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INTEGRATING ARTIFICIAL INTELLIGENCE INTO SUSTAINABLE HUMAN RESOURCE MANAGEMENT PRACTICES: A BIBLIOMETRIC ANALYSIS (2009–2024)

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ABSTRACT

In the context of accelerating digital transformation, the integration of Artificial Intelligence (AI) into sustainable Human Resource Management (HRM) has emerged as a key focus in both academic and practical domains. This study systematically examines the landscape of AI applications in sustainable HRM through a bibliometric analysis based on a dataset of 188 peer-reviewed publications from 2009 to 2024. Utilizing VOSviewer software, the study analyzes citation networks, keyword co-occurrence, and international research collaborations to identify major trends, influential authors, and emerging thematic clusters. The findings reveal a significant surge in research activity since 2020, particularly in areas such as AI-enhanced recruitment, performance evaluation, and green HRM initiatives. In addition, the study highlights ongoing challenges, including concerns about data privacy, algorithmic bias, and ethical transparency that hinder effective AI adoption. By synthesizing fragmented literature, this research provides a comprehensive overview of the field, contributes a novel bibliometric perspective, and proposes future research directions to ensure AI integration aligns with both sustainability goals and ethical HRM practices. The results provide valuable insights for scholars and policymakers aiming to foster responsible innovation in human resource management.

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1. Introduction

The integration of Artificial Intelligence (AI) into human resource management (HRM) has emerged as a critical topic in the era of digital transformation. AI has shown strong potential in optimizing recruitment, training, performance evaluation, and workforce management, thereby contributing to efficiency and fairness in the workplace (Böhmer & Schinnenburg, 2023). At the same time, these advantages are accompanied by persistent ethical concerns, including algorithmic bias, transparency, data privacy, fairness, and employee acceptance, that raise important questions about responsible adoption (Pan & Froese, 2023).

Parallel to technological advances, sustainable HRM has become pivotal in striking a balance between organizational efficiency and employee well-being, thereby supporting long-term stability and development. Research shows that sustainable HRM strategies can enhance employee engagement, improve productivity, and strengthen organizational sustainability (Kramar, 2014; Ehnert et al., 2014). Yet, implementing sustainable HRM effectively remains challenging, particularly in collecting, managing, and analyzing workforce data. This creates opportunities for AI to complement sustainable HRM by providing predictive insights and enabling data-driven decisions (Evseeva et al., 2021).

Despite increasing scholarly interest in AI-driven HRM, research gaps remain evident. Prior studies often address isolated aspects such as intelligent recruitment systems or performance analytics without adopting a holistic perspective (Pan & Froese, 2023; Budhwar et al., 2023). Moreover, there is a shortage of bibliometric analyses that systematically map research trends, influential authors, and thematic clusters in this field (Koştı & Kayadibi, 2025). Addressing these gaps is crucial to developing a comprehensive understanding of how AI and sustainable HRM intersect.

To address these gaps, this study employs bibliometric analysis of peer-reviewed literature on AI and sustainable HRM published between 2009 and 2024 in the Scopus database. Using VOSviewer, the study examines citation patterns, keyword co-occurrence, collaboration networks, and emerging research themes. The primary objectives are threefold: *(1)* to consolidate fragmented research on AI and sustainable HRM, *(2)* to identify dominant research themes, influential scholars, and key contributions, and *(3)* to highlight research gaps and propose directions for future inquiry. By providing this structured overview, the study contributes to a deeper academic understanding while offering practical insights for organizations and policymakers.

2. Theoretical framework and literature review

2.1. Theoretical Framework

The integration of Artificial Intelligence (AI) into sustainable human resource management (HRM) is increasingly viewed through multidimensional theoretical lenses, offering insights into how technology can strategically transform HR practices. From the resource-based view (RBV), AI is considered a strategic intangible asset that enhances organizational competencies and long-term sustainability. Garg et al. (2018) demonstrated that AI applications can improve green HRM practices by optimizing resource usage and mitigating environmental impact (Garg et al., 2018). Supporting this, Muñoz Pascual and Galende del Canto (2020) argued that sustainable HRM, when aligned with AI-driven tools, significantly improves organizational performance through data-informed workforce decisions.

The socio-technical systems theory emphasizes the interplay between technological systems and human elements. Sova et al. (2023) emphasized that AI integration in HRM should focus on a balance between operational efficiency and ethical considerations to ensure equitable treatment of employees within sustainable development frameworks (Sova et al., 2023). In addition, the nested complexity framework developed by Yawson and Goryunova (2024) highlights how AI systems are embedded in complex regulatory, ethical, and organizational contexts. Their approach suggests that AI adoption in HRM requires multi-level strategies that integrate social values, legal constraints, and adaptive technologies.

Recent studies have also examined the transformative role of generative AI in HRM. Chowdhury et al. (2024) proposed a strategic HRM model in which AI not only supports routine functions but also shapes decision-making in areas such as diversity, inclusion, and employee well-being. This approach encourages hybrid models where AI complements, rather than replaces, human judgment in HR strategies (Chowdhury et al., 2024). Complementarily, Soekotjo et al. (2025) integrated ecological and inclusive perspectives in their conceptual framework, arguing that AI can support workforce sustainability by promoting digital equity, reducing cognitive overload, and fostering green competencies across industries.

Overall, these theoretical foundations provide a comprehensive structure for understanding how AI can be responsibly and effectively implemented in sustainable HRM. They serve both as a guide for academic inquiry and a roadmap for practitioners seeking to align human capital development with technological innovation and sustainable values.

