Research Prospects and Trends in Sustainable HRM using Bibliometric and Clustering Approach

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Abstract

Purpose

The purpose of this study is to analyse the existing research on sustainable human resource management (HRM) and to identify significant contributors, research themes, clusters, techniques, and contextual factors.

Design/ Methodology/ Approach

A systematic literature review using PRISMA was carried out, looking at 218 papers from the Scopus and Web of Science databases that were published between 2014 and 2025. Bibliometric, network, and cluster analysis were performed using a variety of analytical software packages, including R studio, Biblioshiny, Vosviewer, and Python.

Findings

The results of the study indicate that although scholars have shown interest in the topic, the field's level of understanding is still quite low. India is the most productive country in the world. The "Journal of Cleaner Production" is the leading contributing journal with 12 published papers and 1190 citations altogether. With seven papers, Piwowar-Sulej K is the most prolific author. The Australian Catholic University of Australia is the most significant organization. This study also found four clusters using K-means clustering namely, Sustainability in HRM for environmental responsibility, Mixed influences of sustainable HRM, Technology-driven HRM and sustainability, and Advancing strategic HRM for sustainable organizations. Thematic analysis is used to define future research themes.

Originality

The paper contributes by providing an in-depth examination of sustainable HRM from two reliable databases. For those new to the sustainable HRM space, it offers a helpful starting point and insightful perspectives from people who have already worked in the subject. The Davies Bouldin Score is used to confirm the study's findings, which are the first of their kind to use the K-means elbow and silhouette techniques

to identify the optimal number of clusters.

Keywords: CSR, Green HRM, K-means clustering, Silhouette, Sustainable HRM, Technology.

Introduction

Human Resource Management (HRM) has undergone profound transformations over the past few decades, influenced by globalization, technological advancements, shifting workforce demographics, and the growing emphasis on sustainability (Kramar, 2022; Shao et al., 2024). The integration of artificial intelligence (AI), and digital HRM solutions has redefined traditional HR functions, making them more data-driven, strategic, and evidence-based (Donald et al., 2020; Gomes et al., 2023). Simultaneously, organizations are recognizing HRM's role in fostering employee well-being, enhancing organizational resilience, and contributing to long-term sustainability (Donald et al., 2020; Nayal et al., 2023). These evolving dynamics have led to an expanding body of research dedicated to HRM's impact on business performance, workforce development, and corporate responsibility. The concept of sustainability in HRM has evolved alongside broader discussions on corporate social responsibility (CSR) and sustainable development. Traditional HRM practices focused on efficiency and performance optimization (Kramar, 2014). However, the rising awareness of environmental issues, social justice, and stakeholder inclusivity has driven the transition toward sustainable HRM (Lopez-Cabrales & Valle-Cabrera, 2020). It encompasses a holistic approach that integrates employee engagement, diversity management, and environmental responsibility (Banga & Gobind, 2025).

Sustainable HRM seeks to balance economic, social, and environmental objectives while maintaining organizational competitiveness (Aust et al., 2020; Ehnert et al., 2016; Kramar, 2014). Unlike conventional HRM, which focuses primarily on maximizing employee productivity and organizational profitability, sustainable HRM aligns human capital with sustainable development goals (Brewster & Brookes, 2024). In particular, the fundamental goal is to create long-term value for organizations, employees, and society (Jiang et al., 2024). Sustainable HRM consists of multiple dimensions that address various aspects of workforce management while adhering to sustainability principles. These dimensions can be broadly categorized into economic, social, environmental, and common good HRM practices (Aust et al., 2020; Jerónimo et al., 2020). Economic sustainability ensures that HR policies contribute to long-term business success while fostering employee growth. This includes strategies such as talent retention, leadership development, and performance management systems that align with sustainable corporate objectives (Genari & Macke, 2022). Sustainable compensation structures, career development initiatives, and financial incentives further reinforce economic resilience (Nakra & Kashyap, 2025). Social sustainability focuses on employee well-being, diversity, and ethical labor practices. Organizations implementing SHRM prioritize fair wages, safe working conditions, work-life balance, and inclusion (Jia et al., 2023; Su et al., 2023). Energy conservation, sustainable transportation, and paperless procedures are all encouraged by environmental sustainability in HRM (R. Chaudhary, 2018). Green training initiatives raise workers' understanding of environmental issues (Jabbour & Renwick, 2018). Digital HRM and remote work are essential for lowering HR's carbon footprint (Aragão & Jabbour, 2017). Embedding sustainability in HR strategy enhances business reputation (Lu et al., 2023). In order to promote moral leadership and sustainable employment practices that improve work-life balance and human dignity, the Common Good HRM strategy places a strong emphasis on social welfare and ethical corporate conduct (Aust et al., 2020; Järlström et al., 2024).

Businesses that incorporate sustainability into HRM are better equipped to handle market upheavals, regulatory changes, and economic uncertainties (Mushtaq & Akhtar, 2024). AI, big data analytics, and automation are driving the digital transformation of HRM, which improves engagement, training, and hiring (Mishra & Pathak, 2024). But it's crucial to strike a balance between technology and moral HRM (Eger & Žižka, 2024). With a focus on moral decision-making, corporate social responsibility, and

employee empowerment, leadership is essential to the advancement of sustainable HRM (Ahmad & Fatima, 2023). It is essential to spend money on leadership development that is in line with sustainability objectives (Brewster & Brookes, 2024). The absence of established measurements makes it difficult to measure the impact of sustainable HRM (Jerónimo et al., 2020). Frameworks for evaluating its efficacy should be developed in future studies (Piwowar-Sulej et al., 2024). A growing body of bibliometric research highlights the evolution of SHRM as a field of study. Recent analyses have mapped the intellectual structure of sustainable HRM, identifying key themes, influential scholars, and emerging research trajectories (Malik & Singh, 2024). Bibliometric studies have revealed an increasing focus on sustainability-driven HRM strategies, employee well-being, and corporate social responsibility. These studies provide valuable insights into the theoretical underpinnings and practical applications of SHRM, shaping future research directions and policy developments (Chaudhary et al., 2025).

Rationale of the study

Academic interest in sustainable HRM has grown, but the bibliometric research that has been done so far has only provided partial answers. Furthermore, previous studies have not completely mapped sustainable HRM research trends using sophisticated bibliometric techniques like topic analysis and K-means clustering. The identified research gaps are presented in Table 1.

