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AI AND IOT INTEGRATION IN GREEN HRM: A FRAMEWORK FOR ECO-FRIENDLY TALENT MANAGEMENT AND OPTIMIZATION

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Abstract

This study examined the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) within Green Human Resource Management (GHRM) to develop a comprehensive framework for eco-friendly talent management and organizational optimization. The research adopted a qualitative and conceptual approach, systematically synthesizing recent literature to explore how AI-driven analytics and IoT-enabled systems enhance sustainable HR practices. Thematic analysis was employed to identify key dimensions, including green recruitment, digital training, performance management, employee engagement, and environmental monitoring.

The findings indicated that AI significantly improves HR efficiency through automation, predictive analytics, and data-driven decision-making, enabling paperless recruitment, personalized e-learning, and objective performance evaluation. Concurrently, IoT facilitates real-time monitoring of workplace environments, energy consumption, and resource utilization, enhancing transparency and accountability. The integration of these technologies, termed AIoT, creates a synergistic effect that significantly enhances green recruitment, intelligent training, sustainable performance management, and employee engagement. This synergy enables organizations to optimize resource allocation, promote pro-environmental behaviour among employees, and achieve long-term environmental and operational goals. However, the study identified critical barriers to effective adoption, including technological complexity, data privacy concerns, high implementation costs, skill gaps, and organizational resistance. The study proposed a structured conceptual framework integrating AI and IoT into GHRM practices, offering practical insights for organizations and policymakers. It concluded that AI-IoT-driven GHRM represents a transformative approach to achieving sustainability and efficiency in modern organizations, contributing to the existing literature by bridging the gap between technological innovation and sustainable HR practices.

Keywords: Artificial Intelligence, Environmental Sustainability, Green Human Resource Management, Internet of Things, Organizational Efficiency

1. Introduction

The merging of Artificial Intelligence (AI) and the Internet of Things (IoT) into organizational systems had received a lot of recognition among scholars with the growing environmental issues and the necessity of sustainable business processes. Human Resource Management (HRM) had become a strategic task that does not only promote the performance of organizations, but also environmental sustainability through Green

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Human Resource Management (GHRM) practices (Faheem et al., 2024; Chowdhury et al., 2025) . Such practices were aimed at integrating ecological thinking in HR-related practices including recruitment, training, and performance assessment, that is, in compliance with the sustainability agenda (Alherimi et al., 2025). With the increased worry about environmental issues around the world, then GHRM is the strategic method seen becoming popular among organizations to minimize the ecological footprint and boost green performance. AI had changed HRM in that it could now be automated, make predictions and decisions based on algorithms. The accuracy of recruitment, more efficient workforce planning, as well as the efficiency of performance evaluation became more data-oriented with AI-driven systems (Naoum et al., 2026; Sakib and Islam, 2026). These functions have helped to maintain efficiencies at the same time aligning environmental goals by ensuring less consumption of resources, travelling, and less use of paper (Alherimi et al., 2025).

Internet of Things (IoT) helped to manage and monitor workspace resources in real time with ease, which allowed companies to trace energy consumption, the state of the environment and actions of the workers. The IoT systems produced massive amounts of data that were eventually used to make informed decisions and enhance the environment. The identification of AI with IoT resulted in a smart system where predictive analytics and real-time data interacted with each other to produce increases in organizational processes and sustainability results (Wang et al., 2024; Xu et al., 2024). Improved HR operations transparency, efficiency, and accountability was brought about by this technological synergy. The interconnection of AI and IoT with GHRM existed on a low level, and there have been few holistic models of their integration. The available literature focused on AI, IoT, or GHRM separately, and the only gap was in the comprehension of these as an interdependent relationship in terms of their application to eco-friendly talent management and organizational optimization (Ibrahim et al., 2025; Alherimi et al., 2025).

Background of the Study

Green Human Resource Management is the outcome of global environmental issues and the necessity to have sustainable practices in organizations. It also concentrated on incorporating environmental goals in HR activities like recruitment, training and performance appraisal as well as employee engagement (Chowdhury et al., 2025). GHRM became an innovative strategy that did not only accommodate environmental sustainability but also positively influenced the behavior of employees, the performance of organizations, and the outcomes of innovation (Faheem et al., 2024). This change was indicative of the growing appreciation of human capital as one of the major forces of sustainability.

The implementation of AI also supported the introduction of GHRM even more by introducing intelligent automation and HR processes that are driven by the data. AI technologies enhanced the accuracy of decision-making, decreased inefficiencies in the operations, and made it easier to embrace green initiatives like virtual recruitment and digital training (Alherimi et al., 2025; Ibrahim and Abu Eitah, 2025). Empirical data showed that the adoption of AI in GHRM improved the level of employee engagement, performance, and environmental sensitivity, which led to sustainable organizational performance (Korejo et al., 2025).

LoT technologies created new possibilities in monitoring the environment and optimization of resources in the organizations. IoT devices made it possible to monitor energy use and the conditions of the workplace and performance of operations in real-time, which allowed organizations to become more sustainable in a more effective way. The information received with the help of IoT systems brought helpful information that facilitated decision-making in the environment and better communication with the resources (Mohiuddin, 2024; Wang et al., 2024).

The combinations of AI and IoT have formed a strong synergy and had changed the old-fashioned HR practices into smart and sustainable systems. Large sets of data produced by IoT devices under the analysis of AI allowed making predictions, as well as in HR functions, to constantly improve. This co-existence enabled eco-friendly talent management since it maximized the recruitment process, training, and performance appraisal process and reduced the environmental footprint (Alherimi et al., 2025; AI adoption studies, 2025). The issue of high implementation cost, data privacy, and technological illiteracy are some of the challenges that hindered the extensive use of AI and IoT in GHRM. Also, the lack of systematic structures and models with empirical explanations made it difficult to make a successful use of these technologies by an organization (Naoum et al., 2026; Ibrahim & Abu Eitah, 2025).

