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*Loubna BOUHSAIEN* [0009-0003-7216-6667]\*, *Abdellah AZMANI* [0000-0003-4975-3807]\*

# THE POTENTIAL OF ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE MANAGEMENT

## Abstract

*The growth of Artificial Intelligence (AI) technologies is revolutionizing Human Resource (HR) practices, offering new opportunities for organizations to optimize their operations and better support for their workforce in an era defined by technological advancement. In this context, the emergence of industry 5.0 highlights human-centricity, resilience, and sustainability, promoting collaboration between humans and technology. This article conducts a bibliometric analysis to explore the intersection of AI and Human Resources Management (HRM), highlighting trends, research directions, and the evolving landscape of this thematic. Through performance analysis, social structure assessment, and thematic evolution examination, this study identifies key themes, emerging topics, and research trends. The findings underscore the transformative potential of AI in reshaping HRM and organizational dynamics, calling for more research and strategic applications of AI technologies to foster adaptive strategies and informed decision-making in the era of industry 5.0.*

## 1. INTRODUCTION

With the emergence of the fourth industrial revolution, transformative technologies like AI have become increasingly prominent (Kong et al., 2021). However, despite the potential benefits, the integration of these technologies into HRM processes has been slow. Despite a surge in academic research on intelligent automation, including AI and robotics, a comprehensive understanding of their implications on HRM, both at the organizational and individual levels, remains elusive (Vrontis et al., 2022).

Industry 5.0 has recently showed up to emphasize human-centricity, resilience, and sustainability. This new phase promotes human–robot collaboration, pushing the research frontier towards a smart and harmonious socio-economic transition powered by the synergistic integration of humans and technologies (Jefroy et al., 2022), which impacts directly HRM. HR managers must adapt work environments that enhance employee well-being, promoting continuous learning for employees, and leveraging data analytics for informed decision-making. This shift also necessitates developing policies that support remote and flexible work, ensure workplace safety, and promote diversity and inclusion. By automating routine tasks, industry 5.0 allows HR managers to focus on enhancing creativity,

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\* Abdelmalek Essaadi University, Faculty of Science and Technologies, Intelligent Automation and BioMedGenomics laboratory, Morocco, loubna.bouhsaine@etu.uae.uae.ac.ma, a.azmani@uae.uae.ac.ma

strategic thinking, and job satisfaction, ultimately aiming to create a more engaged, adaptable, and productive workforce.

During the last decades, organizations have struggled with the challenge of effectively managing and supervising their Human Resources (HR) (Ortega-Cotto et al., 2022). Despite the rapid advancement of technology within these entities, the importance of human contributions remains irreplaceable. AI plays a significant role across various sectors of society, including HRM (Alcalde-Bezhoid et al., 2021).

The potential of AI in HRM is vast, enhancing talent management by identifying crucial skills and streamlining recruitment through efficient candidate evaluation. AI has the potential to reduce bias in HR processes, though ongoing vigilance is needed to ensure fairness. It also brings ethical and legal considerations, requiring proactive management. By automating routine tasks, AI enables HR professionals to focus on strategic initiatives, bridging technological, human, and societal gaps (Fernandes França et al., 2023).

Through AI implementation in HR operations, IBM generated savings amounting to \$107 million in 2017 alone (Guenole & Feinzig, 2018). The rapid evolution of generative AI models like ChatGPT significantly impacts HRM by enhancing productivity and transforming business models while introducing uncertainties about job displacement, ethical dilemmas, bias, misinformation, and privacy, necessitating comprehensive research to explore both their benefits and challenges (Budhwar et al., 2022).

This paper contributes to the existing literature on AI in HRM by presenting a comprehensive bibliometric analysis, which differentiates it from previous works that primarily focused on qualitative reviews or specific case studies. Unlike earlier studies that often examined AI in HRM through a narrower lens, this paper employs a broader, data-driven approach to map the intellectual structure of the field, identify key research trends, and highlight emerging themes. This systematic analysis provides a clearer understanding of how AI applications in HRM have evolved, offering valuable insights for future research directions.

Following this introduction, the paper is organized as follows: Section 2 presents the literature review by highlighting some previous works, section 3 is about the methodology employed in this study. Section 4 elaborates the application, derived from the bibliometric analysis focusing on the intersection of AI and HRM. The discussion shifts to an examination of the top 10 cited articles in section 5, offering detailed insights into their significance and contributions to the field, highlighting future works ideas, the advantages and disadvantages of the approach of the article, and the limitations drawn from this research. Finally, section 6 contains the most important conclusions.

## **2. LITERATURE REVIEW**

Decision-making in venture capital involves various considerations. However, there is limited research on how artificial intelligence (AI) impacts this market. This gap prompts an exploration of AI's potential influence on venture capital decisions, including its ability to identify successful firms and assist in investment selection. It also examines barriers to AI adoption and culminates in recommendations for integrating AI into venture capital decision-making processes (Toumia & Zouari, 2024).

Numerous bibliometric analyses have been conducted according to HR, covering a wide range of topics. These topics include risk analysis like turnover, and burnout (Bouhsaien & Azmani, 2024), as well as factors impacting these risks such as job satisfaction and work-family conflict (Mumu et al., 2021). Training is also a key focus (Danvila-del-Valle et al., 2019), directly influencing performance and productivity (Pedraja-Rejas et al., 2022).