2.2. Literature review

The integration of Artificial Intelligence (AI) into human resource management (HRM) has emerged as a critical research domain, reflecting the global push toward digitized, data-driven, and sustainable business practices. Recent literature indicates that AI has been increasingly adopted to support various HRM functions such as recruitment, performance appraisal, workforce planning, and green HRM initiatives (Menon et al., 2024; Garg et al., 2018).

Several systematic reviews have attempted to consolidate the understanding of AI's role in HRM. Qamar et al. (2021) examined 59 studies and highlighted that AI integration often enhances efficiency but also requires strategic alignment with organizational culture and employee readiness. Similarly, Votto et al. (2021) noted that although AI supports tactical decision-making in HR, it also introduces recurring ethical challenges that scholars consistently associate with issues of fairness, transparency, and accountability.

In a broader technological context, the work of Vrontis et al. (2023) positioned AI and robotics within HRM as catalysts for redefining organizational structures and competencies, particularly when transitioning toward Industry 4.0 environments. Their systematic review urged for an interdisciplinary approach to balance technological adoption and human development.

A growing body of literature has linked AI adoption to sustainability dimensions in HRM. For example, Garg et al. (2018) analyzed AI applications in green HRM and revealed that intelligent systems help reduce environmental footprints by optimizing digital workflows and remote management solutions. In a more recent study, Menon et al. (2024) argued that

AI-driven analytics not only improve workforce performance but also support long-term HRM sustainability through better forecasting, workforce diversity, and data-informed employee wellness programs.

Despite growing scholarly attention, the literature still presents several research gaps. Jatobá et al. (2023) observed that most studies focus on the technical or operational aspects of AI in HRM, while studies synthesizing its strategic role in sustainable organizational transformation are limited (Jatobá et al., 2023). Furthermore, Kaushal et al. (2023) highlighted the lack of integrated bibliometric analysis that maps research trends, contributing authors, and thematic concentrations in this field. While traditional systematic reviews provide valuable narrative insights, they are limited in their ability to reveal structural relationships such as co-authorship networks, citation patterns, and keyword clusters. Bibliometric analysis, by contrast, offers a comprehensive and replicable approach to capture the intellectual structure and thematic evolution of the field, making it especially suitable for understanding the rapidly developing intersection of AI and sustainable HRM.

In conclusion, the literature suggests that AI gains immense potential in transforming HRM towards sustainable outcomes, but the field remains fragmented. Future research should focus on longitudinal studies, ethical AI frameworks, and cross-cultural analyses to better understand the evolving role of AI in sustainable HRM.

3. Materials and research methods

3.1. Research methodology

This study employs a bibliometric analysis to systematically examine the integration of AI into Sustainable HRM practices. Bibliometric analysis is a quantitative research method that applies statistical tools to analyze publication data, enabling the identification of research trends, intellectual structures, and collaboration patterns within a specific academic domain (Böhmer & Schinnenburg, 2023). The methodology of this study is structured into three main phases: *(1)* data collection and preprocessing, *(2)* data analysis using VOSviewer software, and *(3)* interpretation of results.

The data collection and selection process follows the PRISMA 2020 guidelines (Page et al., 2021), ensuring rigor and transparency in the selection of relevant literature. VOSviewer, a widely used bibliometric analysis tool, is utilized to visualize and analyze the dataset (Van Eck & Waltman, 2010). The following analyses were conducted to provide a comprehensive understanding of AI-driven Sustainable HRM research:

- **Citation Analysis:** This analysis identifies the most influential publications, authors, and journals based on citation counts. It helps to map the intellectual structure of the field and highlight seminal works (Faisal, 2023).
- **Keyword Co-occurrence Analysis:** This technique examines the frequency and relationships between keywords to identify key research themes and emerging trends. A minimum threshold of five occurrences was applied to focus on the most significant terms (Van Eck & Waltman, 2010).
- **Collaboration Network Analysis:** This analysis maps collaboration patterns among authors, institutions, and countries, providing insights into global research distribution and key collaborative hubs (Evseeva et al., 2021).
- **Bibliographic Coupling:** This method measures the relationship between documents based on shared references,

helping to detect clusters of closely related studies and emerging research domains (Van Eck & Waltman, 2010).

3.2. Data sources and selection process

To ensure transparency, reproducibility, and rigor in data collection and selection, this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2022 guidelines. PRISMA provides a structured framework for conducting systematic reviews and bibliometric analyses, ensuring a robust approach to identifying, screening, and selecting relevant studies. The data selection process was conducted in four stages: *(1)* identification, *(2)* screening, *(3)* eligibility assessment, and *(4)* inclusion, with a PRISMA flow diagram documenting the process for accountability *(see Appendix 1 online)*.

- *Step 1 – Data Identification:* The initial dataset was compiled from Scopus, a leading academic database known for its extensive coverage of high-quality, peer-reviewed literature. The search strategy aimed to capture all relevant studies published between 2009 and 2024 exploring the integration of AI into Sustainable HRM practices. The following search query was used:

  (TITLE-ABS-KEY ("Artificial Intelligence" OR "AI") AND TITLE-ABS-KEY ("Sustainable Human Resource Management" OR "Sustainable HRM" OR "HRM"))

  The search focused on titles, abstracts, and keywords to ensure relevance. No restrictions were applied regarding document type (e.g., journal articles, conference papers, reviews) or geographic scope. This initial search yielded 210 records.

