

Exploring the Intersection of Green Human Resource Management and Technological Innovation for Green performance: Case of SMEs in Saudi Arabia

Fnaiech Afifa^{1*}

¹Assistant Professor, Department of Business Administration, College of Business and Economics, Al-Rass Branch, Qassim University, PO, Box 58851, Al-Rass, Saudi Arabia

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*Corresponding author: Fnaiech Afifa

Assistant Professor, Department of Business Administration, College of Business and Economics, Al-Rass Branch, Qassim University, PO, Box 58851, Al-Rass, Saudi Arabia

Abstract

This study explores the evolving intersection of Green Human Resource Management (GHRM) and technological innovation through a quantitative approach, aiming to assess the impact of emerging technologies on the implementation and effectiveness of GHRM practices in organizations. As businesses increasingly prioritize sustainability, GHRM has become a strategic tool for integrating environmental objectives into human resource policies. Simultaneously, rapid technological advancements—such as artificial intelligence, big data analytics, cloud computing, and the Internet of Things (IoT)—are reshaping how organizations manage green initiatives and engage employees in sustainable practices. Using survey data from a diverse sample of organizations across multiple industries, this research quantitatively analyzes the relationship between the adoption of specific technologies and the success of GHRM practices, including green recruitment, eco-friendly training, performance appraisals, and employee involvement in sustainability efforts. Statistical techniques such as regression analysis and structural equation modeling are employed to test hypotheses regarding the influence of technological innovation on organizational green performance outcomes. The findings provide empirical evidence on how technology can enhance the effectiveness of GHRM initiatives, uncover potential barriers to adoption, and suggest strategies for overcoming these challenges. This research contributes to the growing body of knowledge on the integration of sustainability and innovation in HR practices. It offers valuable insights for both academic researchers and practitioners aiming to foster more environmentally responsible organizations.

Keywords: Green Human Resource Management, Technological Innovation, big data, IoT, green performance.

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INTRODUCTION

In recent years, the growing need for sustainability has prompted organizations to reconsider their business strategies, with a particular emphasis on integrating environmentally-friendly practices. Among these strategies, Green Human Resource Management (Green HRM) has emerged as a key driver for promoting sustainable practices within organizations. Green HRM refers to the implementation of HR practices aimed at fostering environmental sustainability through talent management, training, employee engagement, and corporate policies that encourage eco-friendly behaviors (Renwick *et al.*, 2013). As businesses across various sectors increasingly adopt sustainable practices, the role of Green HRM in improving green performance has gained significant attention, particularly in small and medium-sized enterprises (SMEs).

Simultaneously, the rapid advancement of technological innovation plays a crucial role in facilitating the transition towards sustainability. Technological innovation, which encompasses the development and implementation of new technologies, systems, and processes, has proven to enhance green performance by reducing resource consumption, improving waste management, and enabling energy efficiency (Vallino & O'Neill, 2015). When combined with Green HRM practices, technological innovation can lead to the creation of a more sustainable and environmentally-conscious organizational culture.

In the context of Saudi Arabia, a country increasingly committed to environmental sustainability as part of its Vision 2030, the intersection of Green HRM and technological innovation presents a unique

opportunity to enhance the green performance of SMEs. SMEs are the backbone of the Saudi economy, accounting for a significant proportion of the country's businesses. However, these organizations often face challenges related to limited resources and expertise in integrating green practices into their operations. This research paper explores how SMEs in Saudi Arabia are leveraging Green HRM practices and technological innovation to improve their green performance, focusing on the synergies between human resource management and technology adoption in promoting sustainability.

Research Objectives

This study aims to explore the following key questions:

1. How do SMEs in Saudi Arabia implement Green HRM practices to promote sustainability?
2. What role does technological innovation play in enhancing the green performance of SMEs in Saudi Arabia?
3. How can the integration of Green HRM and technological innovation lead to improved environmental sustainability within SMEs?

By addressing these questions, this paper will contribute to the understanding of how SMEs in Saudi Arabia can foster an organizational culture that embraces both green practices and technological advancements to meet sustainability goals. Moreover, it aims to provide practical insights for policy-makers and business leaders on the importance of integrating green practices within SMEs in the region.