The most common words used in BA according to AI and HRM are related to information management, resource allocation, decision making, business functions, business management, business scenarios, drop-out, dynamic capability, employee training, ethical implications, industry 4.0, personal recruitment, and virtual reality. Table 1 summarizes the key BA on the tackled theme, published in 2024.

**Tab. 1. Presentation of the main ideas of previous BA according to the thematic**

<b>BA reference</b>	<b>Main idea</b>
(Deepa et al., 2024)	This study systematically reviews and analyzes the application of AI in HRM, focusing on the necessary managerial competencies and developing a competency framework.
(Bondarouk & Meijerink, 2024)	This study conducts a BA to examine whether artificial intelligence is disrupting human resource management.
(Laviola et al., 2024)	This paper conducts a BA to explore the role of AI in HR development, presenting a novel framework for both theoretical and practical advancements in the field.
(Torres-Salazar et al., 2024)	This research conducts a descriptive BA to examine the influence of industry 4.0 on business management, highlighting its positive impact on decision-making.
(Hernández et al., 2024)	This BA analyses the positive impact of AI on HR, revealing significant growth in research since 2019, and identifies four emerging research trends: machine learning for resource management, AI for recruitment management, decision support systems for information management, and AI for training.

AI is employed to streamline processes, improve decision-making, and automate operations in HR. However, research on its impact on job performance remains limited. A study conducted in Tunisia within the service sector observed no connection between job performance and AI awareness, nor any correlation between job performance and awareness of AI (Toumia & Zouari, 2024).

The objective of this study is to undertake a comprehensive bibliometric analysis spanning the past five years (2019-2023) to visualize the intersection of HRM and AI. This analysis aims to trace the evolution of the topic, reveal relationships between various themes, and quantify the number of citations associated with different aspects. This paper seeks to gain insights into the primary focus of research and overarching developments within this domain. Furthermore, it will review and summarize the ten most cited articles, particularly regarding the interplay between AI and other dimensions, and the progression of AI

technologies within HRM implementation. This holistic approach aims to provide a comprehensive overview of the field's advancements, shedding light on emerging trends and future directions.

### 3. METHODOLOGY

Bibliometric analysis (BA) is a well-established method for analyzing scientific data (Moral-Muñoz et al., 2020). It allows to explore the evolutionary dynamics of a field and identify emerging areas serving in the purpose of summarizing extensive scientific data to define the intellectual structure and emerging trends within a given research topic or field. It is of a high importance when the scope of review is wide, and the dataset is too large to be feasibly reviewed manually (Donthu et al., 2021). Before starting a BA, it is necessary to choose the database and go with the filtering criteria applied to it, including keywords, subject area, document type, source type, and language. Fig. 1 presents the process of the BA methodology. This method is particularly useful when the scope of review is broad, and the dataset is too large to be manually reviewed. The process includes both quantitative and qualitative analyses. Quantitative analysis involves using statistical methods to analyze all articles that meet the specified criteria, such as keywords, subject area, document type, source type, and language. When qualitative analysis focuses on a descriptive analysis of the state of the art, addressing the topics considered in the study.



Fig. 1. BA processus

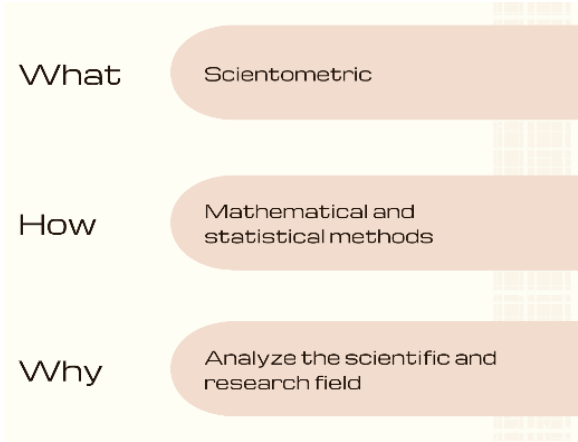
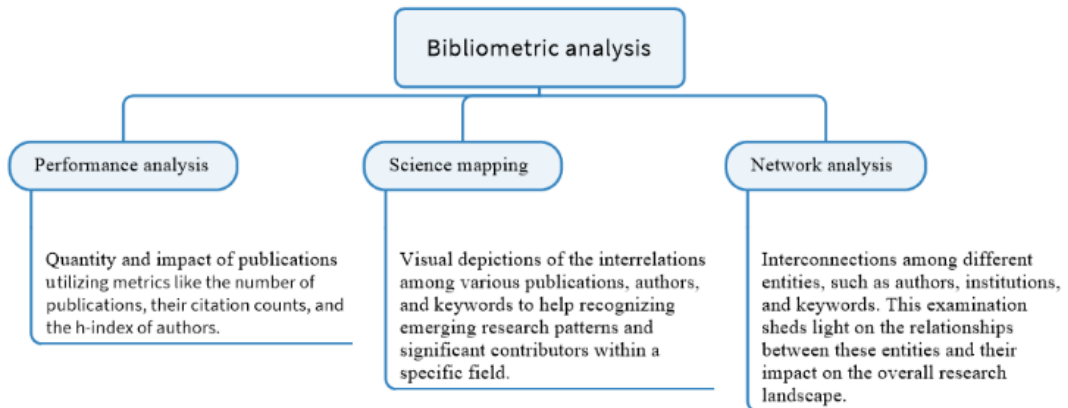


Fig. 2. What, how, and why doing a BA

Fig. 2 summarizes the importance of a BA by giving it definition and explaining how and why it is done.



