021.102810

[35] Darvishmotevali, M., & Altinay, L. (2022). Green HRM, environmental awareness and green behaviors: The moderating role of servant leadership. Tourism Management, 88, 104401. https://doi.org/10.1016/j.tourman.2021.104401

[36] Ali, M., Shujahat, M., Fatima, N., Lopes de Sousa Jabbour, A. B., Vo-Thanh, T., Salam, M. A., & Latan, H. (2024). Green HRM practices and corporate sustainability performance. Management Decision, 62(11), 3681-3703. https://doi.org/10.1108/MD-05-2023-0787

[37] Adu Sarfo, P., Zhang, J., Nyantakyi, G., Lassey, F. A., Bruce, E., & Amankwah, O. (2024). Influence of Green Human Resource Management on firm's environmental performance: Green Employee Empowerment as a mediating factor. Plos One, 19(4), e0293957. https://doi.org/10.1371/journal.pone.0293957

[38] Apolloni, M., Volgger, M., & Pforr, C. (2024). Analysis of accommodation providers' carbon footprint in Australia: Motivations and challenges. International Journal of Contemporary Hospitality Management, 36(5), 1490–1511. https://doi.org/10.1108/IJCHM-09-2022-1183

[39] Sun, L., Luo, L., Dong, C., Hua, H., & Shi, R. (2024). Effects of China's pilot low-carbon city policy on carbon emission reduction in the hotel industry: A quasi-natural experiment in tourism cities. Energy Reports, 11, 3037–3049. https://doi.org/10.1016/j.egyr.2024.02.059

[40] Pham, N. T., Tučková, Z., & Jabbour, C. J. C. (2019). Greening the hospitality industry: How do green human resource management practices influence organizational citizenship behavior in hotels? A mixed-methods study. Tourism Management, 72, 386–399. https://doi.org/10.1016/j.tourman.2018.12.008

[41] Tuan, L. T. (2022). Promoting employee green behavior in the Chinese and Vietnamese hospitality contexts: The roles of green human resource management practices and responsible leadership. International Journal of Hospitality Management, 105, 103253.

[42] Aboramadan, M., & Karatepe, O. M. (2021). Green human resource management, perceived green organizational support and their effects on hotel employees' behavioral outcomes. International Journal of Contemporary Hospitality Management, 33(10), 3199–3222. https://doi.org/10.1108/IJCHM-12-2020-1440/

[43] Nadkarni, S., Kriechbaumer, F., Christodoulidou, N., & Rothenberger, M. A. (2023). Industry 4.0 applications towards sustainability in hospitality: First waves in the guest room. Journal of Global Business Insights, 8(1), 31–48. https://doi.org/10.5038/2640-6489.8.1.1216

[44] Manzoor, S. R., Ullah, R., Khattak, A., Ullah, M., & Han, H. (2024). Exploring tourist perceptions of artificial intelligence devices in the hotel industry: Impact of industry 4.0. Journal of Travel & Tourism Marketing, 41(2), 272–291. https://doi.org/10.1080/10548408.2024.2310169

[45] Tong, J., & Liu, Z. (2024). The construction of hotel information management mode under the trend of low carbon tourism. Applied Mathematics and Nonlinear Sciences, 9(1), 20230340. https://doi.org/10.2478/amns.2023.2.00340

[46] Osei, B. A., & Rasoolimanesh, S. M. (2024). Does value matter? Predicting hotel employees' intentions towards the adoption of Technologies 4.0. Technology Analysis & Strategic Management, 1–17. https://doi.org/10.1080/09537325.2023.2298823

[47] Deri, M. N., Singh, A., Zaazie, P., & Anandene, D. (2024). Demystifying Sustainable Practices in the Hotel Industry: Evidence from Ghana. In Waste Management and Life Cycle Assessment for Sustainable Business Practice (pp. 20–42). IGI Global. https://doi.org/10.4018/979-8-3693-2595-7.ch002

[48] Godovykh, M., Fyall, A., & Baker, C. (2024). Sustainable Labels in Tourism Practice: The Effects of Sustainable Hotel Badges on Guests' Attitudes and Behavioral Intentions. Sustainability, 16(6), 2484. https://doi.org/10.3390/su16062484

[49] Seo, J., Kim, C.-S., Kim, B.-S., & Park, S. (2024). Customers' Behavioral Intentions in Relation to Sustainable Green Marketing Activities in Hotels. Sage Open, 14(2), 21582440241247655. https://doi.org/10.1177/21582440241247655

[50] Khan, A. (2023). Is green leadership associated with employees' green behavior? Role of green human resource management. Journal of Environmental Planning and Management, 66(9), 1962–1982. https://doi.org/10.1080/09640568.2022.2049595

[51] Chatterjee, P., & Karmakar, R. (2023). Role of sustainable development goal and digitalization in hospitality industry: A systematic literature review. In Fostering Sustainable Businesses in Emerging Economies: The Impact of Technology (pp. 223–245).

[52] Ghaderi, Z., Shakori, H., Bagheri, F., Hall, C. M., Rather, R. A., & Moaven, Z. (2024). Green supply chain management, environmental costs and supply chain performance in the hotel industry: The mediating role of supply chain agility and resilience. Current Issues in Tourism, 27(13), 2101–2117. https://doi.org/10.1080/13683500.2023.2223911

[53] 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. https://doi.org/10.1016/j.ijhm.2018.04.007

[54] Ansari, N. Y., Farrukh, M., & Raza, A. (2021). Green human resource management and employees pro-environmental behaviours: Examining the underlying mechanism. Corporate Social Responsibility and Environmental Management, 28(1), 229–238. https://doi.org/10.1002/csr.2044

[55] Minton, E., Lee, C., Orth, U., Kim, C. -H., & Kahle, L. (2012). Sustainable marketing and social media: A cross-country analysis of motives for sustainable behaviors. Journal of Advertising, 41(4), 69–84. https://doi.org/10.1080/00913367.2012.10672458

[56] Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN theory. Journal of Environmental Psychology, 25(4), 415–425. https://doi.org/10.1016/j.jenvp.2005.08.003

[57] ETIC Hotels. (2024). Ethical and Sustainable Hotels in Saudi Arabia. https://etichotels.com/saudi-arabia

[58] Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). An Introduction to Structural Equation Modeling. In J. F. Hair, G. T. M. Hult, C. M. Ringle, M. Sarstedt, N. P. Danks, & S. Ray, Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R (pp. 1–29). Springer. https://doi.org/10.1007/978-3-030-80519-7_1

[59] Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L., & Ringle, C. M. (2022). Progress in partial least squares structural equation modeling use in marketing research in the last decade. Psychology & Marketing, 39(5), 1035–1064. https://doi.org/10.1002/mar.21640

[60] Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

[61] 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(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

[62] Li, Y.-B., Wang, T.-Y., Lin, R.-X., Yu, S.-N., Liu, X., Wang, Q.-C., & Xu, Q. (2022). Behaviour-driven energy-saving in hotels: The roles of extraversion and past behaviours on guests' energy-conservation intention. Buildings, 12(7), 941. https://doi.org/10.3390/buildings12070941

(Executive Editor: Yan Li)