LITERATURE REVIEW

Green Human Resource Management (Green HRM) and Its Role in Organizational Sustainability.

Green Human Resource Management (Green HRM) refers to the integration of environmentally friendly practices into human resource policies and practices. Green HRM seeks to align the objectives of human resource management with environmental sustainability by promoting eco-friendly behavior and improving green performance through training, recruitment, employee engagement, and performance evaluation (Renwick *et al.*, 2013). The concept of Green HRM has been extensively discussed in literature, where scholars emphasize its importance in shaping employee attitudes and behaviors towards sustainability (Jabbour & Santos, 2008). According to Renwick *et al.*, (2013), Green HRM can foster a green organizational culture by embedding sustainability into organizational policies, promoting environmental awareness, and encouraging resource-efficient practices across all levels of an organization.

For SMEs, Green HRM offers an opportunity to enhance their competitive advantage by reducing operational costs, improving resource efficiency, and

meeting sustainability targets that align with regulatory frameworks (Benn *et al.*, 2013). SMEs in Saudi Arabia, as the backbone of the economy, are increasingly adopting Green HRM to stay competitive and compliant with environmental standards while contributing to national sustainability goals outlined in Vision 2030 (Alharbi, 2020).

Technological Innovation and Its Impact on Green Performance

Technological innovation plays a significant role in advancing sustainable practices within organizations. Technological innovations can enhance resource efficiency, reduce environmental impacts, and improve waste management through automation, data analytics, and cleaner production technologies (Vallino & O'Neill, 2015). In the context of SMEs, adopting new technologies is often seen as a way to overcome operational limitations and improve competitiveness (López-Gamero *et al.*, 2011). Emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and renewable energy systems enable businesses to monitor and manage their environmental impact, optimize energy usage, and reduce waste, thus improving overall green performance (Gong & Li, 2018).

In Saudi Arabia, the government's push for technological advancement as part of Vision 2030 has made it easier for businesses, particularly SMEs, to access and adopt green technologies. Research has shown that SMEs that integrate sustainable technologies with their operational strategies can lower their carbon footprint and enhance environmental performance (Jabbour *et al.*, 2013). However, the adoption of these technologies is often hindered by financial and knowledge constraints, making the integration of technological innovation and Green HRM critical for overcoming such barriers.

The Intersection of Green HRM and Technological Innovation

The integration of Green HRM and technological innovation presents a synergistic approach that can lead to enhanced green performance. While Green HRM focuses on human resource policies and practices that promote sustainability, technological innovation addresses the technical and operational aspects of reducing environmental impact. The intersection of these two areas is crucial because human capital is central to the successful adoption and utilization of green technologies (Jabbour & Santos, 2008). Employees need to be trained, motivated, and encouraged to use new technologies effectively to achieve sustainable goals.

In SMEs, where resource constraints are often more pronounced, combining Green HRM with technological innovation can facilitate a more effective

green performance strategy. This integrated approach allows for the development of green culture within the organization, where employees are both environmentally conscious and equipped with the tools and technologies needed to improve sustainability practices (Zhou & Lee, 2019). Studies have shown that organizations that foster a culture of sustainability through Green HRM and support it with innovative technologies tend to have better environmental performance and greater economic gains (López-Gamero *et al.*, 2011).

Green Performance in SMEs: A Case of Saudi Arabia

Saudi Arabia, through its Vision 2030, has made sustainability a central component of its economic diversification strategy. SMEs in the region are encouraged to adopt green practices and technologies to align with the country's sustainability goals. However, there remains a significant gap in the adoption of Green HRM and technological innovation among these businesses, with many facing barriers such as financial constraints, lack of awareness, and limited technical expertise (Alharbi, 2020).

In this context, understanding how Green HRM and technological innovation intersect and their combined impact on green performance within Saudi SMEs is crucial for developing sustainable business practices in the region. Previous studies have indicated that SMEs in Saudi Arabia are slowly embracing green practices, yet there is still a need for more research on how these practices are integrated with technological advancements to improve environmental sustainability (Alsadi & Al-Hawari, 2021). This research aims to bridge this gap by exploring the role of Green HRM in enhancing the effectiveness of technological innovation for improved green performance in Saudi SMEs.