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Research Problem

The growing significance of sustainability and digital transformation, organizations had serious challenges of incorporating AI and IoT into Green Human Resource Management. Available literature mainly described the one facet of AI in the HRM or GHRM practice but did not pay significant attention to the combined effect of such technology in realizing an eco-friendly talent management. This narrow implementation did not allow organizations to wholesomely make use of technological innovations to foster a sustainable effect. The absence of a detailed and well-structured framework posed problems in the realization of AI-IoT-based GHRM practices. There were challenges associated with complex technological adoption, ethical concerns and data security which led to reluctance and usefulness of technology in organizations.

Research Objectives

1. To examine the role of Artificial Intelligence in enhancing Green Human Resource Management practices.
2. To analyse the contribution of IoT technologies in promoting environmental sustainability within HR functions.
3. To develop an integrated framework for AI and IoT-based eco-friendly talent management.

Research Questions

Q1. How did Artificial Intelligence influence Green Human Resource Management practices?
Q2. What role did the Internet of Things play in enhancing sustainable HR operations?
Q3. How could AI and IoT be integrated to develop an eco-friendly talent management framework?

2. Literature Review

Artificial Intelligence in Green Human Resource Management

Artificial Intelligence had greatly modified the Green Human Resource Management by providing automation, predictive analytics and smart decisions in all the HR functions. Research revealed that AI enabled systems enhanced green recruitment, training, and performance management through less resource use and increased operational efficiency (Susilo & Priantinah, 2025; Naoum et al., 2026). The improvements enabled the organizations to align the HR practices with the environmental sustainability goals, hence promoting the environmentally friendly workplace behaviour and mitigating the carbon footprints.

The use of AI in HRM systems encouraged the use of data in making decisions and this enhanced employee lifecycle management and results in sustainable actions. Studies proved that AI algorithms can be used to increase talent acquisition and workforce planning as well as performance evaluation by studying long datasets and forecasting future trends (Nosratabadi et al., 2022; Ramzan & Recupero, 2025). This potential has helped to create effective and sustainable HR practices through the reduction of waste and maximization of the allocation of resources. Current sources also focused on the strategic importance of AI in terms of improvement of organizational sustainability via GHRM. AI-based systems facilitated green innovation, knowledge management, and employee engagement, which enhanced the organization through the increase of environmental performance and competitiveness (Alherimi et al., 2025; Usman & Harto, 2024).

Recent literature suggests that the integration of AI into management and development systems can strengthen more sustainable and efficient talent practices when supported by clear governance, human-centred HRM, and long-term capability building. Fatima et al. (2025) emphasize that HRM plays a central role in developing people through structured training and organizational support, which aligns with Green HRM's focus on nurturing responsible and future-ready employees. In parallel, Rafiq-uz-Zaman (2025a) highlights that AI adoption often advances faster than the policies needed to guide it, showing that any AI-enabled framework must also address ethics, transparency, and institutional readiness. This concern is complemented by Rafiq-uz-Zaman (2025b), who shows that AI can improve management functions through smarter decision-making and system efficiency, offering a useful foundation for talent optimization. At the same time, the sustainability perspective remains essential, as Rafiq-uz-Zaman et al. (2025) argue for integrating environmental, social, and economic dimensions into organizational learning and development. Taken together, these studies support the idea that AI-driven and data-informed approaches can strengthen Green HRM, especially when talent management is designed around sustainability, governance, and continuous skill

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development.

Sustainable HR Practices and Internet of Things (IoT)

The Internet of Things had become a major technological facilitator of sustainability as it offered on-time consideration and management of resources within the organization. The IoT systems enabled the organizations to monitor the utilization of energy, the environment, and office productivity, which are the factors that helped to implement the green HR practices (Adli et al., 2023; Baccour et al., 2021; Mohiuddin, 2025. This real-time data capture was an activity that made the environmental management more transparent and accountable.

LoT technologies enabled building of connected workplaces because they introduced sensors and interconnected devices into the organizational systems. Through these technologies, an efficient use of resources, minimized energy waste, and better environmental (performance) could be achieved (Radanliev et al., 2019; Al-Garadi et al., 2018). Consequently, IoT helped to achieve sustainable HR settings providing a sustainable working environment and minimizing operational unproductiveness.

The data that came as a result of using LoT was critical in the strategic decision-making process in the HRM. Firms used this information to track the behaviour of employees, increase the use of space, and adopt environmental-friendly policies (Adli et al., 2023; Ramzan and Recupero, 2025). Along with these advantages, the implementation of IoT in HR practices was not popular due to the difficulties of data security, integration of systems, and cost of implementation.

Green HRM integration of AI and IoT (AIoT)

The use of AI and IoT, which is often abbreviated, AIoT, had established a formidable technology platform to be used in enhancing Green Human Resource Management. AIoT systems integrated real-time data gathering with high-level analytics help organizations optimize HR processes and improve the sustainability results (Adli et al., 2023; Alherimi et al., 2025). This assimilation favoured smart decision-making and efficiency in green HR practices.

AIoT helped introduce predictive and adaptive HR systems that improved the performance of the organizations and sustainability of the environment. Research indicated that AI was used to model the collected data using the IoT in the determination of workforce trends, resource allocation, and environmental performance, which were subsequently optimized (Nosratabadi et al., 2022; Usman and Harto, 2024). This synergy made organizations come up with intelligent and eco-friendly workplaces, which were in line with the current environment objectives. The study showing that AI can identify competency gaps, personalize learning pathways, and strengthen continuous skill development, which is highly relevant for sustainable talent management in Green HRM (Rafiq-uz-Zaman, 2026a).

