Digitalization of The Industrial Revolution 4.0 Towards Improving Human Resource Management: Systematic Literature Review and Bibliometric Analysis

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ABSTRACT

This study provides an overview of the impact of Industry 4.0 digitalization on Human Resource Management (HRM) through a Systematic Literature Review. It highlights the paradigm shift induced by Industry 4.0, including the integration of technology in HRM, ethical challenges, and the role of humans in industrial digitalization. The findings indicate that industrial digitalization affects HRM and transforms organizational structures. The bibliometric analysis reveals a growing interest in this topic, with significant contributions from countries like Sweden, the United Kingdom, and Italy. The articles were published in various journal databases, with most ranked in Q1. The study concludes by emphasizing the importance of organizational adaptation to technological changes for success in a digitally connected era. This transformation presents challenges, such as changes in competency and skill demands, as well as opportunities for increased efficiency and productivity.

Keywords: Digitalization, Industrial Revolution 4.0, Human Resource Management, Systematic Literature Review

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INTRODUCTION

The Fourth Industrial Revolution has ushered in significant transformations influencing nearly every facet of human existence, particularly within businesses and organizations. This era is marked by a technological revolution characterized by advancements such as artificial intelligence, the Internet of Things (IoT), big data, automation, and hyper-connectivity. Organizations are experiencing a substantial paradigm shift in this context, presenting unprecedented challenges and opportunities. Human resource management plays a vital role in navigating these developments [1].

Haryono argues that the critical challenge for human resource management in the era of the Industrial Revolution 4.0 lies in integrating the Internet with production systems that rely on advanced technology and information [2]. The defining features of the Industrial Revolution 4.0 include digitalization, optimization, and customization of production processes, automation and adaptability, interaction between humans and machines, enhanced value creation in services and business, automatic data exchange and communication, and the application of internet technology [3].

The digitalization brought by the Industrial Revolution 4.0 presents significant opportunities to enhance efficiency and productivity in human resource management. With advancements in technology, HR can leverage data and artificial intelligence to gain deeper insights into workforce needs, make more innovative hiring decisions, manage employee training and development more efficiently, and improve the overall work experience for employees.

Agus Anggiana & Ahmad Gunawan stated that to gain a deeper understanding of the challenges and opportunities in HR management during the Industry 4.0 era, it is crucial to examine several key factors impacting this area. First, there are significant changes in how organizations operate. Second, integrating technology into HR management enables faster and more accurate decision-making. Third, ethical concerns emerge regarding the use of technology in HR practices. Finally, it is vital to consider the role of humans in collaboration with technology [1].

In the ongoing shift towards digitalization and automation, human resource management in the Industry 4.0 era faces numerous critical challenges, particularly in addressing the workforce's evolving competency and skill requirements. However, alongside these challenges, industrial digitalization 4.0 presents substantial opportunities for HR management. Advanced HR software and data analytics enable companies to track employee productivity and satisfaction trends. With access to comprehensive data, organizations can develop more innovative recruitment strategies, assess the effectiveness of training programs, and adapt swiftly to changing workforce demands. Despite the growing prominence of technology, human resources remain essential to every organization. As technology takes on a more significant role, the function of HR is undergoing a necessary transformation. In a time when innovation

and adaptability are crucial for success, companies must embrace these changes and capitalize on the opportunities they offer.

This article aims to systematically review the literature on the impact of Industrial Revolution 4.0 digitalization on human resource management. A bibliometric analysis is conducted to showcase the research developments in this area. The paper is organized into several sections, including a theoretical framework outlining each variable discussed, a systematic literature review methodology to identify the selected articles, and the presentation of results, discussion, and conclusions.

LITERATURE REVIEW

Digitalization of Industrial Revolution 4.0

Friedrich Engels and Louis Auguste Blanqui introduced the term "industrial revolution" in the mid-19th century. This revolution brought about profound changes and had a wide-reaching impact on various aspects of life, such as agriculture, manufacturing, mining, technology, transportation, and the economy. These developments stem from scientific and technological advancements, transforming life patterns towards a more modern and prosperous way of living.

Industry 4.0 is defined in various ways as it is still being researched and developed. Generally, the Fourth Industrial Revolution refers to integrating automation and cyber technology in industries. It highlights the trend of automation and data exchange within manufacturing technology. This concept encompasses cyber-physical systems, the Internet of Things (IoT), cloud computing, and cognitive computing. German Chancellor Angela Merkel described Industry 4.0 as a comprehensive transformation of all aspects of industrial production by merging digital and Internet technologies with traditional industrial infrastructure [4].