Table 1 Research Gaps

Research Gap	Contribution of This Study	Reference
Overreliance on Scopus, ignoring Web of Science, limiting the comprehensiveness of bibliometric insights.	Integrates both Scopus and Web of Science for a more holistic bibliometric analysis of sustainable HRM research.	(Faisal, 2023 ; Piwowar-Sulej K., 2020)
Special focus on the sustainability -HRM nexus, but lacks comprehensive bibliometric insights.	Addresses an exhaustive knowledge gap on sustainable HRM	(Abu-Mahfouz et al., 2023)
Limited mapping of sustainable HRM knowledge due to the evolving nature of the field.	Systematically analyzes sustainable HRM themes, enhancing the existing literature.	(Anlesinya, 2020)

Source: Authors own creation

To bridge these gaps, the research is designed to address following key questions:

RQ1: What is the current publication trend with respect to sustainable HRM Practices?

RQ2: Which countries are leading the publication in the field?

RQ3: Which are the most productive journals, and authors in this area?

RQ4: What is the optimal number of clusters in the field?

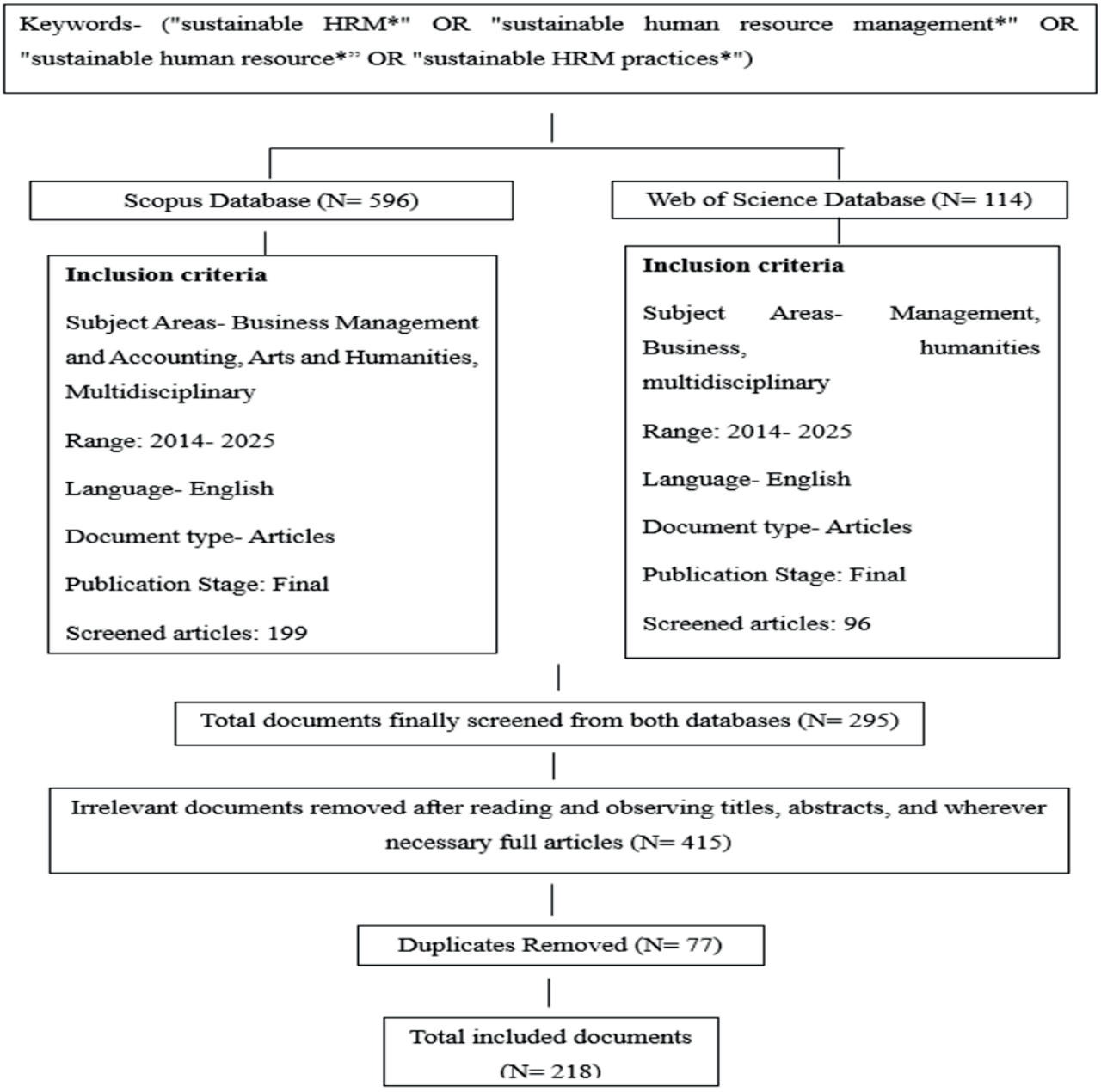
RQ5: What are the different emerging themes pertaining to sustainable HRM Practices?

Research Methodology

Article Identification and Screening

The coverage of the database is important in showing the growth and intellectual framework of previous literature. To identify relevant literature on Sustainable HRM Practices, the authors assessed Scopus and Web of Science databases. A comprehensive search string was formulated using multiple keywords such as "sustainable HRM," "sustainable human resource management," and "sustainable HRM practices," combined with Boolean operators like "AND" and "OR." Articles from 2014 to 2025 were targeted, excluding those before 2014 due to insufficient publications. The search focused on papers within the fields of "business, management, and accounting" or "humanities multidisciplinary," and found 710 articles initially. Peer-reviewed journal articles published in English were considered. To refine the selection, conference papers, book chapters, editorials, non-English content, and papers outside the business/management categories were excluded. Following these inclusion and exclusion criteria, 218 articles that met the defined standards were compiled for review.

Fig. 1 PRISMA flow diagram for Systematic Literature Review



Source: Authors own criteria from Scopus Database

Software

The current study presents a comprehensive assessment of the field using bibliometric analysis. The open-source bibliometric analysis tools Bibliometrix R package (Cuccurullo and Aria, 2017) and Vosviewer (Eck and Waltman, 2009) were used by the authors as they are frequently used for bibliometric analysis and provide a better visual representation over other available tools. Also, the above stated tools and software's are easily assessable. Additionally, this research makes use of Python, and SciPy library for K-means clustering to make the clusters more reliable and authentic.