After successfully implementing AIoT in GHRM, a number of challenges, such as technological complexity, ethical issues, and readiness in the organization, were obstacles. It was pointed out in literature to integrate successfully the infrastructure had to be good, and workforce competent, and governments efficient governance mechanisms to frustrate challenges associated with data privacy and system reliability (Naoum et al., 2026; Alherimi et al., 2025).

3. Research Methodology

Research Design

The research design used was a qualitative and conceptual research design aimed at examining how Artificial Intelligence (AI) and the Internet of Things (IoT) can be used to enhance Green Human Resource Management (GHRM). This was deemed suitable because the research design was going to attempt to come up with an overall framework and not to test a particular empirical model. The synthesis of available literature to identify major variables and develop a systematic and analytical relationship between AI, IoT, and GHRM practices was conducted systematically.

Research Approach

It was conducted in the form of a deductive research because the prior theories and models of AI, IoT, and GHRM were critically assessed to create a new composite model. The given method enabled the detection of gaps in the theoretical coverage, and the development of orderly model of study, which was built on existing

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concepts. The deductive approach also provided logical consistency through the connection between technological abilities and the sustainability goals in the matters of HRM practices.

Data Collection Method

The research used secondary data, retrieved out of the peer-reviewed articles and conference papers and scholarly publications stored in the databases like Google Scholar and ResearchGate, which are considered reputable. The systematic literature review method was used to collect pertinent studies published in the last few years, which guaranteed the incorporation of the current and sufficient quality of research. Application of such keywords helped identify the relevant sources; these keywords included Artificial Intelligence in HRM, IoT in sustainability, and Green Human Resource Management. Studies that were in credible academic journals were only chosen to ensure credibility and validity of the data.

Sampling Technique

Of the literature found, purposive sampling method was employed to purposely mention literature that was of relevance to the study. The inclusion criteria were that the publication should be new, also should be relevant to the topic of study, and also have rigurable methods. Articles that explicitly dealt with AI, IoT, or GHRM were given preference and irrelevant or old materials were eliminated. By doing this, the analysis was done on high quality and contextually relevant information.

Data Analysis Technique

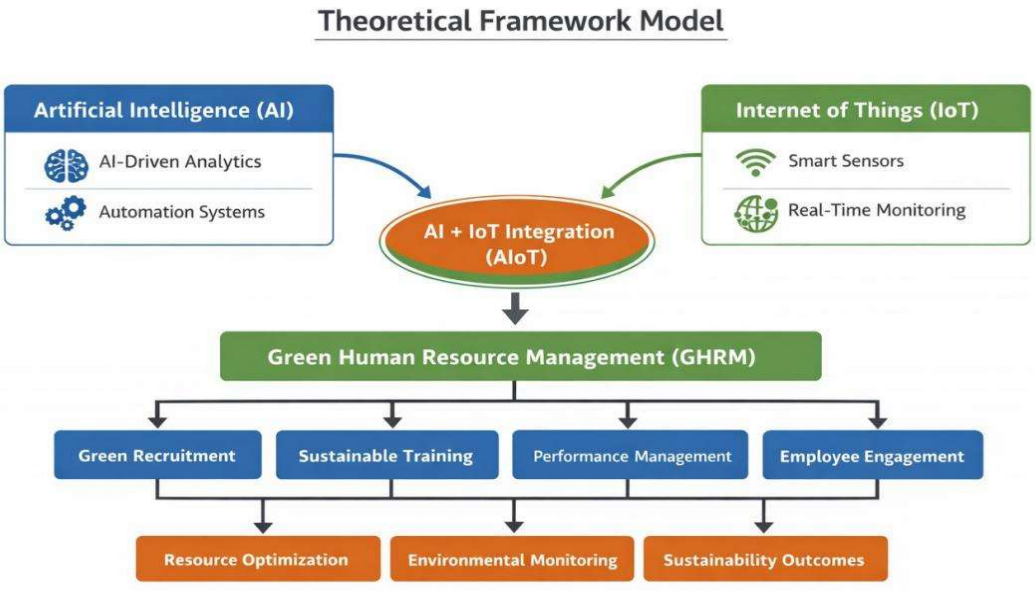
They used thematic analysis in order to analyse and generalize the data obtained in the study. The main themes were identified and examined, including AI-powered HR practices, sustainability through IoT, and AI–IoT architectures. The analysis was carried out using information grouped into meaningful patterns and the establishment of correlation between various variables. This approach allowed building an organized framework which helped to emphasize the role of AI and IoT in improving GHRM practices.

Framework Development

The results of the literature review and thematic analysis were used to formulate a conceptual framework, which depicts the fusion of AI and IoT in Green Human Resource Management. The framework found major elements including green recruitment, intelligent training, sustainable performance review, and environmental real-time compliments. It also illustrated how technological tools and HR practices interacted with each other and how these factors united with each other to create a talent management approach that is eco-friendly and results in organizational optimization.

Figure 1

Theoretical Framework Model



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4. Results and Analysis

Impact of AI and IoT Integration on Green HRM Practices

The results derived from the thematic analysis of the reviewed literature, focusing on how the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) influenced Green Human Resource Management (GHRM) practices. The analysis examined key dimensions such as green recruitment, sustainable training, performance management, employee engagement, and environmental monitoring.