Herman explained that the Fourth Industrial Revolution refers to the digital industrial era, where all components work together and communicate in real-time, anytime and anywhere, through information technology (IT) like the Internet, CPS, IoT, and iOS. This collaboration and communication are designed to foster innovation and enhance operational efficiency and effectiveness [4].

Zesulka indicated that Industry 4.0 is realized through three interconnected aspects: 1) digitalization and economic interactions, which evolve from basic techniques to more complex economic networks; 2) the digitalization of products and services; and 3) the adoption of new market models [5]. Sung noted that machines can operate autonomously or collaborate with humans. Furthermore, Industry 4.0 is defined by the growing digitalization within the manufacturing sector, driven by four primary factors: 1) an increase in data volume, computing power, and connectivity; 2) the development of analytics capabilities and business intelligence; 3) the emergence of new interactions between humans and machines; and 4) advancements in the digital transmission of instructions to the physical world [6].

Indonesia must align with global trends to remain competitive in the industrial sector. The Fourth Industrial Revolution represents a transformative step towards enhancing performance by merging the digital realm with industrial production lines. In this revolution, all production processes are linked to the Internet as the core infrastructure, enabling companies to attain higher efficiency and effectiveness in their operations.

Human Resource Management

Faustino defined Human Resource Management (HRM) as effectively developing and utilizing employees to accomplish goals and objectives. This applies at various levels, including individual, organizational, community, national, and international [7]. Human Resource Management (HRM) encompasses a range of activities focused on workforce oversight within organizations. These activities include recruitment, employee transfers, and overall personnel management. HRM is tasked with creating, implementing, and overseeing employee-related policies and managing the dynamics between the company and its staff. A key responsibility of HRM is designing an effective organizational structure to support operations. As a discipline, HRM plays a crucial role in nurturing and maximizing the workforce's potential, recognizing employees as valuable assets to the company.

The workforce and HR practices can foster a high-performance culture and continuous organizational improvement. Innovative approaches to human resource management and employee engagement often lead to enhanced organizational performance. The significance of HR management practices continues to grow in the era of globalization, which brings numerous challenges for organizations striving to survive in an intensely competitive landscape. HR practices focusing on people, performance, information, and work processes create an environment and infrastructure that significantly impacts employees, customers, organizational effectiveness, and overall performance. These practices are crucial in shaping the organization's ability to thrive in today's dynamic business world [8]. Initiating and implementing optimal human resource management practices can yield multiple benefits for an organization. These include enhanced employee relations, improved financial performance, and increased workforce productivity. Ultimately, these factors contribute to the overall success of the company. Organizations must recognize the importance of investing in such practices, which are critical drivers in gaining a competitive edge in the marketplace.

Human resource management practices are vital in fostering employee engagement across all sectors. Research has shown that specific HR practices, including compensation strategies, job security measures, and performance management systems, significantly influence employee engagement. This, in turn, substantially impacts the organization's overall performance. Jefri and Pontoh highlight that the achievement of organizational objectives is inextricably linked to the effective management of human resources. This underscores the critical role that HR practices play in driving organizational success

through enhanced employee engagement and performance [9]: "The role of human resources is paramount in achieving organizational goals, as these objectives are seldom accomplished by human resources working in isolation." Human resource management practices also play a crucial role in enhancing employee commitment to the organization. Models developed from extensive research demonstrate that HR practices are consistently at the core of every organization's operations. These practices have a direct correlation with employee engagement levels, which in turn leads to improved employee retention and enhanced organizational performance. This underscores the vital link between effective HR management, employee engagement, and overall organizational success [8].

In the current era of Industry 4.0, advancing digitalization significantly influences human resource management. Human Resource Management (HRM) in the context of Industry 4.0 digitalization adopts a strategic approach that leverages digital technologies such as artificial intelligence (AI), Internet of Things (IoT), big data analytics, and automation to enhance workforce management and development. This involves implementing digital tools and systems across various HR functions, including recruitment, training, performance evaluation, and employee engagement. The primary goal is to boost operational efficiency, productivity, and overall organizational performance. By integrating these advanced technologies, HRM in the Industry 4.0 era aims to foster a more adaptable, responsive, and innovative work environment. This approach enables organizations to meet the challenges of modern business landscapes and maintain global competitiveness.

RESEARCH METHODS

This study employs a qualitative research methodology, precisely a systematic literature review approach. The research process involves three key stages, as illustrated in Figure 1, executed using the Website http://watase.web.id/. These stages comprise literature identification, screening, and analysis of results.

This structured approach allows for a comprehensive review and analysis of relevant literature on the research topic.