Bibliometric Analysis and Discussion

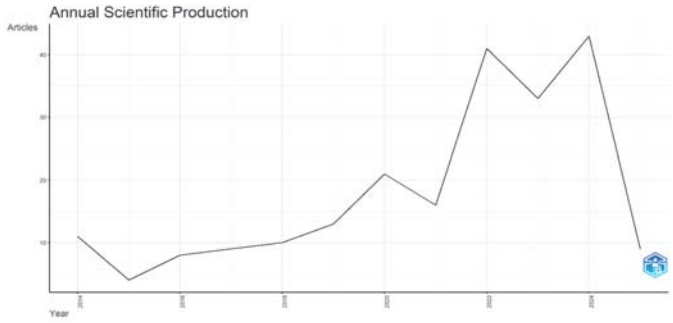
Summary statistics

The dataset includes 218 documents from 112 journals spanning from 2014–2025, revealing a dynamic yet declining field with a -1.81% annual growth rate. Despite this, the average citation counts of 30.43 reflects high academic impact. The research is recent (average age 3.92 years) and diverse, with 722 Author Keywords and 541 Keywords Plus. High collaboration is evident with only 6.4% are single-authored, with 3.32 co-authors per paper and 16.97% featuring international partnerships.

Trend Analysis

The depicted Fig. 2 reveals the unsteady annual scientific production in sustainable HRM from 2014 to 2025. After a slow start and decline in 2015, steady growth emerged between 2016 and 2019. A significant rise occurred post-2020, likely driven by global sustainability goals. Peaks in 2022 and 2024 signal increased interest although fluctuations suggest the field hasn't achieved stable growth, reflecting evolving academic attention.

Fig. 2 Year- wise publication between the time span of 2014- 2025

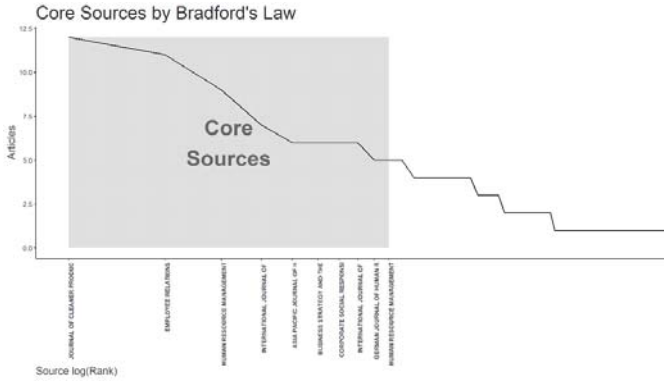


Source: Authors own creation

Top Productive Journals

Journal of Cleaner Production leads with 12 articles and 1,190 citations, indicating top influence. Employee Relations follows with 11 papers but only 199 citations. Human Resource Management Review 9 papers and 734 citations and International Journal of Human Resource Management 7 papers, 902 citations show strong impact. Other contributors include emerging sources like Asia-Pacific Journal of Business Administration with 4 papers and 127 citations. Bradford's Law (Brookes, 1977) categorizes journals into core (Zone I), relevant (Zone II), and peripheral (Zone III). Fig. 3 shows Zone I includes 10 core journals (9.3%) contributing 33.5% of papers, while Zones II consists of 31 journals (28.7%) publishing 74 papers (33.9%) and Zone III contribute nearly equal papers but from many more journals. This underscores the value of focusing on core sources for impactful sustainable HRM research.

Fig. 3 Bradford's law

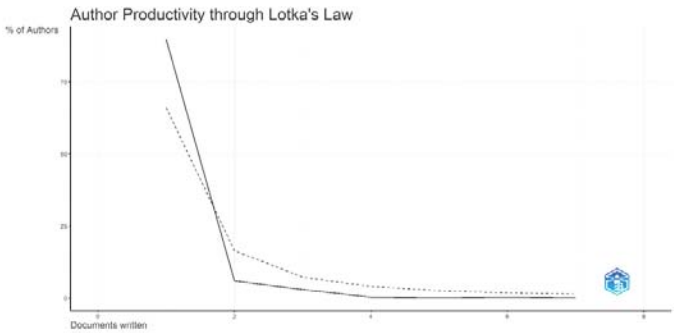


Source: Authors own creation

Most Relevant Authors

The analysis of authorship in sustainable HRM research reveals key contributors shaping the field through both collaborative and individual efforts. Piwowar-Sulej K emerges as the most prolific author with seven publications, though a lower fractionalized score indicates frequent co-authorship. In contrast, Mariappanadar S, with six papers and a higher fractionalized score, demonstrates a more dominant authorship role. This trend continues with other notable contributors like Jabbour C, Kramar R, Edgar F, and Chaudhary R, each bringing distinct thematic focuses such as green HRM, strategic HRM, and CSR. Supporting Lotka's Law, the data in Fig. 4 shows that 89.9% of authors have published only one paper, while very few have multiple contributions. This confirms that sustainable HRM research is largely shaped by a small group of highly productive scholars.

Fig. 4 Lotka's Law



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Geographic Distribution of Articles

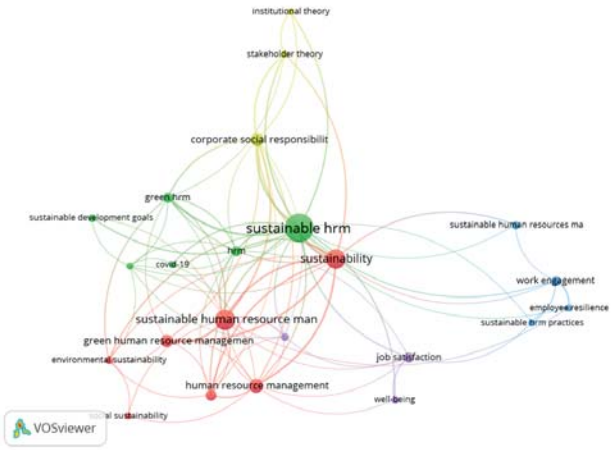
The geographic analysis of corresponding authors in shows Europe leading with 22.5% of research output, notably from the UK, Italy, and Spain. Asia follows with 19.8%, driven by India (13.8%) and China (6%). Developed countries contribute 32.1%, marked by higher international collaborations, especially France (40%) and Italy (36.4%). In contrast, developing countries like India, China, and Brazil account for 22.6%, with a stronger focus on single-country publications. Oceania, led by Australia (6%), and North and South America also contribute significantly. The data suggests a gradual shift toward balanced global contributions, with emerging economies becoming increasingly active in sustainable HRM research.