**Fig. 3. Bibliometric analysis elements**

Moreover, BA techniques can be categorized into three primary domains: performance analysis, science mapping, and network analysis as explained in Fig. 3. When performance analysis examines the productivity and impact of researchers, institutions, or countries, science mapping visualizes the structure and dynamics of scientific research fields, and network analysis investigates relationships between authors, institutions, or countries.

## 4. APPLICATION

This section focuses on the application of bibliometric techniques by using R packages (Derviş, 2020). It begins with filtering the database collected from SCOPUS and giving an overview of the data. Following this, it goes into performance analysis, examining both intellectual and social structures, and concludes by exploring the conceptual structure (Fosso Wamba et al., 2021).

### 4.1. Data collection

The initial step involved identifying the databases suitable for document search, Scopus was selected due to its relevance in our research field. The search terms were related to "Artificial Intelligence" and "Human Resources" were used across both databases in the Article Title, Abstract, and Keywords sections for the timeframe of 2019–2023. Firstly, keywords related to human resources and artificial intelligence (AI) are specified, including variations such as "HR," "e-HR", "AI", "machine learning," "deep learning", "federated learning", "distributed learning", and many others. These keywords encompass a wide range of concepts from traditional human resource management to cutting-edge AI applications in business contexts. Secondly, the subject area is narrowed down to Business, Management, and Accounting to ensure relevance to the research focus. Thirdly, the document type is specified as an article, indicating a preference for scholarly publications. Fourthly, the source type is restricted to journals. Finally, the language filter is set to English, ensuring accessibility and consistency in language across the selected publications (Vlačić et al., 2021). Database bellow provides access to the dataset collected from SCOPUS between

2019 and 2023, containing all references as well as a file containing tables and figures obtained through biblioshiny (Bouhsaien, 2024).

Figure 4 provides an overview of the database. It shows an impressive 53.46% average annual growth rate, these articles average 2.15 years old and receive 16.14 citations each. Keywords selected include those related to HRM and AI, resulting in 1025 keyword occurrences. The collaborative efforts of 430 authors, including 11 single-authors, and an average of 3.48 co-authors per document demonstrate the international scope and collaborative nature of the research.

AI has a potential impact in HRM applications (Palos-Sánchez et al., 2022), though past research notes a disparity between the promise and reality of AI in HRM (Tambe et al., 2019), indicating the early stage of the AI in HRM domain. (Garg et al., 2022) observe a convergence in the publication trends towards AI and Machine Learning (ML). The search yielded 132 articles which were exported in csv file from Scopus, for further analysis on the Biblioshiny platform. Prior to data processing, necessary software installations were completed as per instructions.

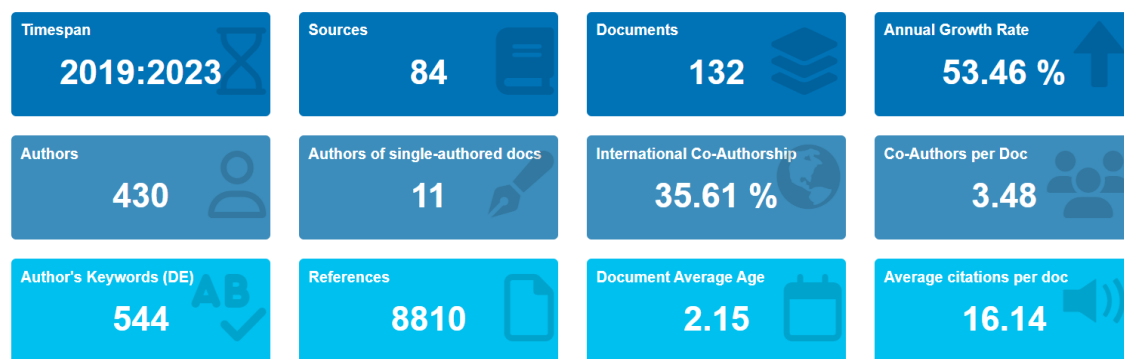
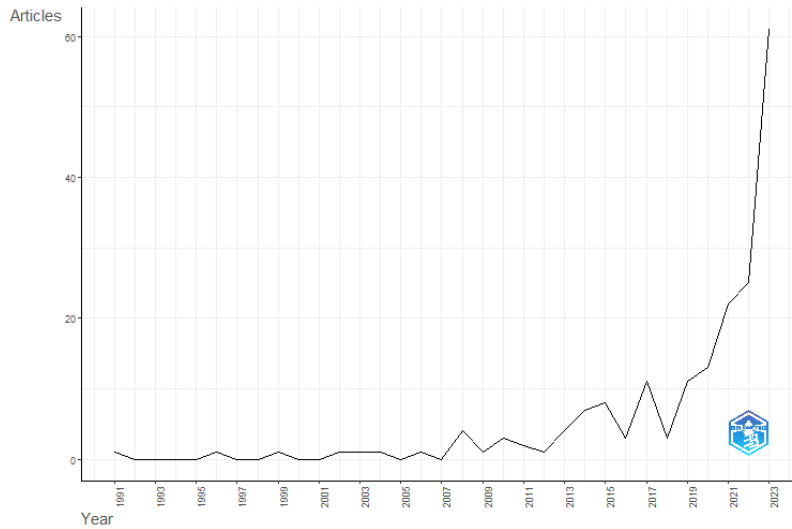