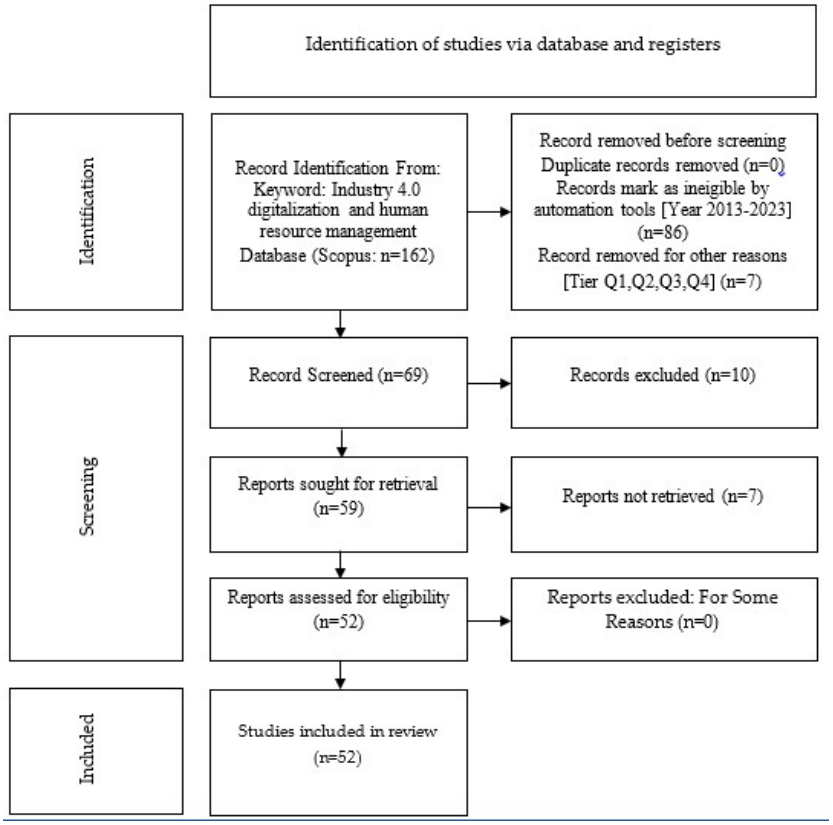


Figure 1. Statges of The Method Used

The initial stage of our research involved identifying relevant literature using the keyword "Industry 4.0 digitalization and human resource management." From an initial pool of 162 articles, 93 were excluded due to various criteria, including publication date outside the 2013-2023 timeframe and lack of quartile information.After thoroughly reviewing titles, abstracts, and themes, 69 articles were selected for further analysis. However, ten were removed due to their irrelevance to the research topic. A subsequent search of various academic databases yielded 52 additional articles, although seven were discarded due to access restrictions.The final dataset of 52 articles formed the basis for our systematic bibliometric Analysis of Industry 4.0 digitalization and human resource management.

RESULTS & DISCUSSION

Based on the screening results, there were 52 articles in Table 1:

Table 1. Results of Systematic Literature Review

No	Authors	Journal Publication	Rank	Title	Main Findings
1	Ghobaklhoo Morteza et al., 2024[10]	Information Systems Frontiers	Q1	From Industry 4.0 Digital Manufacturing to Industry 5.0 Digital Society: a Roadmap Toward Human-Centric, Sustainable, and Resilient Production	This research outlines a path to a more human-focused, environmentally friendly, and adaptable industrial future capable of tackling global issues like climate change and social disparities.
2	Hansen Andreas Kornmaaler et al., 2024[11]	International Journal of Production Research	Q1	Technology is needed for Industry 4.0: on SMEs and hindrances to digital transformation.	The study highlights the importance of a comprehensive strategy, including training, cultural shifts, and Government assistance, to enable small and medium-sized enterprises to address challenges and effectively adopt Industry 4.0 technologies.
3	Mariem Belgith and Sana Bouajaja, 2024[12]	Annales Pharmaceutiques Francaises	Q3	Implementation of an Advanced Planning and Scheduling System in a Pharmaceutical Context	The study demonstrates that Advanced Planning Systems (APS) enhance inventory management, minimize downtime, and foster interdepartmental collaboration. Consequently, pharmaceutical firms can achieve more efficient, coordinated production, lower costs, and elevate service quality, ultimately increasing customer satisfaction.
4	Ashutosh Samadhiya et al., 2024[13]	TQM Journal	Q2	Integrating Industry 4.0 and Total Productive Maintenance for Global Sustainability	The study suggests that merging Industry 4.0 principles with Total Productive Maintenance (TPM) can enhance global Sustainability by boosting operational efficiency and minimizing environmental harm. This integration enables real-time monitoring, predictive analytics, and automated maintenance processes, substantially reducing equipment downtime and maintenance expenses.
5	Mattia Casini et al., 2024[14]	Energy Efficiency	Q2	Machine Learning and image analysis towards improved energy management in Industry 4.0: a practical case study on quality control	The research indicates that machine learning and image analysis can substantially enhance energy management and quality control within Industry 4.0.
6	Salvatore Ammirato et al., 2023[15]	Journal of Innovation & Knowledge	Q1	Still our most crucial asset: A systematic review on human resource management amid the	The study reveals that despite the rise of automation and AI in the Fourth Industrial Revolution, human resources management