Science Mapping

Keyword Analysis

The keyword analysis in Fig. 5, conducted using VOSviewer, identified 24 keywords with a minimum of five occurrences. "Sustainable human resource management" appeared seventy-five times, followed by "sustainability" thirty-five times and "human resource management" nineteen times. Other prominent keywords include "green HRM," "corporate social responsibility," "job satisfaction," "employee engagement," and "stakeholder theory." The strong network links show how sustainable HRM intersects with corporate governance, employee well-being, and environmental sustainability, highlighting modern role of HRM.

Fig. 5 Network Visualization of all keywords



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K- means Clustering

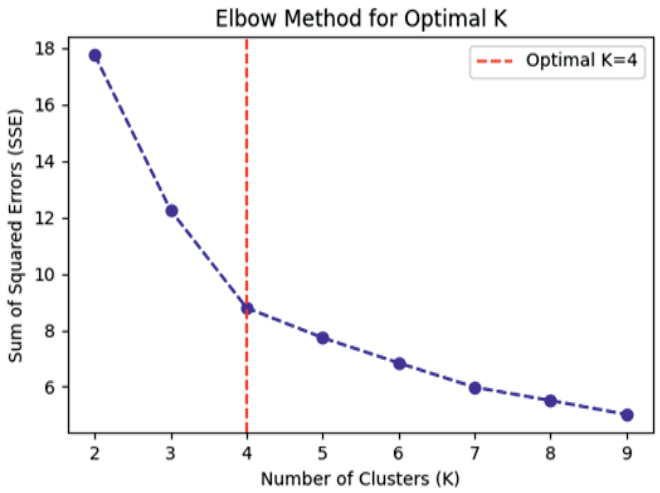
K-means clustering is a fundamental unsupervised learning algorithm widely used to categorize datasets into a predefined number of clusters (k). It is particularly effective in partitioning data based on similarity, where each data point is assigned to the nearest centroid, thereby forming clusters. The effectiveness of K-means largely depends on the initial placement of centroids, as different initial positions can lead to varying results. Therefore, a strategic selection of centroids, ensuring they are as far apart as possible, helps in obtaining optimal clusters (Lloyd, 1982). However, choosing an appropriate value for k remains a challenge. To address this, researchers employ validation techniques such as the Elbow Method and the Silhouette Analysis (Annapurna, 2016).

Elbow Method

Elbow Method is a graphical technique used to determine the optimal number of clusters by evaluating the within-cluster sum of squares (WCSS) (Thorndike, 1953). The procedure involves running K-means clustering for different values of k and plotting WCSS against k. The point at which the WCSS curve experiences a sharp bend (the "elbow") represents the ideal number of clusters. This happens because, initially, increasing k significantly reduces WCSS, but after a certain point, the rate of decrease slows down, indicating that adding more clusters

no longer provides substantial improvement (Annapurna, 2016). In the Fig. 6, the WCSS graph shows a steep decline until K=4 and then stabilizes, it suggests that four clusters optimally represent the data distribution. However, the Elbow Method relies on visual interpretation, which can sometimes be subjective, necessitating supplementary validation methods (Kodinariya & Makwana, 2013).

Fig. 6 Elbow Method



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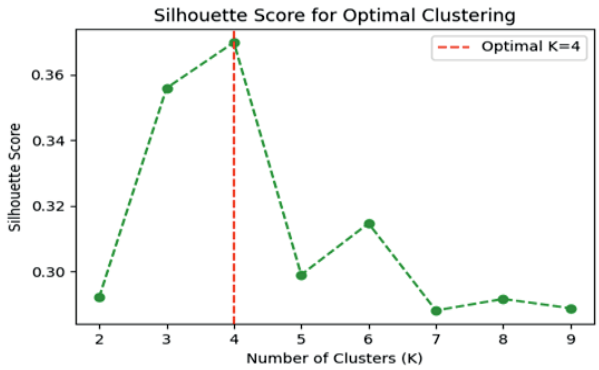
Silhouette Method

The Silhouette Method evaluates clustering quality by measuring how similar each point is to its own cluster compared to other clusters (Rousseeuw, 1987). The silhouette coefficient ranges from -1 to 1, where values close to 1 indicate well-clustered points, values near 0 suggest overlapping clusters, and negative values imply misclassification (Kaufman & Rousseeuw, 1990). The optimal number of clusters corresponds to the k value that yields the highest average silhouette score. Fig. 7, reveals K=4 where the silhouette coefficient is 0.369904949 which is highest among all the tested k in the range of two to nine. In particular, both elbow and silhouette methods suggest the same number of clusters (K=4) providing an optimal balance between minimizing intra-cluster variance and maximizing inter-cluster separation, reinforcing the model's reliability.

Fig. 7 Silhouette Method



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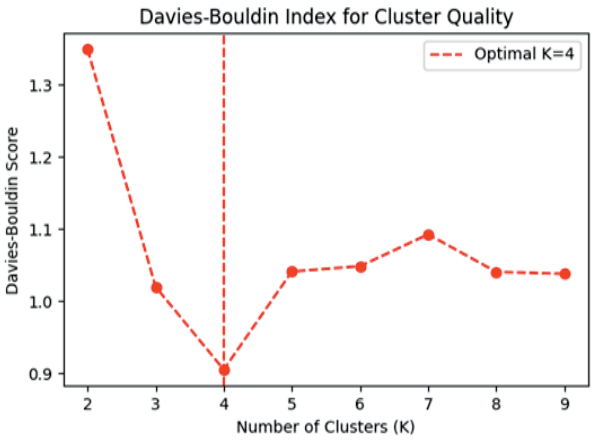
Davies-Bouldin Index

DBI was introduced by Davies and Bouldin (1979), assesses clustering quality by evaluating compactness and separation. Lower DBI values indicate distinct clusters, while higher values suggest poor separation (Rousseeuw, 1987). The DBI score of 0.905 for k = 4 signifies a well-structured clustering solution. Other k values, ranging from 2 to 9, show DBI values above 1, suggesting suboptimal clustering. The elbow and silhouette methods also support k = 4, confirming its optimality. The agreement among these techniques demonstrates clustering stability, as highlighted by Tan in his 2018 book, "Introduction to Data Mining."

Fig. 8 Davies-Bouldin Index



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Implementing K-means in Python

Python offers open source, cross-platform, object-oriented programming, dynamic typing, ease of learning, and a wealth of supporting libraries for statistics, mathematics, and visualization. Python modules such as matplotlib, Python-Sklearn, Scipy (Open-Source Library of Scientific Tools), and Numpy (Scientific Computing Tools for Python—Numpy) are utilized (Annapurna, 2016). It provides the silhouette score function from sklearn.metrics to validate the results and the K-means class from sklearn.cluster, which enables smooth clustering (Soobramoney, J. et al, 2025).