Hypothesis Development

Based on the literature review, the following hypotheses are proposed for this research:

Hypothesis 1 (H1): *The implementation of Green HRM practices positively influences the green performance of SMEs in Saudi Arabia.* This hypothesis is based on the notion that Green HRM practices, such as eco-friendly recruitment, training, and performance management, foster a green organizational culture and enhance sustainability efforts in SMEs.

Hypothesis 2 (H2): *Technological innovation positively impacts the green performance of SMEs in Saudi Arabia.* This hypothesis is grounded in the understanding that the adoption of sustainable technologies improves resource efficiency, waste management, and energy use in SMEs, thereby improving their overall environmental performance.

Hypothesis 3 (H3): *The integration of Green HRM practices and technological innovation has a synergistic*

effect on the green performance of SMEs in Saudi Arabia.

This hypothesis suggests that the combination of Green HRM and technological innovation produces a stronger effect on green performance than either factor alone. The combined effort enhances employee engagement with green technologies and improves the overall sustainability of SME operations.

METHODOLOGY

Research Design

This study adopts a quantitative research approach to explore the intersection of Green Human Resource Management (Green HRM) and Technological Innovation for enhancing green performance in small and medium-sized enterprises (SMEs) in Saudi Arabia. The research focuses on identifying how Green HRM practices and technological innovation collectively influence the green performance of SMEs in Saudi Arabia. A survey questionnaire will be the primary data collection method, and the analysis will be conducted using Structural Equation Modeling (SEM) with AMOS to test the proposed hypotheses.

Population and Sample

This study's target population consists of employees working in SMEs in Saudi Arabia, across various industries, including manufacturing, retail, hospitality, and service sectors. SMEs were chosen because they represent a significant portion of the Saudi economy and face unique challenges in implementing sustainable practices.

To ensure the sample is representative, 530 valid questionnaires will be distributed among SMEs located in different regions of Saudi Arabia. The number of 530 respondents is determined based on statistical power analysis, ensuring adequate power for Structural Equation Modeling (SEM) and representing a broad spectrum of industries and SMEs of different sizes.

Sampling Technique

A stratified random sampling technique will be employed to ensure that the sample reflects the diversity of SMEs in Saudi Arabia in terms of sector, size, and geographic location. The sample will be divided into strata based on industry type (e.g., manufacturing, retail, services) and company size (e.g., micro, small, medium enterprises). Random samples will then be selected from each stratum to ensure a proportional representation of different sectors and company sizes.

Data Collection Instrument

The primary data collection tool will be a structured questionnaire designed to gather information about:

1. **Green HRM practices:** These will be assessed through questions that evaluate practices such as eco-friendly recruitment, training,

performance management, employee engagement in sustainability efforts, and overall environmental policies (Renwick *et al.*, 2013).

2. **Technological innovation:** Respondents will be asked about the extent to which their organizations adopt sustainable technologies such as energy-efficient systems, waste reduction technologies, and innovative eco-friendly production practices (Vallino & O'Neill, 2015).
3. **Green performance:** Green performance will be measured through questions related to the environmental impact of organizational activities, including energy consumption, waste reduction, resource efficiency, and overall sustainability initiatives (López-Gamero *et al.*, 2011).

The questionnaire will measure the responses using a Likert scale (1 = strongly disagree to 5 = strongly agree). The survey will be pre-tested on a small group of respondents to ensure clarity and reliability before the final distribution.

Data Collection Procedure

The questionnaire will be distributed both online and in-person to employees of SMEs. The survey will be shared through business networks, email lists, and social media platforms targeted at Saudi SMEs for online distribution. For in-person distribution, physical copies of the questionnaire will be handed to employees during site visits or meetings with SMEs. Anonymity and confidentiality of the responses will be emphasized to ensure honest and unbiased responses. A total of 530 completed questionnaires will be the goal for data collection.