Fig. 4. Overview of the database

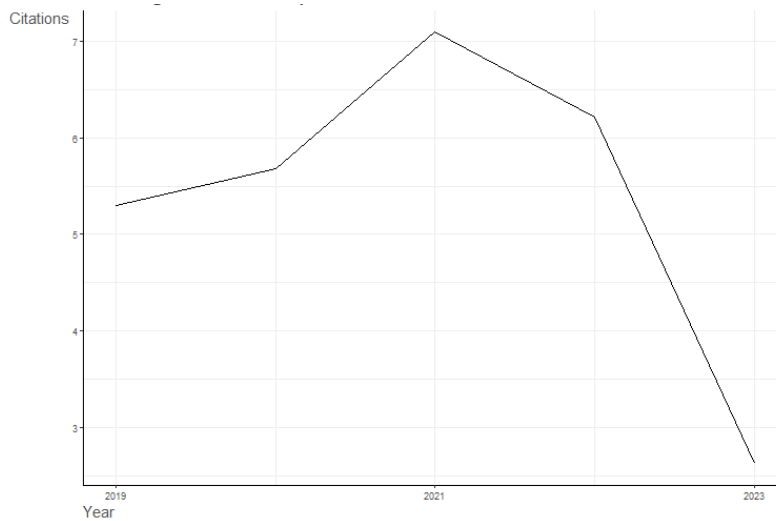
## 4.2. Performance analysis

In bibliometric analysis, performance analysis often involves assessing the annual scientific production and the average citations per year for a given set of publications or researchers.

Over the past two decades, there has been a notable surge in scientific publications focusing on the insertion of the new technologies and AI into HRM, especially in the last five years, as shown in Fig.5. This increase suggests a growing recognition of the significance of integrating AI technologies into HR practices. While growth rates fluctuated before 2019, there has been a consistent upward trend since then, peaking at 25 articles in 2023. Figure 6 shows the number of citations per year.



**Fig. 5. Annual scientific production of the subject**



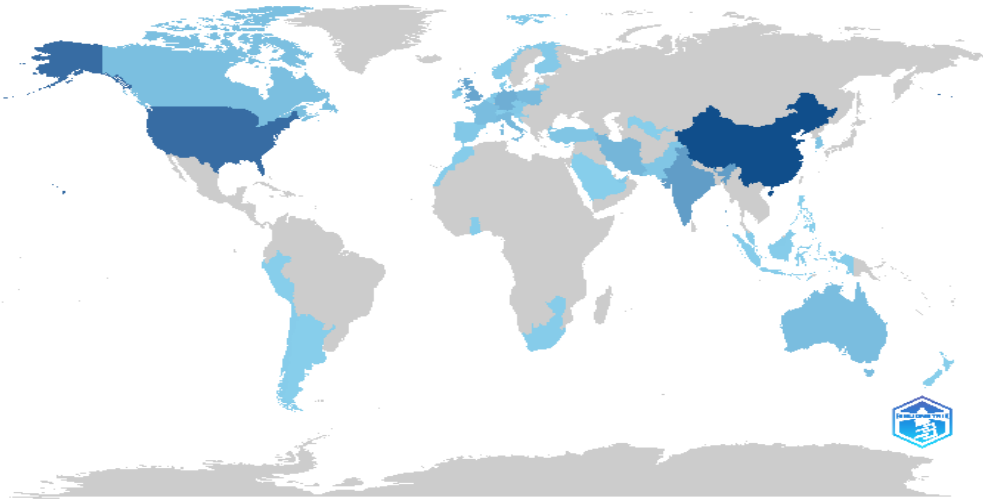
**Fig. 6. Average citations per year**

### 4.3. Social structure

The social dimension plays a crucial role in assessing initiatives and policies sought after and championed by both public and private entities, as well as society collectively. Consequently, there is a growing interest in researching social impact, particularly regarding its measurement and assessment. This study delves into the increasing focus on social impact, aiming to pinpoint key players in the field and organize the conceptual framework of research in this area (Baraibar-Diez et al., 2020).

Figure 7 illustrates the geographic distribution of research contributions by region. It shows that China leads in the number of publications, with 91 articles, followed by the USA with 68 articles and India with 34 articles. The UK, Germany, and Iran also demonstrate

significant research output with 28, 22, and 17 articles respectively. Additionally, Italy, Poland, and Australia each contribute 15, 14, and 12 articles respectively. Other countries, such as France, Canada, and South Korea, also display notable research activity in this domain.



**Fig. 7. Country scientific production**

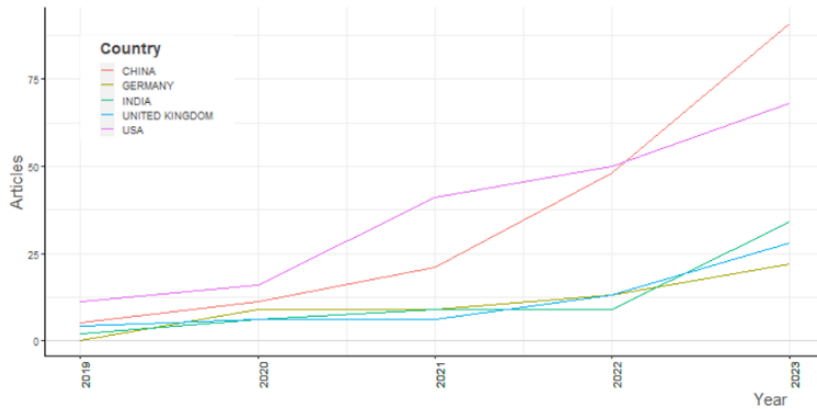
Figure 8 illustrates how research articles published by country and year offer valuable insights into the global distribution of contributions to the field. Notably, China demonstrates remarkable growth over the years, with a notable increase in the number of articles published annually, reaching a peak of 91 articles in 2023. India also shows significant growth, gradually increasing its contributions from 2 articles in 2019 to 34 articles in 2023. The United Kingdom and the USA consistently maintain substantial research activity throughout the years, with the USA particularly notable for its high number of publications, reaching 68 articles in 2023. Germany, although starting with fewer contributions, also demonstrates steady growth over the years. This data underscores the international interest and research focus on the integration of Human Resources and Artificial Intelligence across various countries.