Cluster Size Distribution and PCA Visualization

Cluster size distribution is essential for assessing clustering effectiveness. Ideally, clusters should be well-balanced. Large clusters may indicate overgeneralization, while small ones could represent noise or outliers. The cluster distribution in Fig. 9, based on keywords from 218 documents, shows Cluster 2 as the largest (78 data points, 35.78%), representing a broad thematic area. Cluster 0 follows with 55 data points (25.22%) and Cluster 3 with 53 data points (24.31%), both showing a balanced distribution. Cluster 1 is the smallest, with 32 data points (14.68%), potentially reflecting niche topics. The PCA visualization in Fig. 10 provides a two-dimensional view of clustering, illustrating distinct thematic groups. Cluster 0 (dark blue) is dense and concentrated, indicating strong similarity, while Cluster 1 (teal) shows more variance. Cluster 2 (green) covers a wide range of topics, and Cluster 3 (light green) has moderate dispersion with some overlap. The red crosses represent centroids, indicating cluster cohesion and thematic diversity, with overlapping regions suggesting shared keywords between clusters. Thus, the formed clusters are named and discussed in detail.

Fig. 9 Distribution of Cluster Size

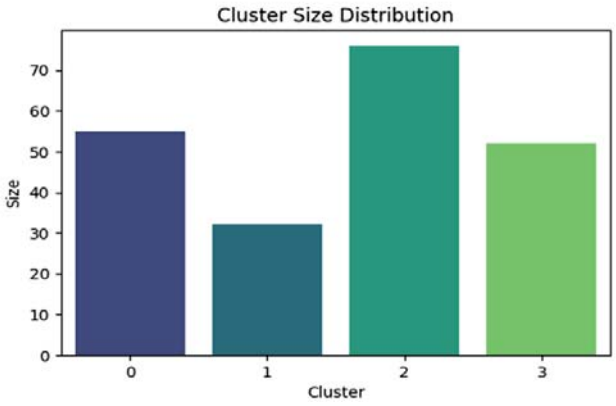

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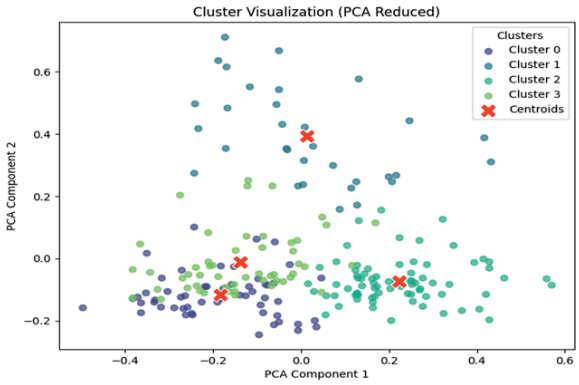
Fig. 10 PCA Cluster Visualization



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Cluster 0: Sustainability in HRM for environmental responsibility (Dark Blue)

This cluster delves into the integration of sustainability principles within HRM, widely recognized as Green HRM. Research in this domain highlights the implementation of environmentally conscious HR practices, including green recruitment initiatives, sustainability-centered employee training programs, and performance management systems that align with ecological objectives (Cosenza et al., 2024; Kramar, 2022; Liang et al., 2024). The growing interconnection between Green HRM, corporate social responsibility, and organizational performance underscores the pivotal role of stakeholder's theory in enhancing employees and corporate reputation (Song et al., 2023; Stahl et al., 2020).

Empirical findings suggest that organizations that actively integrate Green HRM practices benefit from enhanced brand equity, increased employee commitment, and a notable reduction in environmental impact (Markey et al., 2016; Ntsiful, 2025).

Cluster 1: Mixed influences of sustainable HRM (Teal)

This cluster examines HRM strategies designed to foster employee well-being (Diaz-Carrion et al., 2020; Qamar et al., 2024), engagement, and resilience. Employee engagement and well-being play fundamental role in influencing workplace productivity, retention, and overall job satisfaction (Donald et al., 2020). The Job Demands-Resources (JD-R) model provides a structured framework for balancing workplace demands with HR policies that enhance employee engagement and job performance (Bakker & Demerouti, 2017; Lu et al., 2023). Empirical studies indicate that organizations that prioritize employee engagement and resilience experience elevated performance outcomes(Lu et al., 2023). Sustainable HRM policies, such as leadership development initiatives and resilience-building strategies, are instrumental in enabling organizations to navigate crises while maintaining operational stability (Ahmad & Fatima, 2023; W. Schaufeli, 2021).

Cluster 2: Technology-Driven HRM and Sustainability (Green)

The transformative impact of technology on HRM, particularly in the areas of AI-driven recruitment, HR analytics, and the use of digital platforms to enhance employee engagement is highlighted in this cluster (Gomes et al., 2023, 2025; Maley, 2024; Shao et al., 2024). The integration of artificial intelligence and big data analytics in HR decision-making processes has garnered significant academic and industry attention, as machine learning optimizes performance (Agarwal et al., 2022; Gamage et al., 2024). Person-Organization (P-O) Fit and Ability-Motivation-Opportunity (AMO) theories have the potential to improve overall performance (Jia, X., Hou, Y., 2024). The widespread adoption of HR technology has revolutionized traditional workforce management by driving efficiency, facilitating data-driven decision-making, and enabling personalized career development programs (Donald et al., 2020; Nayal et al., 2023; Sharma et al., 2022).

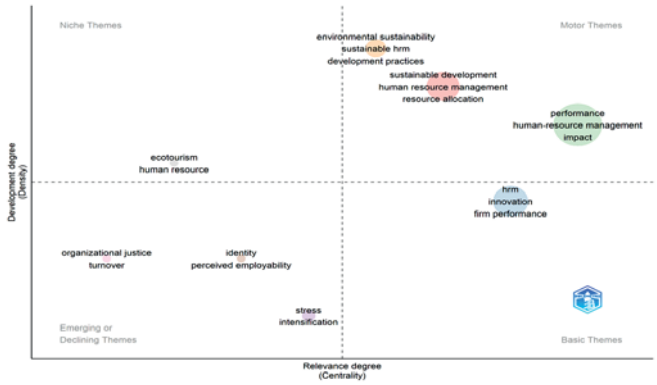
Cluster 3: Advancing Strategic HRM for Sustainable Organizations (Light Green)

This cluster explores the strategic dimensions of HRM, emphasizing talent management, leadership development, and performance optimization as essential drivers of long-term organizational sustainability. Research underscores the necessity of aligning HRM with corporate strategy to establish a sustainable competitive advantage in dynamic business environments (Cheng et al., 2024; Lu et al., 2023; Piwowar-Sulej, 2021; Piwowar-Sulej et al., 2024). Studies highlight the importance of structured leadership development programs, succession planning mechanisms, and competency-based HR models in ensuring organizational agility and resilience (Mariappanadar, 2020; Poon & Law, 2022). Furthermore, talent retention, learning and employee motivation emerge as pivotal themes within strategic HRM, with empirical findings supporting the effectiveness of career development pathways and performance-linked engagement initiatives (Bhatti M.A., 2024; Guerci et al., 2019; Nakra & Kashyap, 2024).