- *Step 2 – Data Screening:* The screening phase involved removing duplicate records and excluding irrelevant studies based on titles and abstracts. After manual cross-checking, no duplicate records were identified, leaving 210 records for further screening. Next, studies that did not explicitly address the intersection of AI and Sustainable HRM were excluded. Additionally, studies outside the 2009–2024 timeframe were removed, resulting in the exclusion of 20 records, leaving 190 records for eligibility assessment.

- *Step 3 – Eligibility Assessment:* A full-text review of the 190 remaining records was conducted to determine their suitability for inclusion. The following inclusion criteria were applied:

  – **Focus:** The study must explicitly address AI applications in Sustainable HRM.

  – **Relevance:** The study must contribute to understanding AI-driven HR practices, including but not limited to talent acquisition, workforce analytics, ethical AI governance, and HR sustainability.

  – **Language:** Only English-language publications were included for consistency in analysis.

  – **Timeframe:** Studies published between 2009 and 2024 were considered.

  Studies that did not meet these criteria were excluded. Specifically, two non-English publications were removed, leaving 188 records for final inclusion.

- *Step 4 – Data Inclusion:* The final dataset comprised 188 publications that satisfied all predefined eligibility criteria. These records were exported in CSV format, containing essential metadata such as titles, authors, abstracts, keywords, publication years, citation counts, and affiliations. To ensure analytical consistency and accuracy, the dataset underwent a detailed preprocessing phase, which involved: *(1)* standardizing keywords by merging singular/plural forms and unifying spelling variants (e.g., "HRM"

and "human resource management"), *(2)* removing generic or non-informative terms (e.g., "study," "impact"), and *(3)* refining textual data for coherence. Keyword normalization was conducted using the association strength method in VOSviewer, following established bibliometric practices.

4. Result and discussion

4.1. Overview Analysis of the Research Topic

The search results from the Scopus database yielded 188 research articles from 2009 to the end of 2024 (details in Figure 1).

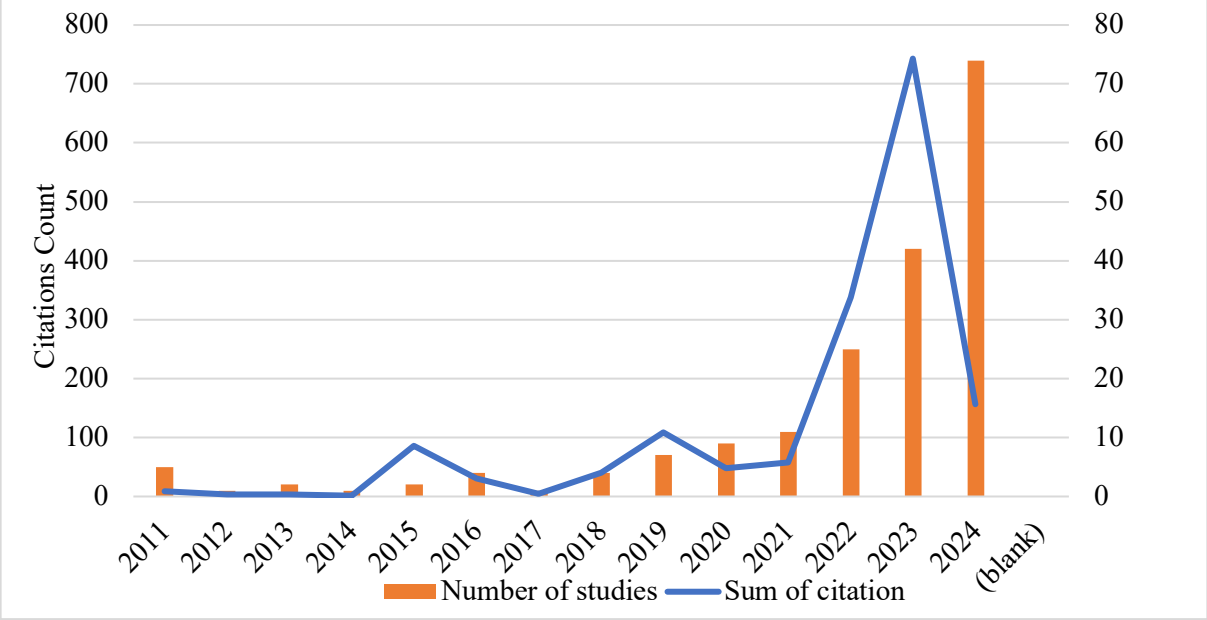

Figure 1. Time trend of the publication

Between 2011 and 2019, research on the integration of AI into Sustainable HRM remained relatively limited, with only a small number of studies published each year. A notable increase in academic interest began in 2020, coinciding with the rising awareness of AI's potential to enhance HRM practices. Since then, the number of studies has grown exponentially, particularly in the last four years, with a sharp increase from 2021 onwards.

Notably, the number of published studies surged significantly in 2022, reaching a peak in 2024 with the highest number of documents recorded. This trend indicates a strong and growing academic interest in the field. Similarly, the total citation count follows a comparable trajectory, demonstrating the increasing impact of these studies. The number of citations peaked in 2023, reflecting the influence of prior research on the field's development. However, despite a slight drop in citations in 2024, the substantial number of published studies suggests a continued research momentum.

These findings underscore the increasing recognition of AI's role in transforming sustainable HRM practices. The rapid growth of publications and citations underscores AI's critical role in shaping the future of HRM strategies, particularly in improving efficiency, decision-making, and sustainability. This trend also suggests ample opportunities for future research, with a need to further explore AI-driven HRM frameworks, ethical considerations, and best practices for sustainable workforce management.