Figure 9 illustrates the distribution of citations across different countries, shedding light on the impact of research contributions from various regions. Notably, the United States leads with 424 total citations, followed by Cyprus with 239 citations and China with 236 citations. Countries like Slovenia, Germany, and the United Kingdom also demonstrate significant impact, each accumulating over 100 total citations. France stands out with a notably high average article citation rate of 42. Meanwhile, several countries, including the United Arab Emirates, Morocco, and South Africa, did not gather any citations during the examined period. This data underscores the global reach and impact of research at the intersection of HR and AI.

Figure 10 illustrates the collaboration world map in terms of scientific production, showcasing a diverse network of collaborative efforts among countries. Notable collaborations include China with the USA (7 collaborations), Hong Kong with the USA (4



collaborations), and France with Morocco (2 collaborations). Additionally, there are instances of singular collaborations between various countries, such as Australia with France, Austria with Lithuania, and Chile with Argentina. These collaborations underscore the global nature of scientific research and underscore the significance of international cooperation in advancing knowledge and innovation across borders.



**Fig. 8. Country production over time**

#### **4.4. Intellectual structure**

The intellectual structure pertains to the organization and interconnectedness of knowledge within a particular field or domain, including the identification of key concepts, theories, and methodologies (Foroudi et al., 2021).

##### **4.4.1. Word frequency over time**

Fig.11 illustrates the evolving frequency of key terms in the field of research from 2019 to 2023. Notably, there is a significant upward trend in the occurrence of terms related to human resource management, artificial intelligence, decision making, machine learning, and data mining over the years. For instance, in 2023, "artificial intelligence" appears 33 times, compared to 2 times in 2019. This suggests a growing emphasis on these topics within the academic literature. Additionally, terms like "information management," and "deep learning" also demonstrate an increasing presence, indicating the expanding scope and complexity of research in this domain.