Thematic Map

The thematic map in Fig. 11, based on Callon's density and centrality, categorizes research themes in sustainable HRM. Motor themes (top-right quadrant), such as "performance," "human resource management," and "impact," are highly developed and relevant, central to the field. Niche themes (top-left), like "environmental sustainability" and "sustainable HRM," are specialized but less connected to the broader HRM discourse. Basic themes (bottom-right), including "HRM," "innovation," and "firm performance," are foundational and widely relevant but not deeply explored. Emerging or declining themes (bottom-left), such as "organizational justice," "turnover," and "stress intensification," represent topics with either diminishing or minimal research momentum. The thematic map highlights opportunities for further exploration and expansion within sustainable HRM.

Fig. 11 Thematic Map



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Conclusion

Sustainable human resource management is a strategic imperative for organizations aiming to balance social, economic, and environmental goals. By integrating sustainability into HRM processes, businesses can enhance employee engagement, well-being, and long-term organizational sustainability. Based on a review of 218 papers from Scopus and Web of Science, the study highlights key themes, influential authors, and emerging trends in sustainable HRM, demonstrating the field's growing scholarly interest. Through K-means clustering, supported by elbow, silhouette, and Davis-Bouldin indices, four distinct clusters were identified. However, gaps remain in global representation and comprehensive database coverage. Future research should explore sustainable HRM's practical applications across diverse regions and industries to ensure integration of sustainability into HRM.

Implications of the Study

Cluster 1 highlights the critical role of sustainable HRM in fostering workplace well-being through enhanced employee engagement and promoting diversity and inclusion by aligning HRM practices with regulatory standards. The surge in publications since 2020 reflects the rising interest in sustainability-focused HRM frameworks that support the United Nations Sustainable Development Goals by 2030. A growing international co-authorship rate (16.97%) signals global collaboration, enabling firms to adapt HRM strategies to diverse regulatory environments while supporting accountability and responsiveness to evolving labor and environmental standards in organizational practices.

Proposed Research directions

Future research should integrate niche and motor themes to develop a holistic sustainable HRM framework. Deeper exploration is needed into how environmental sustainability and development practices influence performance and HRM strategies. Studies can also bridge basic themes with advanced ones by examining the link between HR innovation and sustainable HRM (Kramar, 2014). Addressing emerging themes like stress intensification and organizational justice may offer insights into balancing performance with employee well-being. Additionally, examining the role of resource allocation across diverse organizations and applying methods like MAP-DP, DBSCAN, or hierarchical clustering is recommended.

Limitations of the study

This research has limitations, including a narrow focus on "sustainable HRM," potentially overlooking relevant studies using different terms. Bibliometric analysis tools like R and VOSviewer have inherent drawbacks, such as database indexing reliance and exclusion of non-English publications. Citation-based analysis may also miss conceptual advancements. Additionally, sustainability research is constantly evolving, and the dataset may not reflect emerging trends. Future research should incorporate mixed methods, broader search terms, and diverse data sources for a more comprehensive view of sustainable HRM.

References

- Abu-Mahfouz, S., Halim, M. S. A., Bahkia, A. S., Alias, N., & Tambi, A. M. (2023). Sustainable human resource management practices in organizational performance: The mediating impacts of knowledge management and work engagement. Journal of Entrepreneurship, Management and Innovation, 19(2), 57–97. https://doi.org/10.7341/20231922
- Agarwal, V., Mathiyazhagan, K., Malhotra, S., & Saikouk, T. (2022). Analysis of challenges in sustainable human resource management due to disruptions by Industry 4.0: an emerging economy perspective. International Journal of Manpower, 43(2), 513–541. https://doi.org/10.1108/IJM-03-2021-0192

- Ahmad, J., & Fatima, S. (2023). Meaningful leadership and sustainable HRM: catalysts for follower calling – a moderated mediational model. Leadership and Organization Development Journal, 44(5), 609–626. https://doi.org/10.1108/LODJ-09-2022-0438
- Anlesinya, A. (2020). Sustainable human resource management: A systematic review of a developing field. Human Resource Management. https://doi.org/10.1108/JGR-04-2019-0038
- Aragão, C. G., & Jabbour, C. J. C. (2017). Green training for sustainable procurement? Insights from the Brazilian public sector. Industrial and Commercial Training, 49(1), 48–54. https://doi.org/10.1108/ICT-07-2016-0043
- Aust, I., Matthews, B., & Muller-Camen, M. (2020). Common Good HRM: A paradigm shift in Sustainable HRM? Human Resource Management Review, 30(3). https://doi.org/10.1016/j.hrmr.2019.100705
- Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: Taking stock and looking forward. Journal of Occupational Health Psychology, 22(3), 273–285. https://doi.org/10.1037/ocp0000056
- Banga, C. M., & Gobind, J. (2025). Implementation of sustainability in human resource management: A literature review. SA Journal of Human Resource Management, 23. https://doi.org/10.4102/sajhrm.v23i0.2741
- Bhatti, M. A. (2024). Perceived Organisational Fit Influence on Employees Performance: A Study of Sustainable HRM. Transformations in Business and Economics, 23(1), 233–258. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85193595040&partnerID=40&md5=6129b33c6f1efe880812c399840e0d3b
- Brewster, C., & Brookes, M. (2024). Sustainable development goals and new approaches to HRM: Why HRM specialists will not reach the sustainable development goals and why it matters. German Journal of Human Resource Management, 38(2), 183–201. https://doi.org/10.1177/23970022241229037
- Chaudhary, A., Khandelwal, S., Deshpande, P., & Panjabi, P. (2025). An intriguing convergence between metaverse and sustainable human resource management. SA Journal of Human Resource Management, 23. https://doi.org/10.4102/ sajhrm.v23i0.2699
- Chaudhary, R. (2018). Can green human resource management attract young talent? An empirical analysis. Evidence-Based HRM, 6(3), 305–319. https://doi.org/10.1108/EBHRM-11-2017-0058
- Cheng, B., Yu, X., Dong, Y., & Zhong, C. (2024). Promoting employee career growth: the benefits of sustainable human resource management. Asia Pacific Journal of Human Resources, 62(1). https://doi.org/10.1111/1744-7941.12371
- Cosenza, A. C. de S., Motta Reis, J. S. da, Souza, C. G. de, Barbastefano, R. G., Santos, G., & Barbosa, L. C. F. M. (2024). Sustainable Human Resource Management, Green Human Resource Management, and Environmental Human Resource Management: Analysis of New and Emerging Terms Related to the Human Resource Area. Quality Innovation Prosperity, 28(1), 127–153. https://doi.org/10.12776/qip.v28i1.1904
- Davies, D. L., & Bouldin, D. W. (1979). A cluster separation measure. IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-1(2), 224–227. https://doi.org/10.1109/ TPAMI.1979.4766909
- Diaz-Carrion, R., López-Fernández, M., & Romero-Fernandez, P. M. (2020). Sustainable human resource management and employee engagement: A holistic assessment instrument. Corporate Social Responsibility and Environmental Management, 27(4), 1749–1760. https://doi.org/10.1002/csr.1921
- Donald, W. E., Baruch, Y., & Ashleigh, M. J. (2020). Striving for sustainable graduate careers: Conceptualization via career ecosystems and the new psychological contract. Career Development International, 25(2), 90–110. https://doi.org/10.1108/CDI-03-2019-0079
- Eck, N.J.V. and Waltman, L. (2009), "How to normalize cooccurrence data? An analysis of Some Well- Known similarity measures", Journal of the American Society for Information Science and Technology, Vol. 60 No. 8, pp. 1635-1651. 10.1002/asi.
- Eger, L., & Žižka, M. (2024). Industry 4.0, digital