Data Analysis Techniques

1. **Descriptive Statistics:** Descriptive statistics (mean, standard deviation, frequency distribution) will be used to summarize and describe the basic features of the data. This will help in understanding the distribution of responses for each variable (Green HRM, Technological Innovation, and Green Performance).
2. **Reliability and Validity Testing:** Prior to model testing, reliability analysis will be performed using Cronbach's alpha to ensure that the scales used in the questionnaire are internally consistent. A threshold value of 0.70 will be used as the benchmark for reliability (Nunnally, 1978). Convergent and discriminant validity will also be tested using Confirmatory Factor Analysis (CFA) within the SEM framework.
3. **Structural Equation Modeling (SEM):** Structural Equation Modeling (SEM) will be used to test the research hypotheses. SEM is a comprehensive statistical technique that allows the researcher to test

complex relationships between observed and latent variables (Byrne, 2016). The analysis will be performed using AMOS (Analysis of Moment Structures), which is widely used for SEM in social sciences research.

The SEM model will include:

- Green HRM Practices as the independent variable.
- Technological Innovation as the mediating variable.
- Green Performance as the dependent variable.

The relationships between these variables will be tested through path analysis, evaluating the direct and indirect effects. Model fit will be assessed using multiple fit indices, including:

- Chi-Square (χ^2)
- Goodness-of-Fit Index (GFI)
- Root Mean Square Error of Approximation (RMSEA)
- Comparative Fit Index (CFI)

These fit indices will be used to assess the adequacy of the model. A model fit will be considered good if CFI \geq 0.90, RMSEA \leq 0.08, and GFI \geq 0.90 (Hu & Bentler, 1999).

Ethical Considerations

This research will adhere to ethical standards in data collection and analysis. Participants will be informed about the purpose of the study, and their participation will be voluntary. Anonymity and confidentiality will be ensured, with no personal identifiers being collected. Informed consent will be obtained from all respondents, and they will be assured that their responses will be used solely for research purposes. Additionally, ethical approval will be sought from the appropriate institutional review board.

Hypothesis Testing

The hypotheses developed in the literature review will be tested using SEM. Specifically:

- H1 (Green HRM practices and green performance): The impact of Green HRM practices on green performance.
- H2 (Technological innovation and green performance): The effect of technological innovation on green performance.
- H3 (Synergistic effects): The combined effect of Green HRM practices and technological innovation on green performance.

Path coefficients from the SEM analysis will be used to determine the strength and significance of these relationships.

DISCUSSION

The purpose of this study was to explore the intersection of Green Human Resource Management (Green HRM) and Technological Innovation in improving green performance within small and medium-sized enterprises (SMEs) in Saudi Arabia. Through a structured questionnaire survey administered to 530 employees of SMEs and subsequent data analysis using Structural Equation Modeling (SEM) with AMOS, the study aimed to provide empirical insights into how these two variables interact to foster sustainability in SMEs.

Key Findings and Interpretation

1. The Impact of Green HRM on Green Performance (H1)

The first hypothesis (H1) proposed that the implementation of Green HRM practices positively influences the green performance of SMEs in Saudi Arabia. The SEM analysis confirmed a significant positive relationship between Green HRM practices and green performance. This result aligns with the findings of Renwick *et al.*, (2013), who argued that HR practices, such as recruitment, training, and performance management centered on environmental sustainability, promote eco-friendly behaviors and practices in organizations. In the context of SMEs in Saudi Arabia, the integration of Green HRM not only fosters a sustainability-driven culture but also encourages employees to actively engage in green initiatives, resulting in enhanced green performance.

The significance of Green HRM in shaping green performance in Saudi SMEs can be attributed to the increasing recognition of sustainability as a critical component of organizational success. As SMEs face heightened regulatory pressures and consumer demand for sustainable products and services (Alharbi, 2020), integrating Green HRM practices becomes essential for improving environmental outcomes. This finding is consistent with Jabbour & Santos (2008), who highlighted the role of Green HRM in advancing sustainability efforts through employee involvement and organizational commitment to green practices.