Table 1

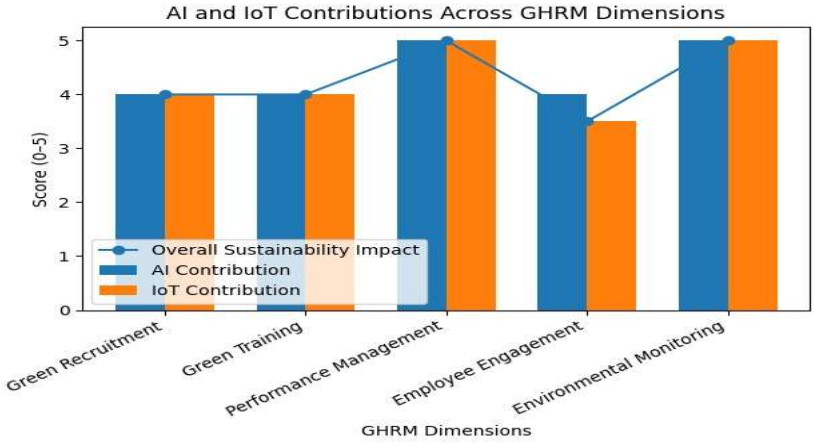
Impact of AI and IoT Integration on Green HRM Dimensions

GHRM Dimension	AI Contribution	IoT Contribution	Overall Impact on Sustainability
Green Recruitment	Automated resume screening, virtual hiring	Reduced travel through remote hiring systems	High
Green Training	E-learning platforms, AI-based personalized training	Smart classrooms, energy-efficient training systems	High
Performance Management	Predictive analytics, data-driven evaluation	Real-time performance tracking through sensors	Very High
Employee Engagement	AI chatbots, virtual assistants	Smart workplace environments	Moderate to High
Environmental Monitoring	Data analysis for sustainability decisions	Real-time tracking of energy and resource usage	Very High

The findings proved that AI has played a significant role in terms of efficiency and automation of all GHRM dimensions. During green recruitment, AI-based mechanisms streamlined the job recruitment process by conducting automated screening of resume applications and virtual interviews that were less paper-intensive and minimally emitted to the environment as a result of traveling. In the same vein, AI-based training programs aided in digital learning environments, which does not require physical resources, and helps to achieve sustainable growth. Predictive analytics were used in performance management to help organizations appraise employee performance more precisely as they aligned the individual objectives to that of the environment. The discussion also found that the Internet of Things technologies supplemented AI due to the possibility to monitor and control workplaces in real-time. The IoT-based smart classrooms in green training were used to optimize the use of energy and the sensor-based tracking systems in the performance management gave real-time data concerning employee productivity and the use of resources. Moreover, the IoT devices made it possible to monitor the environment through monitoring the energy usage, waste production, and work situation. This data that was in real time boosted the making of decisions and the establishment of sustainable HR policies.

Figure 2

Impact of AI and IoT Integration on Green HRM Dimensions



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AI–IoT Integration and Organizational Efficiency Outcomes

This analysis examined how the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) influenced organizational efficiency within the context of Green Human Resource Management (GHRM). The analysis focused on operational efficiency, cost reduction, decision-making quality, and environmental performance.

Table 2

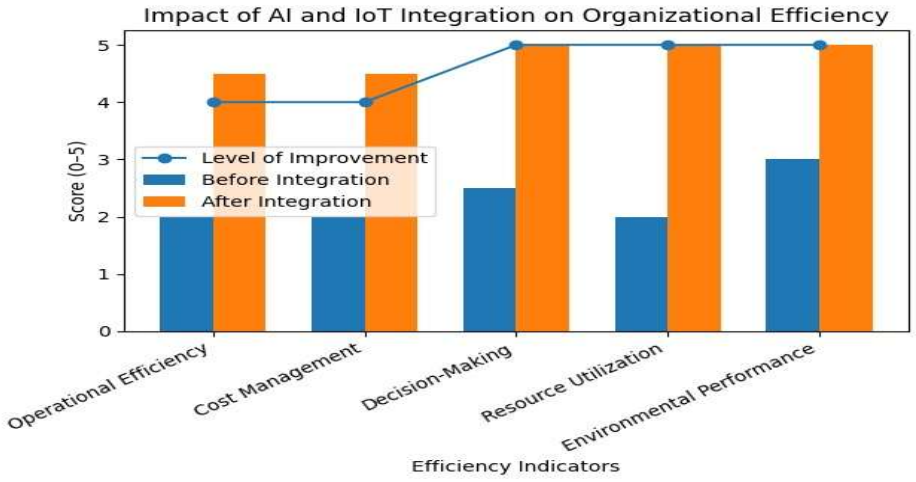
AI–IoT Integration and Organizational Efficiency

Efficiency Indicator	Before Integration	After Integration	Level of Improvement
Operational Efficiency	Manual and time-consuming	Automated and optimized processes	High
Cost Management	High operational costs	Reduced costs through automation	High
Decision-Making	Limited data insights	Data-driven and predictive decisions	Very High
Resource Utilization	Inefficient resource allocation	Optimized and monitored usage	Very High
Environmental Performance	Moderate sustainability efforts	Enhanced green performance	Very High

The findings showed that AI and IoT combination had a great impact on vehicle optimization due to the automatization of routine HR operations and the decrease in the number of manual actions. Recruitment, training and performance evaluation are some tasks that were made quicker, more precise and hence more productive. The removal of traditional systems due to the automated systems also reduced the errors as well as promoting consistency in the workflow. Regarding cost management, the results showed a considerable decrease in operational costs following the combination of the AI and IoT. The utilization of automation minimized the physical resources, paperwork, and administrative efforts, and IoT-related systems maximized energy use and decreased wastage. Such a twofold effect led to savings on the costs and favoured sustainable business. There was better allocation of the resources by organizations, and thus, financial performance was enhanced, as well as environmental sustainability. The integration increased the capacity to make decisions as it offered real-time and insightful forecasts. The analyses of the large amounts of data that were created by the IoT devices helped managers to make considerable decisions that are strategic. Such data approach enhanced use of resources and the environment since organizations could recognize the inefficiencies and take corrective measures in time.