4.2. Citation Analysis

A citation analysis was conducted to identify the most influential publications, authors, and journals in the field of AI integration into Sustainable HRM. Appendix 2 *(see Appendix 2 online)* highlights the most impactful studies in this domain, specifically those that have been cited at least 40 times. Among them, Budhwar et al. (2023) stands out as the most cited work, with 280 citations, emphasizing the significant role of AI, particularly generative AI like ChatGPT, in shaping HRM practices. Other notable studies, such as Del Giudice et al. (2023) with 94 citations and Arroyo et al. (2015) with 85 citations, further illustrate the diverse applications of AI in decision-making, organizational development, and sustainable HR strategies.

Several other studies, including those by Larbi-Siaw et al. (2022) with 75 citations and Ogbeibu et al. (2022) with 63 citations, emphasize the intersection of AI, eco-innovation, digital transformation, and sustainable HR practices. Additionally, works like Böhmer and Schinnenburg (2023) and Murugesan et al. (2023) delve into AI-driven HRM capabilities and digitalization trends, further enriching the discourse in this field.

The distribution of citation counts suggests that AI-powered HRM is a rapidly evolving area, with research contributions spanning multiple perspectives. Rather than being concentrated in a few foundational studies, the field exhibits a diverse and growing knowledge base, underscoring the increasing recognition of AI's role in fostering sustainable and strategic HRM practices *(see Appendix3 online)*.

Additionally, the study analyzes the authors who have made the most significant contributions to the research topic presented in Appendix 3 *(see Appendix 3 online)*. This author-level analysis highlights the influence of individual scholars and their intellectual contributions to the field.

Appendix 4 *(see Appendix 4 online)* highlights the most cited organizations in research on AI integration into sustainable HRM, with Neoma Business School leading at 314 citations. Several institutions, including Aston University, The University of Newcastle (UON), and Cranfield University, follow closely with 280 citations each, indicating a strong academic influence in this field. Unlike the author-level analysis in Table 2, which focuses on individual scholars, the organization-level analysis reflects institutional concentration of research power and demonstrates how research expertise is clustered within particular universities or research centers. Together, these two perspectives provide complementary insights into both individual and institutional contributions, rather than overlapping results.

Appendix 5 *(see Appendix 5 online)* presents the most cited journals in research on AI integration into sustainable HRM, with the Human Resource Management Journal leading at 280 citations, followed by Sustainability (Switzerland) with 111 citations. Other notable journals, such as the Human Resource Management Review (94 citations) and the Journal of Construction Engineering and Management (85 citations), also demonstrate significant influence in the field.

Appendix 6 *(see Appendix 6 online)* presents the most cited countries in research on integrating AI into sustainable human resource management practices, with the United States (539 citations), Australia (467 citations), and the United Kingdom (459 citations) leading the field. Other key contributors include France (428 citations), the Netherlands (315 citations), and India (278 citations), indicating global interest in this topic.

4.3. Keyword Co-occurrence Analysis

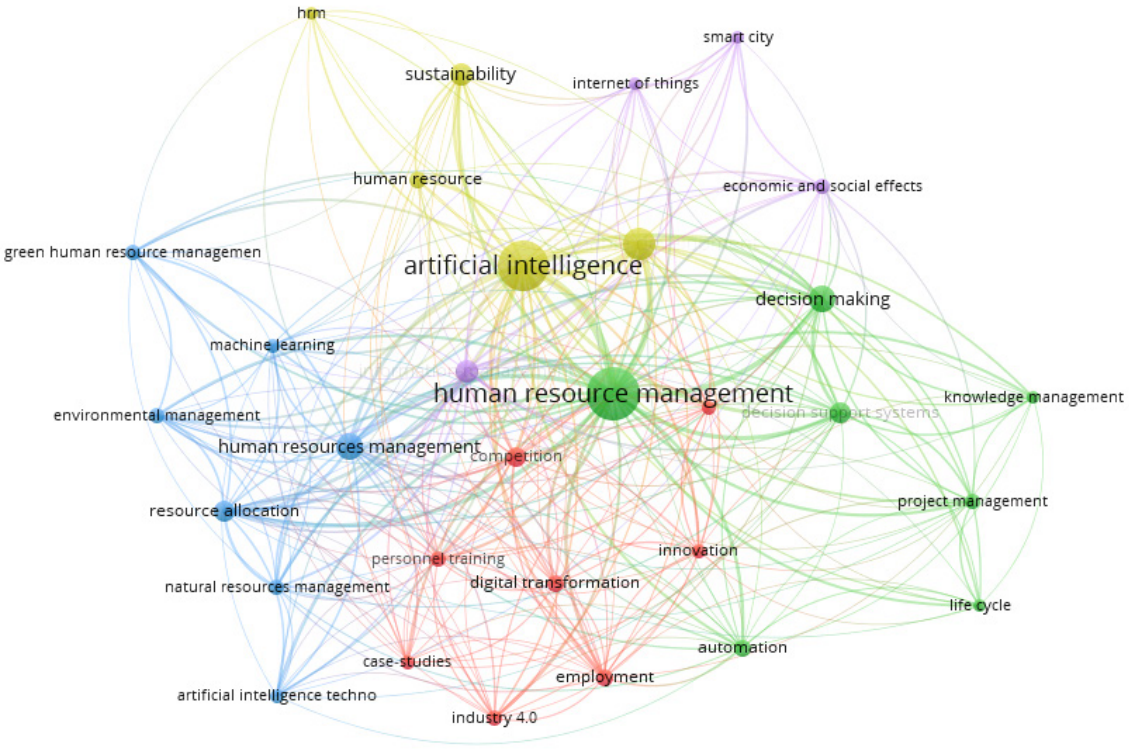

Figure 2. Keyword Co-occurrence Network

The analysis of the keyword co-occurrence network provides valuable insights into the intellectual structure and thematic evolution of research related to the integration of artificial intelligence (AI) into sustainable human resource management (HRM) practices. The visualization of co-occurring keywords, as depicted in the network graph (Figure 3), highlights the interconnectivity and clustering of key thematic areas within this research domain.