transformation and human resource management: Emerging themes and research trends in the context of the Visegrad countries. Oeconomia Copernicana, 15(3), 1021–1065. https://doi.org/10.24136/oc.3034

- Ehnert, I., Parsa, S., Roper, I., Wagner, M., & Muller-Camen, M. (2016). Reporting on sustainability and HRM: a comparative study of sustainability reporting practices by the world's largest companies. International Journal of Human Resource Management, 27(1), 88–108. https://doi.org/10.1080/09585192.2015.1024157
- Gamage, A., Pyke, J., & de Lacy, T. (2024). Building resilience and sustainable HRM in the visitor economy: An uneasy relationship. Journal of Hospitality and Tourism Management, 58, 497–505. https://doi.org/10.1016/j.jhtm.2023.05.006
- Genari, D., & Macke, J. (2022). Sustainable human resource management practices and the impacts on organizational commitment. RAE Revista de Administracao de Empresas, 62(5). https://doi.org/10.1590/S0034-759020220505
- Gomes, D. R., Ribeiro, N., & Santos, M. J. (2023). "Searching for Gold" with Sustainable Human Resources Management and Internal Communication: Evaluating the Mediating Role of Employer Attractiveness for Explaining Turnover Intention and Performance. Administrative Sciences, 13(1). https://doi.org/10.3390/admsci13010024
- Guerci, M., Decramer, A., van Waeyenberg, T., & Aust, I. (2019). Moving Beyond the Link Between HRM and Economic Performance: A Study on the Individual Reactions of HR Managers and Professionals to Sustainable HRM. Journal of Business Ethics, 160(3), 783–800. https://doi.org/10.1007/s10551-018-3879-1
- Jabbour, C. J. C., & Renwick, D. W. S. (2018). The soft side of environmentally-sustainable organizations. RAUSP Management Journal, 53(4), 622–627. https://doi.org/10.1108/RAUSP-07-2018-0044
- Järlström, M., Saru, E., Viitasaari, M., & Akrivou, K. (2024). Integrating 'common good' authenticity for sustainable human resource management reporting. German Journal of Human Resource Management, 38(2), 159–182. https://doi.org/10.1177/23970022241229035
- Jerónimo, H. M., de Lacerda, T. C., & Henriques, P. L. (2020). From Sustainable HRM to Employee Performance: A Complex and Intertwined Road. European Management Review, 17(4), 871–884. https://doi.org/10.1111/emre.12402
- Jia, X., Hou, Y. Architecting the future: exploring the synergy of AI-driven sustainable HRM, conscientiousness, and employee engagement. (2024). Discovering Sustainability, 5(30). https://doi.org/10.1007/s43621-024-00214-5
- Jia, J., Yuan, S., Wei, L.-Q., & Tang, G. (2023). When firms adopt sustainable human resource management: A fuzzy-set analysis. Human Resource Management, 62(3), 283–305. https://doi.org/10.1002/hrm.22164
- Jiang, Y., Jamil, S., Zaman, S. I., & Fatima, S. A. (2024). Elevating organizational effectiveness: synthesizing human resource management with sustainable performance alignment. Journal of Organizational Effectiveness, 11(2), 392–447. https://doi.org/10.1108/JOEPP-03-2023-0111
- Kaufman, L., & Rousseeuw, P. J. (2009). Finding groups in data: An introduction to cluster analysis. John Wiley & Sons. https://doi.org/10.1002/9780470316801
- Kodinariya, T. M., & Makwana, P. R. (2014). Review on determining number of clusters in K-Means clustering. International Journal of Advanced Research in Computer Science and Management Studies, 1(6), 90-95.
- Kramar, R. (2014). Beyond strategic human resource management: Is sustainable human resource management the next approach? International Journal of Human Resource Management, 25(8), 1069–1089. https://doi.org/10.1080/09585192.2013.816863
- Kramar, R. (2022). Sustainable human resource management: six defining characteristics. Asia Pacific Journal of Human Resources, 60(1), 146–170. https://doi.org/10.1111/1744-7941.12321
- Liang, X., Taddei, M., & Xiao, Q. (2024). Sustainable human resource management: the perspectives of Italian human resource managers. International Journal of Human Resource Management, 35(11), 2029–2056. https://doi.org/10.1080/09585192.2024.2325548