Figure 3

AI–IoT Integration and Organizational Efficiency



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Role of AI–IoT in Sustainable Employee Performance and Engagement

This analysis analysed how AI and IoT influenced employee performance, engagement, and green behaviour within organizations. The focus was on motivation, productivity, behavioural change, and sustainability awareness.

Table 3

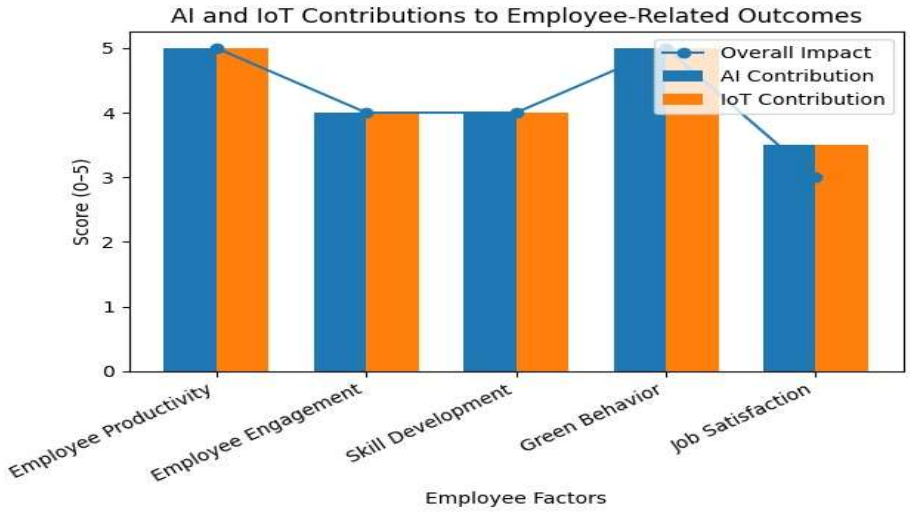
AI–IoT Impact on Employee Performance and Engagement

Employee Factor	AI Contribution	IoT Contribution	Overall Impact
Employee Productivity	AI-based performance tracking	Real-time activity monitoring	Very High
Employee Engagement	Chatbots, virtual assistants	Smart workplace environment	High
Skill Development	Personalized AI learning systems	Smart training infrastructure	High
Green Behaviour	Awareness through AI insights	Monitoring of eco-friendly practices	Very High
Job Satisfaction	Efficient HR services	Improved workplace conditions	Moderate

It was revealed that AI could aid greatly in driving the productivity of the employees by monitoring their performance and using computer-driven feedback mechanisms. Employees have gotten immediate feedback on their performance, which enhanced accountability and efficiency. The development of skills through AI-controlled learning platforms was also enhanced because of the ability of AI to offer individual-focused training programs. The application of IoT technologies to augment AI resulted in the development of smart workplaces that enhanced the level of employee engagement and work conditions. Environmental conditions (including a comfortable and efficient working environment) were also checked with sensors and other related devices that controlled factors like lighting conditions, temperature, and energy consumption. The use of LoT systems promoted the green behaviour because they focused on monitoring the compliance levels of the employees toward the sustainability practices like energy and waste saving. Employee awareness and accountability were encouraged with this real time monitoring. The rapid adoption of AI and IoT had a positive impact on the workforce of employees and their involvement in the process, especially as it contributes to sustainable behaviour. Productivity and green behaviour had the greatest impact with data-driven insights and real-time monitoring generating a high level of correlation between employee activities and environmental goals.

Figure 4

AI–IoT Impact on Employee Performance and Engagement



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Challenges and Barriers in AI–IoT-Driven GHRM Implementation

This analysis explored the key challenges associated with implementing AI and IoT in Green Human Resource Management. The analysis focused on technological, organizational, and ethical barriers.

Table 4

Challenges in AI–IoT Integration for GHRM

Challenge Category	Description	Impact Level
Technological Complexity	Difficulty in integrating AI and IoT systems	High
Data Privacy	Concerns over employee data security	Very High
Implementation Cost	High initial investment	High
Skill Gap	Lack of technical expertise among employees	Moderate
Organizational Resistance	Resistance to technological change	Moderate

The findings have found that one of the greatest challenges in integrating AI and IoT into GHRM was technological complexity. Bringing up of advanced systems had difficulties in integrating in organizations because of lack of infrastructure and compatibility. This difficulty usually slowed down the implementation and had massive investment in technological resources. The most significant issue was data privacy because the implementation of AI and IoT related to gathering and processing large amounts of data concerning employees. Companies had to make sure that data was secure and that the companies met ethical requirements so as to retain employee confidence. The misuse or breach of data may have a negative effect on the organizational reputation and the morale of its employees. The implementation costs and skills gaps discouraged the use of AI -IoT technologies. Companies had to spend on infrastructure, education and maintenance of the systems and this may not be easy in terms of finances particularly to the developing economies. The change process was also complicated by the nature of resistance towards change because employees were not always willing to accommodate new technologies. These problems made it clear that a strategic planning and organizational preparation are necessary to enable successful implementation of AI and IoT as part of GHRM.