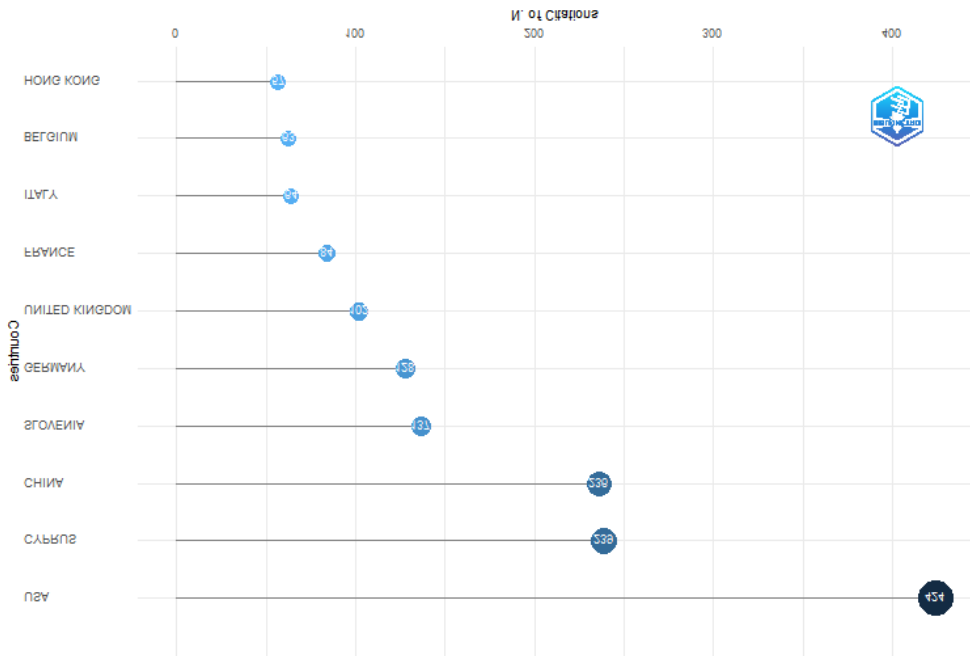


Fig. 9. Most cited countries

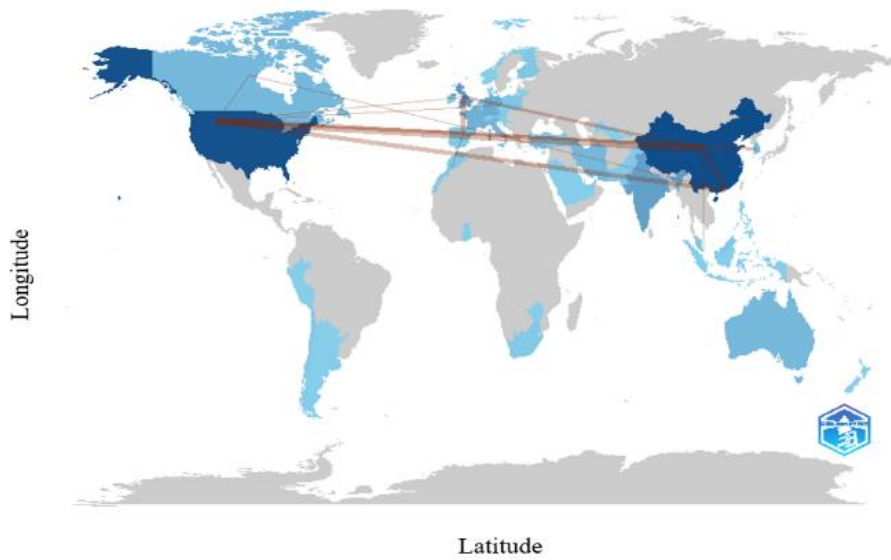


Fig. 10. Collaboration map

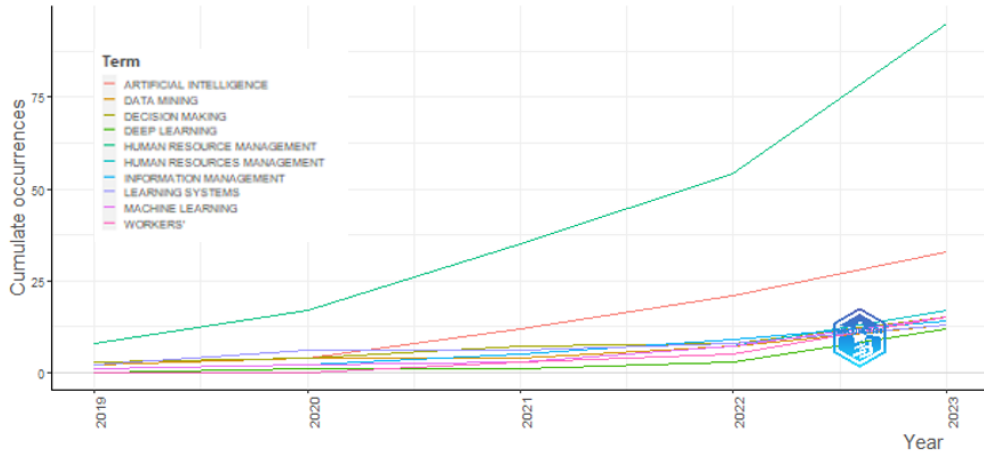


Fig. 11. Words' frequency over time

#### 4.4.2. Thematic evolution

The emergence of deep learning in 2023 represented a notable shift, rapidly intertwining with other themes such as Bayesian networks and learning systems. HRM remained a prominent theme, evolving to encompass various subtopics such as client satisfaction, employee performance, and the incorporation of AI and big data for decision-making. Moreover, themes like competition and productivity demonstrated sustained interest in organizational efficiency and collaboration. Risk management also underwent development, reflecting a broader approach to addressing occupational risks and accident prevention through the integration of AI and Bayesian networks. Overall, Fig.12 emphasizes the ongoing exploration and incorporation of AI technologies across diverse sectors, influencing how organizations approach decision-making, productivity enhancement, and risk management.

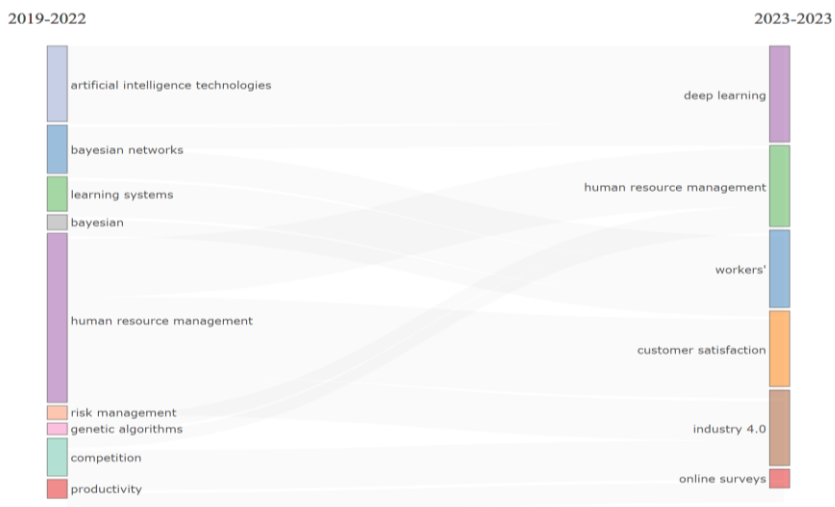


Fig. 12. Thematic evolution

### 4.4.3. Co-word net

Figure 13 represents the connecting words to depict their interrelationships. Notable connecting words such as "artificial intelligence," "customer," "information technology," and "project management" highlight the diverse skill set required in HRM. The co-word network figure reveals the intricate landscape of terms within AI and related fields, with HRM and AI emerging as central themes. Terms like decision making, learning systems, and data mining exhibit significant centrality, emphasizing their importance in AI discussions, while machine learning forms a distinct cluster, showcasing its essential role. Additionally, terms related to risk management and accident prevention underscore the integration of AI technologies into various domains to address occupational risks, ultimately illustrating the complex interplay of concepts within the AI landscape and their interconnectedness.