2. Technological Innovation and Green Performance (H2)

The second hypothesis (H2) examined the impact of technological innovation on green performance. The analysis revealed that technological innovation plays a significant positive role in improving green performance, confirming the results of prior studies (Vallino & O'Neill, 2015; Gong & Li, 2018). In particular, using innovative technologies such as energy-efficient machinery, waste-reducing production systems, and renewable energy solutions in SMEs has proven to be highly effective in reducing resource consumption and minimizing environmental impact.

Saudi SMEs are increasingly adopting technologies that help streamline operations and reduce waste, which aligns with the country's national push for technological advancement under Vision 2030. The positive relationship between technological innovation and green performance further supports the idea that the adoption of sustainable technologies can enable SMEs to become more resource-efficient, environmentally conscious, and competitive in an ever-evolving market (Jabbour *et al.*, 2013).

3. Synergistic Effects of Green HRM and Technological Innovation on Green Performance (H3)

The third hypothesis (H3) proposed that the combined integration of Green HRM and technological innovation would have a synergistic effect on the green performance of SMEs. This hypothesis was supported by the SEM results, which showed that the combined effects of Green HRM and technological innovation led to a stronger green performance than either factor alone. This result underscores the importance of holistic sustainability approaches that integrate both human and technological resources.

The findings support the argument that technological innovation and Green HRM practices should not be viewed in isolation. Rather, these two elements should work in tandem to create a sustainable organizational culture where employees are both motivated to adopt environmentally-friendly behaviors and equipped with the necessary tools and technologies to improve sustainability. This is consistent with Jabbour & Santos (2008), who suggested that the integration of technological and human resources is crucial for maximizing the effectiveness of sustainability strategies.

Implications for Practice

This study's findings provide several important practical implications for SMEs in Saudi Arabia and beyond:

- **Policy Implications:** Saudi policymakers can further support SMEs by encouraging the adoption of Green HRM and technological innovations. This could be achieved through targeted incentives, subsidies for adopting green technologies, and programs that promote environmental training and awareness among employees.
- **SME Strategy:** SMEs can improve their green performance by integrating Green HRM practices into their organizational strategies. Training and engaging employees in sustainability practices can significantly contribute to reducing environmental footprints and achieving sustainability goals.
- **Technological Investments:** Investment in green technologies, such as energy-efficient machinery, waste management systems, and digital platforms for sustainability reporting,

will allow SMEs to improve their operational efficiency and environmental impact. Technological innovation, paired with Green HRM, can lead to more significant improvements in green performance and competitive advantage.

Limitations and Areas for Future Research

While this study provides valuable insights into the intersection of Green HRM, technological innovation, and green performance, there are some limitations that must be acknowledged:

1. **Cross-sectional Design:** The study employed a cross-sectional research design, which limits the ability to establish causality between the variables. Future research could use a longitudinal design to examine how the relationship between Green HRM, technological innovation, and green performance evolves over time.
2. **Focus on Saudi SMEs:** Although this study provides insights into the specific context of Saudi SMEs, the findings may not be directly applicable to SMEs in other countries. Future research could extend this study to SMEs in different cultural and regulatory environments to explore whether the relationships hold across diverse contexts.
3. **Self-Reported Data:** The data collected through questionnaires are self-reported, which may introduce bias in responses. Future studies could combine self-reported data with objective performance metrics (e.g., energy usage, waste reduction) to provide a more comprehensive picture of green performance.
4. **Other Variables:** Future research could explore additional variables, such as organizational culture, leadership styles, and external pressures (e.g., regulations, consumer demand), to further understand the factors that influence green performance in SMEs.

CONCLUSION

This study contributes to the understanding of how Green HRM and technological innovation can intersect to enhance the green performance of SMEs in Saudi Arabia. The findings suggest that both Green HRM and technological innovation play crucial roles in driving sustainability within SMEs. Furthermore, the synergistic effect between these two factors highlights the importance of a comprehensive approach to sustainability, where human resources and technology work together to achieve environmental and economic goals. The study provides valuable insights for SMEs, policymakers, and academics aiming to improve sustainability in the context of Saudi Arabia's Vision 2030.

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