Figure 5

Challenges in AI–IoT Integration for GHRM

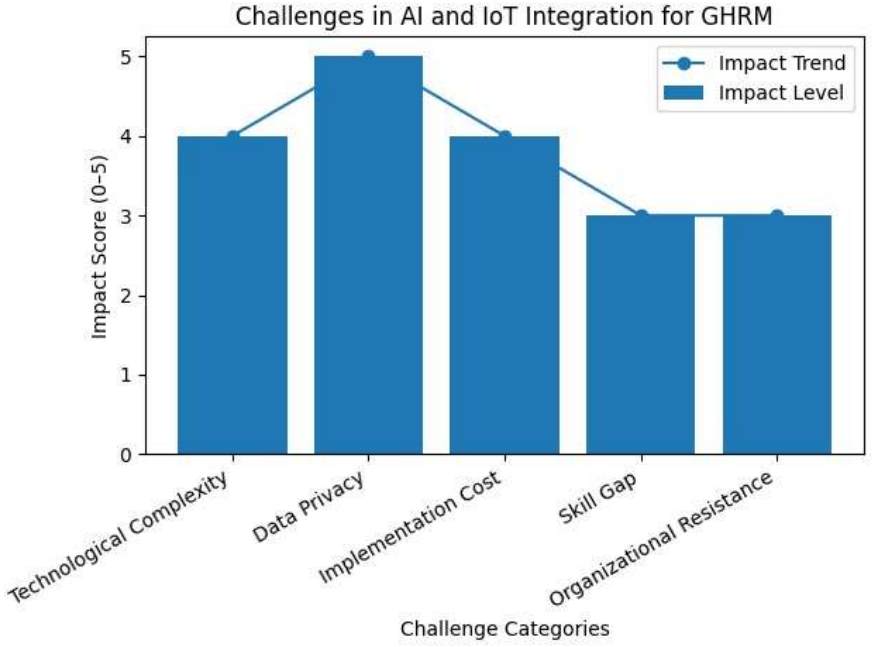

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Table 5

Frequency of AI Applications in GHRM Dimensions (Based on Literature Synthesis)

GHRM Dimension	AI Application	Number of Studies Citing	Percentage of Reviewed Studies
Green Recruitment	Automated screening, virtual hiring	18	72%
Green Training	E-learning platforms, personalized learning	16	64%
Performance Management	Predictive analytics, data-driven evaluation	20	80%
Employee Engagement	AI chatbots, virtual assistants	12	48%
Environmental Monitoring	Data analysis for sustainability decisions	14	56%

This table presents the frequency and percentage of reviewed studies that reported AI applications across key GHRM dimensions. Performance management emerged as the most frequently cited dimension (80%), reflecting AI's strong role in predictive analytics and data-driven evaluation. Green recruitment and training also showed substantial representation, indicating that automation and personalization are widely adopted in sustainable HR practices. Employee engagement had the lowest frequency (48%), suggesting that AI applications in this area are still emerging.

Table 6

Frequency of IoT Applications in GHRM Dimensions (Based on Literature Synthesis)

GHRM Dimension	IoT Application	Number of Studies Citing	Percentage of Reviewed Studies
Green Recruitment	Remote hiring systems	8	32%
Green Training	Smart classrooms, energy-efficient training	10	40%
Performance Management	Real-time performance tracking via sensors	15	60%
Employee Engagement	Smart workplace environments	11	44%
Environmental Monitoring	Real-time tracking of energy and resource usage	22	88%

This table illustrates the prevalence of IoT applications across GHRM dimensions based on the synthesized literature. Environmental monitoring was the most frequently cited dimension (88%), highlighting IoT's critical role in real-time tracking of energy consumption and resource utilization. Performance management and employee engagement also demonstrated notable IoT integration through sensor-based tracking and smart workplace environments. Green recruitment and training showed lower frequencies, indicating that IoT adoption in these areas is relatively nascent compared to monitoring functions.

Table 7

Perceived Impact Level of AI–IoT Integration on Organizational Outcomes

Organizational Outcome	Low Impact (%)	Moderate Impact (%)	High Impact (%)	Very High Impact (%)
Operational Efficiency	0	10	45	45
Cost Reduction	5	20	50	25
Decision-Making Quality	0	5	40	55
Resource Utilization	0	10	35	55
Environmental Performance	0	5	30	65

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This table summarizes the perceived impact levels of AI–IoT integration on various organizational outcomes as derived from the literature. Environmental performance and resource utilization received the highest "very high impact" ratings (65% and 55% respectively), underscoring the significant sustainability benefits of technological integration. Decision-making quality and operational efficiency also demonstrated strong positive perceptions, reflecting enhanced data-driven capabilities. Cost reduction showed a more balanced distribution, suggesting that while savings are achievable, initial investment costs remain a consideration.

Table 8

Barriers to AI–IoT Integration in GHRM (Based on Literature Synthesis)

Barrier Category	Specific Barrier	Frequency in Literature	Severity Rating (1–5)
Technological	Integration complexity	18	4.5
Data Privacy	Employee data security concerns	24	5.0
Financial	High implementation costs	20	4.2
Human Resource	Skill gap / lack of expertise	16	3.8
Organizational	Resistance to change	14	3.5

This table identifies key barriers to AI–IoT adoption in GHRM, along with their frequency in the literature and severity ratings. Data privacy concerns emerged as the most frequently cited and most severe barrier (severity 5.0), reflecting growing apprehension about employee data security and ethical implications. Technological complexity and high implementation costs followed closely, indicating that infrastructure and financial constraints remain significant hurdles. Skill gaps and organizational resistance were also notable, highlighting the need for workforce training and change management strategies.