The keyword co-occurrence network reveals four dominant clusters. The artificial intelligence cluster (yellow) encompasses keywords such as *machine learning*, *automation*, and *decision making*, indicating a strong emphasis on AI-driven HRM decision-making processes and technological advancements. The human resource management cluster (green) is interconnected with concepts such as *knowledge management*, *project management*, and *lifecycle*, reflecting the role of AI in optimizing HR strategies and workforce management. Another significant cluster (blue) revolves around sustainability and environmental management, emphasizing the increasing importance of AI-driven solutions in fostering green HRM practices. Keywords such as *sustainability*, *green human resource management*, and *resource allocation* suggest a growing focus on integrating AI technologies to enhance sustainable workforce management and resource efficiency. This aligns with the broader trend of incorporating sustainability into HRM strategies through technological innovation. Furthermore, the digital transformation and innovation cluster (red) highlights the intersection of AI with emerging HRM trends such as *Industry 4.0*, *employment*, and *personal training*. The presence of keywords such as *case studies* and *digital transformation* suggests that

empirical research is actively exploring the practical implications of AI adoption in HRM, particularly in areas of employee development and automation.

In addition to these four major clusters, Figure 3 also highlights several peripherals but noteworthy keywords that extend the thematic scope of research. For example, terms such as *Internet of Things* and *smart city* (purple cluster) suggest that AI-driven HRM is increasingly linked with broader digital ecosystems, where workforce management intersects with urban digitalization and smart governance. This indicates that sustainable HRM practices are not isolated but part of larger socio-technical transformations.

Moreover, the strong interconnections between keywords such as *decision support systems*, *knowledge management*, and *innovation* illustrate the practical orientation of research in this field. These links emphasize that AI is not only used to automate HR functions but also to support strategic decision-making and continuous innovation within organizations. Another important observation is the overlap of *employment* and *digital transformation* with both HRM and sustainability clusters. This reflects ongoing concerns about how AI adoption affects job design, employee well-being, and the creation of sustainable employment opportunities in the context of Industry 4.0.

From a methodological perspective, the keyword co-occurrence analysis demonstrates a multidisciplinary convergence, integrating insights from AI, HRM, sustainability, and digital innovation. The interlinkages among these clusters suggest that AI-driven HRM practices are not only advancing technological efficiency but also addressing critical socio-economic and environmental challenges.

In conclusion, the keyword co-occurrence network provides a comprehensive overview of the conceptual landscape in the domain of AI-integrated sustainable HRM. The identified thematic clusters underscore the evolving nature of this field and highlight potential research directions, such as the ethical implications of AI in HRM, the role of AI in workforce sustainability, and the development of AI-driven decision support systems for HR professionals.

4.4. Collaboration Network Analysis

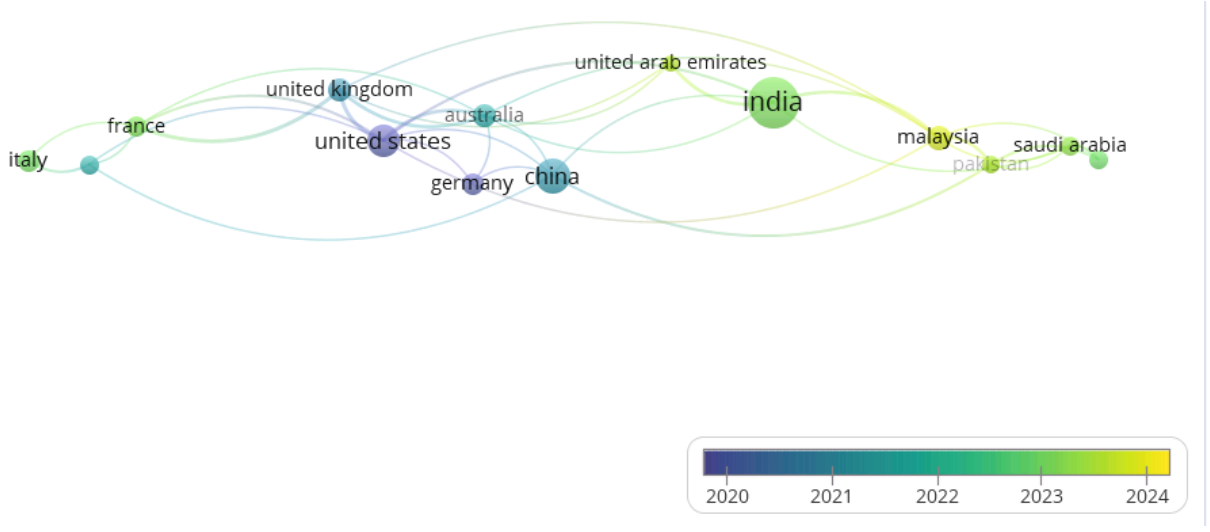

Figure 3. Network of Research Collaboration between Countries

The collaboration network analysis reveals the global distribution and interconnectedness of research efforts in the field of AI-integrated sustainable human resource management. The visualization (Figure 4) illustrates the relationships between countries, highlighting key contributors and emerging collaborations.