No	Authors	Journal Publication	Rank	Title	Main Findings
				fourth industrial revolution	(HRM) continues to be a crucial factor in organizational success.
7	Marina Dabic et al., 2023[16]	Journal of Innovation & Knowledge	Q1	Future of digital work: Challenges for sustainable human resources management	The study pinpoints the primary challenges encountered by the human resources (HR) department in managing a growingly interconnected and diverse workforce. These challenges encompass the need to develop digital skills, maintain a harmonious equilibrium between work flexibility and the necessity for stability, and tackle issues about privacy and data security.
8	Adriana Hofmann Trevisan et al., 2023[17]	Journal of Environmental Management	Q1	Barriers to employing digital technologies for a circular economy: A multi-level perspective	The study elucidates the primary hindrances in implementing digital technology to establish a circular economy, considering factors from diverse structural, organizational, and individual perspectives.
9	Joselia Elvira Teixeira and Ana Teresa Tavares, 2023[18]	Competitiveness Review	Q2	Industry 4.0: the future of manufacturing from the perspective of business and economics – a bibliometric literature review	The study pinpoints emerging domains, such as the influence of digital technology on production processes, labour dynamics, and global supply chains. Simultaneously, it acknowledges the necessity for further investigation into the socioeconomic ramifications and policy framework encompassing the adoption of Industry 4.0 technology.
10	Awadesh Kumar Malik, 2023[19]	Results in Engineering	Q1	The future of technology-based manufacturing in the European Union	The study demonstrates the robust, innovative impetus and growth prospects of artificial intelligence, the Internet of Things, and additive manufacturing technologies. Moreover, the research underscores the necessity to surmount technical skills deficiencies, incomplete standardization, and regulatory ambiguity.
11	Amaya Erro Garces and Maria Elena Aramendia Muneta, 2023[20]	Journal of Organizational Change Management	Q2	The role of human resource management practices on the results of digitalization. From Industry 4.0 to Industry 5.0	The study reveals that effective human resource management, encompassing the development of technology-relevant skills, creating an inclusive work culture conducive to innovation, and adjusting organizational structures, can significantly

No	Authors	Journal Publication	Rank	Title	Main Findings
					contribute to the successful implementation of digital technology and adaptation to the evolving workplace.
12	Lindstrom Veronica et al., 2023[21]	Computers in Industry	Q1	Data quality issues in production planning and control – Linkages to smart PPC	The study underscores the significance of data integrity, accuracy, and consistency in guaranteeing the effective implementation of intelligent production planning and control systems (PPCs).
13	Melberg Kjersti and Gressgard Leif Jarle, 2023[22]	Cognition, Technology and Work	Q1	Digitalization and changes to work organization and management in the Norwegian petroleum industry	The study demonstrates that digitization has substantially transformed the workplace landscape, influencing workers' engagement with technology, work processes, and organizational structures.
14	Milichovsky Frantisek and Kuba Karel, 2023[23]	Processes	Q2	Expected Impact of Industry 4.0 on Employment in Selected Professions in the Czech Republic and Germany	The study underscores significant shifts in the structure and demands of the workforce stemming from theadoption of advanced technologies such as automation, artificial intelligence, and robotics.
15	Kambur Emine and Yildirim Tulay, 2022 [24]	International Journal of Manpower	Q2	From traditional to smart human resources management	The study incorporates advanced analytics, artificial intelligence, and digital platforms to streamline HR processes such as recruitment, performanceevaluation, and talent development. Innovative HR prioritizes proactive decision-making, personalized employeeexperiences, and continuous learning and adaptation to fulfil the requirements of ever-expanding organizations.
16	Saniuk Sebastian et al., 2023[25]	Mobile Networks and Applications	Q2	Knowledge and Skills of Industrial Employees and Managerial Staff for the Industry 4.0 Implementation	The study underscores the significance of industry employees and managerial staff possessing the knowledge and skills necessary for implementing Industry 4.0, emphasizing the importance of their comprehension and preparedness for the novel technologies and concepts associated with this industrial revolution.
17	Juliana Salvadorinho	Sustainability	Q2	Happy and Engaged Workforce in Industry	The study summarizes the theoretical and practical trends