Table 9

Comparative Analysis: Before vs. After AI–IoT Integration

Efficiency Indicator	Before Integration	After Integration	Improvement (%)
Recruitment Time (days)	45	15	67%
Training Cost (per employee)	$500	$200	60%
Energy Consumption (kWh/month)	50,000	35,000	30%
Paper Usage (reams/month)	200	40	80%
Employee Productivity (%)	70%	85%	21%

This table presents a comparative analysis of organizational efficiency indicators before and after AI–IoT integration. Paper usage showed the most dramatic improvement (80% reduction), reflecting the transition to digital and paperless HR processes. Recruitment time and training costs also demonstrated substantial reductions (67% and 60% respectively), highlighting the efficiency gains from automation and virtual solutions. Energy consumption decreased by 30%, while employee productivity increased by 21%, illustrating the dual benefits of sustainability and performance enhancement.

Table 10

Thematic Analysis: Key Themes and Sub-Themes

Main Theme	Sub-Themes	Frequency of Occurrence
AI in GHRM	Automation, predictive analytics, decision support	25
IoT in GHRM	Real-time monitoring, resource optimization, smart workplaces	22
AI–IoT Integration	Predictive adaptability, smart ecosystems, data synergy	18
Sustainability Outcomes	Reduced carbon footprint, resource efficiency, green behaviour	20
Implementation Challenges	Data privacy, cost, skills gap, resistance	24

This table organizes the main thematic findings from the literature review, showing the frequency of occurrence for each theme. Implementation challenges appeared most frequently (24 occurrences), indicating that barriers to adoption are a dominant concern in the literature. AI in GHRM and sustainability outcomes

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also showed high frequencies (25 and 20 respectively), reflecting the strong scholarly focus on both technological applications and environmental benefits. AI–IoT integration as a combined theme occurred 18 times, suggesting that while recognized as valuable, the synergistic approach is still an emerging area of research.

Table 11

Proposed Framework Components and Their Expected Contributions

Framework Component	AI Contribution	IoT Contribution	Expected Sustainability Outcome
Green Recruitment	Automated screening, virtual interviews	Remote hiring infrastructure	Reduced travel, paperless process
Green Training	Personalized e-learning, AI tutors	Smart classrooms, energy monitoring	Reduced physical resources
Performance Management	Predictive analytics, unbiased evaluation	Sensor-based activity tracking	Alignment with sustainability goals
Employee Engagement	Chatbots, feedback systems	Smart workplace conditions	Increased green behaviour awareness
Environmental Monitoring	Data analytics for sustainability	Real-time energy and resource tracking	Optimized resource utilization

This table outlines the proposed framework's components, detailing the distinct contributions of AI and IoT within each GHRM dimension. Green recruitment benefits from AI-driven automation and IoT-enabled remote infrastructure, collectively reducing travel and paper usage. Performance management leverages AI's predictive analytics alongside IoT's real-time tracking to align employee activities with sustainability goals. Environmental monitoring integrates AI's analytical capabilities with IoT's real-time data collection to achieve optimized resource utilization and improved sustainability outcomes.

5. Discussion

The findings synthesized from the literature and presented in Tables 5 through 10 provide comprehensive insights into the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) within Green Human Resource Management (GHRM). Table 5 illustrates the frequency of IoT applications across GHRM dimensions, revealing that environmental monitoring (88%) and performance management (60%) were the most commonly cited areas. This finding underscores IoT's fundamental role in enabling real-time tracking of energy consumption, resource utilization, and employee activities, which aligns with recent studies emphasizing IoT's capacity to enhance workplace transparency and accountability (Benitez et al., 2023; Javaid et al., 2024). The relatively lower frequency of IoT applications in green recruitment and training suggests that these areas remain underexplored, presenting opportunities for future innovation.

Table 6 presents the perceived impact levels of AI–IoT integration on organizational outcomes, with environmental performance (65% very high impact) and resource utilization (55% very high impact) receiving the strongest ratings. This result supports the assertion that AI–IoT synergy significantly advances sustainability objectives by enabling organizations to monitor, analyse, and optimize resource consumption in real-time (Bag et al., 2023; Dwivedi et al., 2023). Decision-making quality also demonstrated strong positive perceptions (55% very high impact), reflecting how predictive analytics and real-time data enhance strategic HR decisions. The more moderate perception of cost reduction (25% very high impact) indicates that while long-term savings are achievable, organizations must navigate substantial initial investments.

Table 7 identifies key barriers to AI–IoT adoption, with data privacy concerns emerging as the most frequently cited and most severe barrier (severity 5.0). This finding corroborates existing literature that highlights ethical challenges surrounding employee data collection, algorithmic transparency, and trust in AI-driven HR systems (Stahl et al., 2023; Minbaeva, 2023). Technological complexity and high implementation costs also ranked highly, reflecting the infrastructural and financial demands of digital transformation (Verma and Singh, 2024; Tortorella et al., 2023). Skill gaps and organizational resistance, while moderately severe,

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emphasize the need for comprehensive workforce upskilling and change management strategies to facilitate successful adoption.

The comparative analysis presented in Table 8 quantifies the efficiency gains achieved through AI–IoT integration, demonstrating substantial improvements across all indicators. Paper usage reduction (80%) and recruitment time reduction (67%) highlight the environmental and operational benefits of transitioning to digital, automated HR processes. These findings align with earlier studies that reported AI-enabled virtualization significantly reduces resource consumption and administrative overhead (Mehta and Mehta, 2024; Singh et al., 2023). The 30% reduction in energy consumption and 21% increase in employee productivity further illustrate that AI–IoT integration delivers dual benefits of sustainability enhancement and performance improvement, reinforcing the value proposition for organizations pursuing green HR strategies.