The network exhibits a strong presence of the United States, which serves as a central node, actively collaborating with various countries such as the United Kingdom, Germany, China, and Australia. This suggests that the U.S. plays a leading role in research on AI-driven HRM, contributing significantly to technological advancements and policy-oriented studies.

In recent years, there has been a notable shift towards emerging economies, with India, Malaysia, and the United Arab Emirates forming strong collaborative links. India, in particular, has emerged as a major hub, displaying robust ties with Middle Eastern and Southeast Asian countries such as Saudi Arabia, Pakistan, and Malaysia. This highlights a growing interest in AI applications in HRM within developing economies, driven by the need for workforce optimization and digital transformation.

The color gradient in the network visualization indicates the temporal evolution of collaborations, with darker shades representing earlier collaborations (2020-2021) and lighter shades denoting more recent engagements (2023-2024). The trend suggests an increasing diversification of research partnerships, with newer alliances forming between European and Asian nations. Countries such as France and Italy have recently entered the network, indicating a rising interest in AI's role in sustainable HRM across different economic and cultural contexts.

In addition to these main hubs, the network also shows bridging roles played by certain countries. For instance, Australia and China appear to act as intermediaries linking Western research hubs with Asian and Middle Eastern partners. Similarly, the United Arab Emirates functions as a connector between South Asia and the Gulf region, suggesting that research on AI and HRM is expanding along regional knowledge corridors rather than being confined to traditional Western-centric networks.

Another important observation is the eastward shift of collaborations after 2021. While the early period (2020–2021) was dominated by transatlantic links between the United States and Europe, the later years (2022–2024) show stronger connections across Asia, particularly through India and Malaysia. This temporal pattern indicates not only the globalization of AI–HRM research but also its increasing contextualization in emerging economies, where the challenges of digital transformation and sustainable workforce development are especially pressing.

Overall, the collaboration network analysis underscores the dynamic and evolving nature of international research in AI-integrated HRM. The increasing participation of emerging economies, coupled with sustained contributions from established research hubs, suggests a future trajectory where cross-regional collaborations will play a critical role in advancing sustainable and AI-driven HR practices.

4.5. Bibliographic coupling

The bibliographic coupling analysis of documents exploring AI integration in HRM and sustainable development included only highly cited articles (with a minimum of 20 citations), resulting in a selection of 15 studies. This analysis identified four distinct clusters based on the strength of their interconnections, highlighting shared intellectual foundations and thematic alignments through similarities in references.

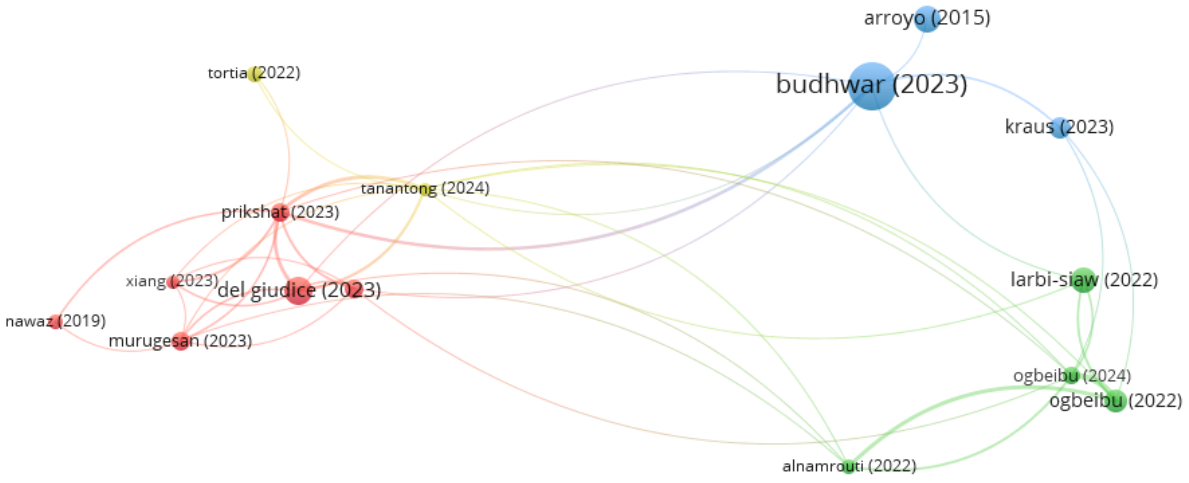

Figure 4. Bibliographic coupling between authors

Cluster 1: AI and HRM integration in green practices (Red Cluster)

The red cluster primarily focuses on the role of artificial intelligence in enhancing green practices within HRM. AI is increasingly used to optimize resource management and develop strategies that reduce an organization's environmental footprint. This involves leveraging AI to streamline HR functions such as recruitment, training, and performance management, all while aligning with sustainable practices. Research in this area underscores the growing intersection between AI technologies and environmentally conscious HR policies. Del Giudice (2023) and Prikshat (2023) emphasize the importance of AI in optimizing HR operations to support sustainability goals. Similarly, Murugesan et al. (2023) and Xiang (2023) explore how AI applications in HRM contribute to eco-friendly decision-making. Tanantong and Wongras (2024) further investigates AI-driven approaches to sustainable HR strategies. The prominence of this cluster reflects the increasing global emphasis on environmental, social, and governance (ESG) standards, where organizations face mounting pressure to integrate eco-friendly practices into their operations. AI is viewed as a practical enabler that helps HRM reduce waste, improve efficiency, and demonstrate measurable contributions to sustainability agendas.