### 4.4.4. Thematic map

The thematic map depicted in Fig.14 highlights various trends in emerging, declining, basic, and highly developed themes within the research landscape. It indicates a decline in emphasis on themes such as industry 4.0 and sustainable development. Meanwhile, themes like customer satisfaction, deep learning, knowledge management, and performance are recognized as fundamental within the field. Notably, there is significant development and importance attributed to themes such as workers, machine learning, HRM, and AI, indicating their central role in current research discussions. On the other hand, themes like online survey, psychological empowerment, service sector, work performance, and social networking (online) appear to be highly developed but isolated, suggesting they may require further integration into broader research contexts or interdisciplinary collaboration to enhance their significance and impact within the field.

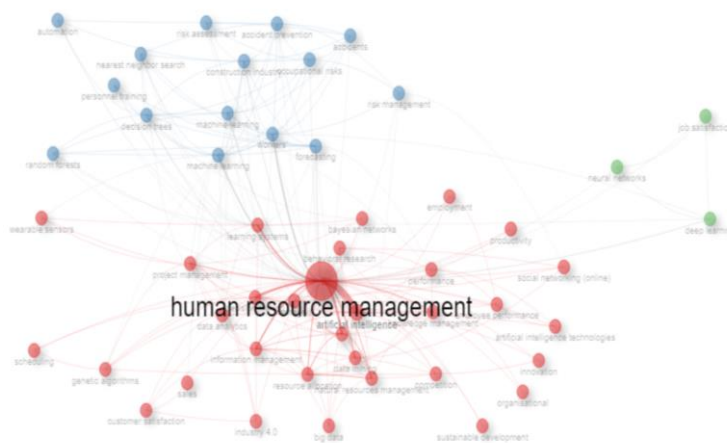
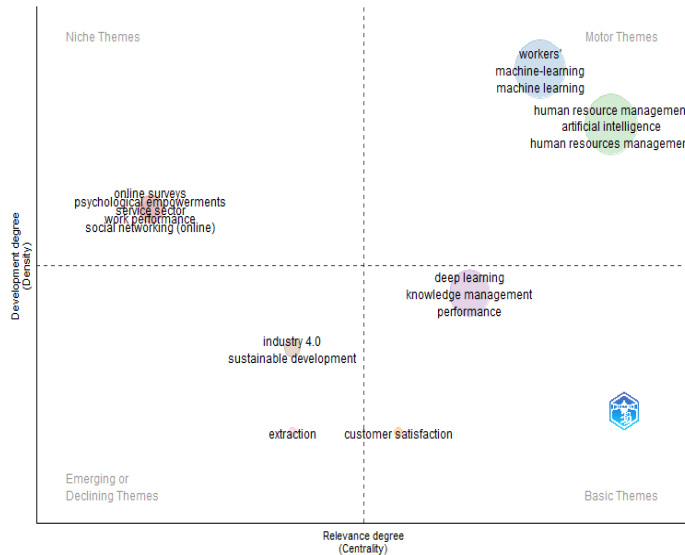


Fig. 13. Co-word net



**Fig. 14. Thematic map**

## 5. DISCUSSION

To enhance future developments in AI-driven HRM, researchers and practitioners should focus on integrating advanced machine learning techniques with human-centric approaches to create more adaptive and personalized HR solutions. Future research could explore the ethical implications of AI in HR, ensuring fairness, transparency, and inclusivity in AI-driven decisions. Additionally, expanding AI applications to areas like employee wellness, career development, and organizational culture could provide more holistic HR management. Collaborative efforts between academia, industry, and policymakers will be crucial in establishing standardized guidelines and best practices for AI integration in HRM, ensuring that these technologies are used effectively and responsibly.

The subsequent analysis unveils a significant surge in scientific publications spanning the last two decades, particularly highlighting the pervasive integration of new technologies and AI within the realm of HRM. This surge reflects a collective recognition of the transformative potential these technologies hold for reshaping HR practices and organizational dynamics. However, amidst this proliferation of research, there is an intriguing observation of fluctuating trends in average citations per year. This variability suggests a nuanced landscape wherein despite the increasing volume of research, the impact or influence of individual studies may not be consistently maintained over time. This raises questions about the depth of engagement with the subject matter and the degree of novelty or relevance of newer contributions. Moreover, the discussions on the most cited references underscore the profound impact of AI and robotics on HRM and productivity enhancement. These discussions emphasize the imperative for a thorough comprehension of their implications, not only in shaping future work practices but also in navigating the evolving landscape of employment dynamics. This call for comprehensive understanding underscores the urgency for researchers, policymakers, and industry stakeholders to delve deeper into the

ramifications of these technologies and their potential to revolutionize the workplace paradigm. Ultimately, such insights are pivotal for steering informed decision-making and fostering adaptive strategies to harness the benefits of AI and robotics while addressing potential challenges and concerns.

The data analysis reveals a widespread interest and active engagement in exploring the implications of AI technologies in HR practices, particularly evident in countries like China, the USA, and India. China's remarkable increase in research output over the years underscores the evolving nature of the field and its growing recognition. Moreover, the distribution of citations across different regions highlights the impact and recognition of research contributions worldwide, emphasizing the collaborative and globally connected nature of research in HR and AI. According to the collaboration between countries, three countries appeared, namely Hong Kong, Morocco, and France. In summary, the data portrays a vibrant and interconnected research community dedicated to advancing knowledge and understanding in this field.