- Lloyd, S. (1982). Least squares quantization in PCM. IEEE Transactions on Information Theory, 28(2), 129-137.
- Lopez-Cabrales, A., & Valle-Cabrera, R. (2020). Sustainable HRM strategies and employment relationships as drivers of the triple bottom line. Human Resource Management Review, 30(3). https://doi.org/10.1016/j.hrmr.2019.100689
- Lu, Y., Zhang, M. M., Yang, M. M., & Wang, Y. (2023). Sustainable human resource management practices, employee resilience, and employee outcomes: Toward common good values. Human Resource Management, 62(3), 331–353. https://doi.org/10.1002/hrm.22153
- Maley, J. F. (2024). Operationalising employee capabilities post pandemic crisis: a sustainable HR approach. Review of Managerial Science, 18(12), 3575–3596. https://doi.org/10.1007/s11846-024-00726-4
- Malik, G., & Singh, P. (2024). Fostering social sustainability: unveiling HR's power in enhancing employee resilience via social exchange and broaden-and-build theories. Employee Relations, 46(3), 675–701. https://doi.org/10.1108/ER-08-2023-0427
- Mariappanadar, S. (2020). Do HRM systems impose restrictions on employee quality of life? Evidence from a sustainable HRM perspective. Journal of Business Research, 118, 38–48. https://doi.org/10.1016/j.jbusres.2020.06.039
- Mishra, A. A., & Pathak, D. K. (2024). Industry 4.0 Technologies Adoption and Sustainability Integration in Human Resource Management: An Analysis Using Extended TOE Framework and TISM. IEEE Transactions on Engineering Management, 71, 14688–14703. https://doi.org/10.1109/TEM.2024.3456604
- Mushtaq, S., & Akhtar, S. (2024). Sustainable HRM strategies, enhancing organizational resilience and advancing sustainability goals. Journal of Management Development, 43(5), 712–726. https://doi.org/10.1108/JMD-02-2024-0072
- Nakra, N., & Kashyap, V. (2025). Responsible leadership and organizational sustainability performance: investigating the mediating role of sustainable HRM. International Journal of Productivity and Performance Management, 74(2), 409–426. https://doi.org/10.1108/IJPPM-03-2023-0115
- Nakra, N., Kashyap, V., & Arora, R. (2024). Interactive effects of sustainable HRM, career adaptability and career sustainability on employee well-being. Employee Relations, 46(8), 1706–1722. https://doi.org/10.1108/ER-01-2024-0021
- Nayal, K., Raut, R. D., Mangla, S. K., Kumar, M., Tuček, D., & Gavurova, B. (2023). Achieving market performance via industry 4.0 enabled dynamic marketing capability, sustainable human resource management, and circular product design. Industrial Marketing Management, 115, 86–98. https://doi.org/10.1016/j.indmarman.2023.09.010
- Ntsiful, A. (2025). Sharing is caring for the environment: But why would managers resist shared mobility? Business Strategy and the Environment, 34(1), 612–633. https://doi.org/10.1002/bse.4006
- Piwowar-Sulej, K. (2020). Core functions of sustainable human resource management: A hybrid literature review with the use of H-Classics methodology. Sustainable Development. https://doi.org/10.1002/sd.2166
- Piwowar-Sulej, K. (2022). Environmental strategies and human resource development consistency: Research in the manufacturing industry. Journal of Cleaner Production, 330. https://doi.org/10.1016/j.jclepro.2021.129538
- Piwowar-Sulej, K., Malik, S., Shobande, O. A., Singh, S., & Dagar, V. (2024). A Contribution to Sustainable Human Resource Development in the Era of the COVID-19 Pandemic. Journal of Business Ethics, 191(2), 337–355. https://doi.org/10.1007/s10551-023-05456-3
- Poon, T. S.-C., & Law, K. K. (2022). Sustainable HRM: An extension of the paradox perspective. Human Resource Management Review, 32(2). https://doi.org/10.1016/j.hrmr.2020.100818
- Qamar, F., Afshan, G., & Rana, S. A. (2024). Sustainable HRM and well-being: systematic review and future research agenda. Management Review

Quarterly, 74(4), 2289–2339. https://doi.org/10.1007/s11301-023-00360-6
- Rousseeuw, P. J. (1987). Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. Journal of Computational and Applied Mathematics, 20, 53-65.
- Schaufeli, W. (2021). Engaging Leadership: How to Promote Work Engagement? Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.754556
- Shao, D., Ji, Y., Zhou, R., & Liu, T. (2024). Unpacking the Mixed Influences of Sustainable Human Resource Management on Employee Resilience: Effects of Challenge–Hindrance Appraisal and Trait Mindfulness. Asia Pacific Journal of Human Resources, 63(1). https://doi.org/10.1111/1744-7941.12433
- Sharma, M., Luthra, S., Joshi, S., & Kumar, A. (2022). Analysing the impact of sustainable human resource management practices and industry 4.0 technologies adoption on employability skills. International Journal of Manpower, 43(2), 463–485. https://doi.org/10.1108/IJM-02-2021-0085
- Song, W., Ma, Y., Fan, X., & Peng, X. (2023). Corporate environmental ethics and employee's green creativity? The perspective of environmental commitment. Corporate Social Responsibility and Environmental Management, 30(4), 1856–1868. https://doi.org/10.1002/csr.2459
- Soobramoney, J., Chifurira, R., Zewotir, T., & Chinhamu, K. (2025). Identifying the Intents Behind Website Visits by Employing Unsupervised Machine Learning Models. In Annals of Data Science. Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s40745-024-00586-5
- Stahl, G. K., Brewster, C. J., Collings, D. G., & Hajro, A. (2020). Enhancing the role of human resource management in corporate sustainability and social responsibility: A multi-stakeholder, multidimensional approach to HRM. Human Resource Management Review, 30(3). https://doi.org/10.1016/j.hrmr.2019.100708
- Su, Y., Xia, J., Zahra, S. A., & Ding, J. (2023). Family CEO successor and firm performance: The moderating role of sustainable HRM practices and corporate philanthropy. Human Resource Management, 62(3), 307–330. https://doi.org/10.1002/hrm.22143
- Tan, P. N., Steinbach, M., & Kumar, V. (2018). Introduction to data mining (2nd ed.). Pearson.
- Thorndike, R. L. (1953). Who belongs in the family? Psychometrika, 18(4), 267-276.

Abbreviations:

AI Artificial Intelligence
AMO Ability Motivation Opportunity theory
CSR Corporate Social Responsibility
JD-R Job Demands– Resources theory
HR Human resource
HRM Human resource management
P-O Person-Organization Fit
SHRM- Sustainable Human resource management

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Availability of data and materials: Data taken from Scopus and Web of Science, Used easily available software's like R studio, Biblioshiny, Vosviewer, and Python.

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