Cluster 2: AI, sustainability, and employee engagement (Yellow Cluster)

The yellow cluster emphasizes the integration of AI into HRM systems to improve both employee engagement and sustainability. AI-driven systems are being used to foster a more connected and engaged workforce while also promoting organizational sustainability. This includes utilizing AI to enhance recruitment practices, employee well-being programs, and overall performance management with an eye toward sustainability. Tanantong and Wongras (2024) highlight how AI technologies enhance employee engagement while aligning with sustainable HRM goals. Additionally, Del Giudice (2023) discusses the role of AI in implementing HR policies that support both employee well-being and environmental sustainability.

This cluster's relevance has grown particularly in the post-pandemic context, where employee well-being and resilience have become central to organizational survival. The convergence of engagement and sustainability

indicates that firms increasingly recognize the value of human-centric strategies supported by AI to build long-term workforce commitment and organizational adaptability.

Cluster 3: AI-driven data insights for HRM sustainability (Blue Cluster)

The blue cluster highlights the role of AI in providing data-driven insights that support the sustainable transformation of HRM. In this context, AI is employed to collect and analyze data to help HR departments measure, assess, and enhance their sustainability efforts. AI tools help organizations identify trends, predict future needs, and ensure that their HR practices contribute to long-term sustainability goals. Budhwar et al. (2023) serve as a key reference in this cluster, focusing on AI-driven analytics in sustainable HRM. Kraus (2023) and Arroyo et al. (2015) provide additional perspectives on how AI enhances workforce planning and predictive HR analytics to drive sustainability. The dominance of this cluster is linked to the rise of big data and predictive analytics as essential tools for strategic HRM. Organizations increasingly rely on evidence-based decision-making to align HR practices with sustainability metrics, reflecting a broader shift toward data accountability in management.

Cluster 4: AI and strategic HRM in sustainability (Green Cluster)

The green cluster focuses on the strategic use of AI in HRM to foster sustainable organizational practices. This research explores how AI can assist in aligning HR strategies with sustainability objectives, providing a framework for integrating sustainable practices into HR policies. Authors in this cluster discuss the potential of AI to reshape HRM practices in ways that contribute to the long-term sustainability of organizations. Larbi-Siaw (2022) and Ogbeibu et al. (2022) analyze AI's role in aligning HR policies with sustainability-driven business objectives. Additionally, Nugraha Adz Zikri et al. (2024) provide insights into how AI-powered HRM contributes to long-term workforce sustainability planning.

This cluster illustrates the strategic dimension of AI adoption: rather than being confined to operational tasks, AI is increasingly seen as a driver of organizational transformation. Its strength in the network highlights how sustainability is no longer peripheral but central to HRM strategy, influenced by global policy frameworks and corporate commitments to sustainable development goals (SDGs). These clusters present a comprehensive view of how AI is transforming HRM practices in the context of sustainability, showcasing the pivotal role of AI in driving change and fostering environmentally conscious HR policies across organizations.

4.6. Discussion

The findings of this bibliometric analysis offer valuable insights into the evolving intersection of Artificial Intelligence (AI) and sustainable human resource management (HRM), reflecting both scholarly trends and practical shifts in organizational strategies. The sharp increase in AI-related HRM publications since 2020, particularly in the fields of recruitment, performance management, and workforce sustainability, demonstrates an accelerated academic response to the global push for digital transformation and sustainable development (Budhwar et al., 2023).

The citation and co-authorship analyses indicate that a small number of influential scholars and institutions (e.g., Budhwar, Pereira, Neoma Business School) have played a pivotal role in shaping this domain. This aligns with the findings of Vrontis et al. (2023), who noted that thought leadership in AI-HRM is largely concentrated among researchers in Europe and Australia, where digital policy innovation has also progressed. However, the emergence of new collaboration networks in

Asia, particularly India and Malaysia, suggests a growing democratization of research efforts and cross-border knowledge diffusion.

The keyword co-occurrence mapping revealed four major thematic clusters: *(1)* AI for green HRM, *(2)* employee engagement and well-being, *(3)* data-driven decision-making, and *(4)* strategic sustainability alignment. These findings corroborate earlier reviews, such as those by Menon et al. (2024) and Qamar et al. (2021), which emphasized that AI is increasingly being leveraged not just for automation but for values-based HR strategies that align with environmental and social governance (ESG) goals.

While the results confirm the potential of AI to optimize resource allocation, reduce operational footprints, and enhance employee experience (Soekotjo et al., 2025; Garg et al., 2018), the study also highlighted ongoing challenges. Notably, these ethical concerns, which have been consistently highlighted across the literature, remain underexplored in empirical studies. This reinforces the conclusions of Jobin et al., 2019, who called for robust AI governance frameworks to ensure that automation does not undermine fairness or employee autonomy.

A significant contribution of this study is its identification of fragmented scholarly coverage. Most existing research focuses on isolated HRM functions, like intelligent recruitment or analytics, rather than examining integrated, sustainability-driven AI-HRM frameworks. Moreover, few studies have employed bibliometric methods to map the structural landscape of AI in sustainable HRM. This justifies the current study's methodology and fills a critical gap, as noted by Kaushal et al. (2023), who advocated for more systematic knowledge synthesis in this fast-evolving field.