The rapid integration of deep learning with themes such as Bayesian networks and learning systems coincided with HRM's evolution towards incorporating AI and big data for decision-making, customer satisfaction, and employee performance. Continued focus on competition and productivity underscored organizational efficiency, alongside a broader approach to risk management that incorporated AI and Bayesian networks. This ongoing exploration and adoption of AI technologies across sectors were evident in the co-word network, which emphasized HRM and AI as central themes and highlighted the critical role of decision-making, learning systems, and risk management in their interconnectedness within the AI landscape.

The most cited references collectively underscore the transformative impact of AI and robotics across diverse domains, particularly in HRM and productivity enhancement. They highlight the integration of AI and robotics into HRM strategies, emphasizing their role in reshaping recruitment, training, performance enhancement, and talent management processes. Moreover, the positive effects of flexibility, both temporal and geographic, on productivity and individual outcomes are emphasized. Discussions extend to the implications of AI and robotics on various industries, including hospitality, and the potential shifts in the job market, with considerations for changes in employment patterns. Additionally, the dual nature of AI in improving employee productivity through enhanced feedback quality, while also posing challenges in its disclosure, underscores the importance of careful deployment and communication strategies. These insights are drawn from the most cited references in the field, indicating their significance and widespread recognition within the academic community. Overall, these references converge on recognizing AI and robotics as pivotal forces driving significant changes in work practices and employment dynamics, urging for comprehensive understanding and management of their implications. Table 2 displays the ten most cited references, providing their titles, main ideas, and publication years.

In the future, it will be important to explore how AI affects how businesses invest money and manage their employees. Research should focus on how AI helps in deciding where to invest and how it can make HR tasks easier. Additionally, the collaboration between different countries in using AI in HR and business should be studied. However, there are challenges. While AI can help save money and make work easier, it can also create problems like job loss and privacy issues. Continued study of these issues is necessary to ensure AI is

used responsibly. By studying AI and HR, businesses can be improved, and jobs created, while ensuring everyone's rights are protected.

**Tab. 2. Presentation of the most cited references**

<b>Title</b>	<b>Main idea</b>
Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review (Vrontis et al., 2022)	The impact of AI regarding HR replacement with human-robot/AI collaboration in HRM activities.
Work-from-anywhere : The productivity effects of geographic flexibility (Choudhury et al., 2021)	The positive impact of both temporal and geographic flexibility on productivity and employees.
Text mining of industry 4.0 job advertisements (Pejic-Bach et al., 2020)	Two profiles are developed based on publicly available job advertisements based on for the type of knowledge.
Automated Action Recognition Using an Accelerometer-Embedded Wristband-Type Activity Tracker (Ryu et al., 2019)	The feasibility of employing an accelerometer in masonry work is explored through the utilization of classifiers.
Unlocking the value of artificial intelligence in human resource management through AI capability framework (Chowdhury et al., 2023)	The proposal focuses on recruitment and selection processes, training and development, evaluation and motivation, talent management and planning, and change strategies aimed at <u>facilitating its integration into these domains.</u>
Gender Matters in Hospitality (Morgan & Pritchard, 2019)	The future of hospitality gender research involves examining women's employment prospects within the industry, with AI and robotics standing out as key areas for scholars to lead discussions on gendered human experiences.
Trends And Opportunities Of Artificial Intelligence In Human Resource Management: Aspirations For Public Sector In Bahrain (Abdeldayem & Aldulaimi, 2020)	The integration of AI across all aspects of HRM, from recruitment to performance analysis and compensation, signifies a comprehensive transformation aimed at <u>optimizing talent management processes.</u>
The Robot Revolution: Managerial and Employment Consequences for Firms (Dixon et al., 2021)	A prediction that middle-skilled workers may decline while low-skilled and high-skilled workers will increase.
Energy- and labor-aware flexible job shop scheduling under dynamic electricity pricing: A many-objective optimization investigation (Gong et al., 2019)	A flexible workshop planning model, integrated with numerous objectives, considering energy and labor, to optimize production costs in a context of volatile electricity prices and wages. Through tailored algorithms and experiments, it demonstrates efficient resource allocation to minimize costs under various operational conditions.
The Janus face of artificial intelligence feedback: Deployment versus disclosure effects on employee performance (Tong et al., 2021)	AI can enhance employee productivity by improving the quality and consistency of performance feedback, but its disclosure to employees may lead to negative perceptions and reduce productivity.

## 6. CONCLUSION

The comprehensive bibliometric analysis conducted on the intersection of HRM, and new technologies provides valuable insights into the revolution state of research. The analysis revealed a significant surge in scientific publications, indicating a growing recognition of the transformative potential of AI technologies in reshaping HR practices and organizational dynamics. Despite this investigation of research, there appears to be variability in the impact of individual studies, highlighting the need for continued engagement and relevance in the field. The most cited references underscored the profound impact of AI and robotics on HRM and productivity, emphasizing the importance of understanding and managing their implications. Furthermore, the geographic distribution of research contributions highlighted the global awareness, interest, and collaborative nature of research in HR and AI, particularly in China and USA. The purpose of this analysis is to contribute to the understanding of current trends, emerging themes, and future directions in integrating AI technologies into HRM practices, enabling faster, more precise decision-making and adaptive strategies to facilitate the evolution of organizations with the assistance of HR managers.

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