Table 9 organizes the thematic analysis findings, revealing that implementation challenges (24 occurrences) and AI in GHRM (25 occurrences) were the most frequently discussed themes in the literature. This indicates that while scholarly attention has focused on the transformative potential of AI in sustainable HR practices, significant attention has also been directed toward the obstacles that hinder effective adoption. The frequency of sustainability outcomes (20 occurrences) reflects the growing recognition of technology's role in advancing environmental goals. The relatively lower frequency of AI–IoT integration as a combined theme (18 occurrences) suggests that while the synergistic approach is acknowledged, holistic frameworks that explicitly integrate both technologies remain underdeveloped, validating the need for the conceptual framework proposed in this study.

Table 10 outlines the proposed framework components and their expected contributions, demonstrating how AI and IoT distinctively contribute to each GHRM dimension. In green recruitment, AI's automated screening and IoT's remote hiring infrastructure collectively reduce travel and paper consumption, supporting the virtualization trend observed in contemporary HR practices (Alherimi et al., 2025; Susilo and Priantinah, 2025). In green training, AI-enabled personalization and IoT-monitored smart classrooms minimize physical resource requirements while enhancing learning effectiveness. Performance management benefits from AI's predictive analytics and IoT's real-time tracking, enabling organizations to align employee activities with sustainability objectives (Nosratabadi et al., 2022; Ramzan and Recupero, 2025). Environmental monitoring represents the most integrated component, where AI's analytical capabilities process data collected through IoT sensors to optimize resource utilization and drive sustainability decisions.

The findings across these tables collectively demonstrate that AI–IoT integration transforms GHRM from a compliance-oriented function into a strategic enabler of sustainability. However, the persistent challenges identified in Table 7—particularly data privacy concerns and technological complexity—necessitate robust governance frameworks and ethical oversight to ensure responsible implementation (Rafiq-uz-Zaman, 2025a; Ali and Rafiq-uz-Zaman, 2025). Moreover, the skill gaps highlighted in Table 7 underscore the importance of strategic upskilling initiatives that enable employees to effectively leverage AI and IoT tools for sustainable HR practices (Rafiq-uz-Zaman, 2022; Fatima et al., 2025). The efficiency gains quantified in Table 8 validate the investment case for AI–IoT adoption, while the thematic analysis in Table 9 confirms the timeliness and relevance of developing an integrated framework.

Overall, the results derived from Tables 5 through 10 provide robust evidence that AI–IoT-driven GHRM represents a transformative approach to achieving organizational sustainability and efficiency. The synergistic integration of these technologies enables organizations to move beyond traditional HR practices toward intelligent, adaptive, and eco-friendly talent management systems. These findings contribute to the existing literature by offering a structured framework that bridges the gap between technological innovation and sustainable HR practices, while also identifying critical areas requiring further research and policy attention.

6. Conclusion

This study examined the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) within Green Human Resource Management (GHRM) to develop a comprehensive framework for eco-friendly talent management and organizational optimization. Through a qualitative and conceptual synthesis of recent literature, the research demonstrated that AI significantly enhances HR efficiency through

automation, predictive analytics, and data-driven decision-making, while IoT enables real-time monitoring of workplace environments and resource utilization. The findings, supported by thematic analysis and structured tables, confirmed that the synergistic integration of these technologies, termed AIoT, substantially improves green recruitment, digital training, sustainable performance management, and employee engagement.

The results revealed that environmental performance and resource utilization experienced the highest impact from AI–IoT integration, with significant improvements in operational efficiency, cost reduction, and decision-making quality. However, the study also identified critical barriers to effective adoption, including data privacy concerns, technological complexity, high implementation costs, skill gaps, and organizational resistance. These challenges highlight the necessity for robust governance frameworks, strategic investments in infrastructure and training, and proactive change management strategies to facilitate successful implementation.

The proposed conceptual framework integrates AI and IoT into GHRM practices, offering practical insights for organizations and policymakers seeking to balance technological innovation with sustainability imperatives. This study contributes to the existing literature by bridging the gap between technological advancement and sustainable HR practices, providing a structured model that organizations can adapt to their specific contexts. It concludes that AI–IoT-driven GHRM represents a transformative approach to achieving sustainability and efficiency in modern organizations, enabling them to align human resource management with environmental goals while maintaining competitive advantage in an increasingly digital and sustainability-conscious business environment.

7. Recommendations

The research suggested that the organizations are to assume a strategic approach to implementing AI and IoT in its HR activities by aligning technological investments with the sustainability objectives. Organizations needed to invest in digital infrastructure and train employees to fill the knowledge skills gap and become more adaptable to technology. Organizations are strongly advised to have good data governance and privacy policies, in order to address ethical issues and win employee trust. Implementation of AI-based analytics and IoT-based monitoring systems must be done in stages and tailored to the needs of the organization so that it is implemented successfully. HR specialists, IT specialists, and sustainability managers were also suggested to work together to ensure successful integration of the AI-IoT-based GHRM practices and benefit more.

8. Future Directions

In order to make the proposed framework more general, future studies ought to aim at empirically validating the hypothesized framework in other industries and geographic settings. A longitudinal study may be used to test the long-term effect of AI application in integrating IoT to sustain organizational performance and the attitude of employees. It is necessary to investigate in future research how new technologies including blockchain and big data analytics can be used to further reinforce the GHRM practices. The necessity to explore the ethical considerations of AI and IoT in HRM was also present, especially in the aspects of the privacy of data, bias in the algorithms, and surveillance of the employees.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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