Overall, these results suggest that while adopting AI in sustainable HRM is gaining momentum, its successful and ethical implementation requires a more unified theoretical foundation and cross-disciplinary collaboration. Bridging the gap between technological innovation and human-centric values will be essential to ensure that AI serves not only operational goals but also long-term sustainability imperatives.

This interpretation can also be reinforced by established theoretical frameworks in management and HRM. From the resource-based view (RBV), AI in sustainable HRM can be regarded as a strategic intangible resource that enhances organizational competencies and long-term advantage, as reflected in the clustering of themes around decision-making, knowledge management, and innovation. The findings are also consistent with Socio-Technical Systems theory, which emphasizes the balancing of technological efficiency and human-centered values; this balance is evident in the observed focus on employee well-being and inclusivity. Finally, the emphasis on sustainability and green HRM aligns directly with environmental, social, and governance (ESG) frameworks, suggesting that AI-driven HRM research is increasingly converging with broader global agendas of ethical governance and responsible innovation.

In addition, this study's novelty offers a more comprehensive and updated bibliometric mapping of AI in sustainable HRM. Unlike prior narrative reviews such as Pan & Froese, 2023, our dataset covers 188 publications from 2009 to 2024 and employs multiple bibliometric techniques, including citation analysis, keyword co-occurrence, collaboration networks, and bibliographic coupling, to provide a multidimensional view of the field. This integrated approach enables us to capture emerging research themes such as generative AI, employee well-being, and sustainability-oriented HR practices that were not fully addressed in earlier studies.

Another distinctive contribution lies in the regional perspective. While much of the existing literature has focused on Western contexts, our analysis reveals the growing influence of emerging economies such as India, Malaysia, and Vietnam in shaping the AI–HRM research agenda. This eastward shift of research collaborations highlights the globalization of the field and provides insights that are particularly relevant to developing economies, where challenges of digital transformation and sustainable workforce development are most pressing.

Finally, this study emphasizes practical contributions by linking bibliometric findings to organizational realities. In particular, the insights generated here can support startups and SMEs in aligning their HRM practices with the dual transformation of digitalization and sustainability. By mapping thematic clusters and collaboration networks, the study offers concrete guidance for organizations seeking to adopt AI responsibly while maintaining long-term sustainability goals.

5. Conclusion and future research directions

5.1. Conclusion

The integration of Artificial Intelligence (AI) into sustainable human resource management (Sustainable HRM) is reshaping the landscape of workforce management. This bibliometric analysis provides a comprehensive overview of research from 2009 to 2024, showing that AI in HRM brings multifaceted implications across economic, environmental, and social dimensions. While AI offers significant opportunities to support sustainable HRM, persistent challenges such as ethical concerns, implementation costs, and governance requirements must be carefully addressed.

This study highlights a clear gap in existing literature, particularly in the holistic integration of AI within Sustainable HRM. Most prior research has examined isolated HRM functions without considering their broader alignment with sustainability objectives. By consolidating fragmented studies and mapping thematic clusters, this research calls for more comprehensive approaches that explore the synergistic effects of AI across all HR functions and their role in long-term organizational sustainability.

At the same time, this study is limited to English-language publications, which may exclude valuable insights from non-English sources and reduce the inclusiveness of global perspectives. This restriction was applied to ensure consistency in data processing and comparability across international research. Future research could extend the scope by incorporating non-English publications to capture more diverse and regionally nuanced perspectives on AI in sustainable HRM.

In summary, the novelty of this study lies in its updated and comprehensive dataset spanning 2009–2024, the integration of sustainability into the AI–HRM discourse, and the identification of emerging research hubs in Asia. By combining multiple bibliometric techniques, the paper offers a multidimensional view that extends beyond earlier narrative reviews. Importantly, the findings provide practical implications for startups and SMEs in the context of digital–green dual transformation, offering guidance for organizations seeking to align AI adoption with long-term sustainability goals. These contributions reinforce the paper's academic relevance while also enhancing its practical impact.

5.2. Future research directions

Moving forward, three priority research directions emerge from this study, each directly linked to the gaps identified in the existing literature:

(1) Ethical governance of AI in HRM

The most urgent priority is to develop ethical AI frameworks that address recurring concerns of algorithmic bias, data privacy, fairness, and accountability. Given that current studies highlight ethical risks but lack systematic solutions, future research should design governance models that integrate insights from technology, ethics, and HRM to ensure responsible adoption and safeguard employee rights.

(2) Cross-cultural and inclusive perspectives

A second priority concerns the imbalance created by the dominance of English-language and Western-focused research. To broaden inclusiveness, future studies should incorporate non-English publications and investigate emerging economies, capturing regionally nuanced insights. This will help overcome the geographic and linguistic gaps identified in this study and ensure that AI–HRM research reflects truly global perspectives.

(3) Integrated frameworks across HR functions

A third priority is to move beyond fragmented approaches that analyze AI in isolated HRM functions, such as recruitment or performance appraisal. Future research should adopt holistic perspectives that connect multiple HR functions and align them with long-term sustainability objectives. Developing such integrated frameworks would fill a critical gap in the literature and provide organizations with comprehensive strategies for digital–green transformation.

In conclusion, while the integration of AI into sustainable HRM presents significant opportunities, its responsible adoption depends on addressing ethical and managerial challenges. By outlining clear priorities for future research, this study not only contributes to the academic debate but also provides actionable insights for advancing sustainable HR practices.

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