No	Authors	Journal Publication	Rank	Title	Main Findings
	and Leonor Teixeira, 2023[26]			4.0: A New Concept of Digital Tool for HR Based on Theoretical and Practical Trends	that have led to the development of digital tools, enabling companies to manage aspects such as recruitment, employee development, and labour retention moreeffectively.
18	Mazurchenko A and Zalenka M, 2022[27]	Central European Business Review	Q3	Employees' Digital Competency Development In The Construction And Automotive Industrial Sectors	The survey highlights the necessity of investing in ongoing training and learning to enhanceemployees' capacity to adapt to digital transformation within the workplace.
19	Veronika Bikseet al., 2022[28]	Sustainability	Q2	Consequences and Challenges of the Fourth Industrial Revolution and the Impact on the Development of Employability Skills	The study underscores thenecessity of modifying educational and training curricula to equip individuals with skills aligned with technological advancements, such as artificial intelligence, robotics, and data analytics.
20	LBP da Silva et al., 2022[29]	Computers & Industrial Engineering	Q1	Human resources management 4.0: Literature review and trends	The study demonstrates a paradigm shift in human resources management (HRM) towards a more technology-integrated, data-driven, and strategic approach. The literature review underscores the applications of technologies such as artificial intelligence, data analytics, and digital platforms in diverse facets of HRM, including recruitment, employee development, and performance management.
21	Afriyadi Cahyadi et al., 2022[30]	Economics	Q2	Leadership Styles, High-Involvement Human Resource Management Practices, and Individual Employee Performance in Small and Medium Enterprises in the Digital Era	The study emphasizes the significance of incorporating leadership styles that foster employeeempowerment and employee participation-centred human resources management practices to enhance individual performance within the continually evolving digital technology context.
22	Jorge Heredia Perez et al., 2022[31]	International Journal of Technology	Q2	A Configuration Approach to Reduce the Risk of COVID-19 Employee Infection in Manufacturing Firms: The Role of Machine Automatization	The study demonstrates that integrating automated machines can reduceemployees' risk of virus exposure by minimizing physical contact and human interaction.

No	Authors	Journal Publication	Rank	Title	Main Findings
23	Anastasiia Mazurchenko and Martin Zelenka, 2022[27]	Central European Business Review	Q3	Employees' Digital Competency Development In The Construction And Automotive Industrial Sectors	The study underscores the necessity of investing in ongoing training and learning to enhanceemployees' capacity to adapt to digital transformation within the workplace.
24	Madhan Jeyaraman et al., 2022[32]	Indian Journal of Orthopaedics	Q3	Industry 5.0 in Orthopaedics	The study is within the domain of orthopaedics, encompassing the integration of novel technologies like artificial intelligence, robotics, and 3D modelling to enhance the production process and patient care.
25	Kolmykova Marina et al., 2022[16]	Human Systems Management	Q2	Transformation of management culture in the context of supply chain digitalization	The study underscores that digitization catalyzes a metamorphosis of a management culture more receptive to collaboration, adaptation to technological change, and data-driven decision-making.
26	Hadi Balouei Jamkhaneh et al., 2021[33]	TQM Journal	Q2	The new concept of quality in the digital era: a human resourceempowerment perspective	The study demonstrates that quality is not solely associated with products or services in digital transformation but also with employees' experiences and capacity to adapt to technological change.
27	Trzaska Rafal et al., 2021[34]	Energies	Q1	Digitalization business strategies in theenergy sector: Solving problems with uncertainty under industry 4.0 conditions	The study demonstrates that digitization offers potential solutions to manage uncertainty within theenergy sector by implementing technologies such as sensing, real-time monitoring, and sophisticated data analytics.
28	Rohit Kumar Singh et al., 2021[35]	International Journal of Manpower	Q2	Developing human capital 4.0 in emerging economies: An Industry 4.0 perspective	The study underscores the necessity of investing in developing skills and knowledge pertinent to advanced technologies such as artificial intelligence, data analytics, and digital manufacturing to equip the workforce for rapid industrial change.
29	Saifuddin Asep et al., 2021[36]	International Journal of Data and Network Science	Q2	Hospital digitalization in theera of Industry 4.0 based on GHRM and service quality	The study underscores that digitization empowers hospitals to enhance operational efficiency, improve patient access, and elevate patient satisfaction. By integrating Green Human Resources Management (GHRM) and prioritizing service quality,

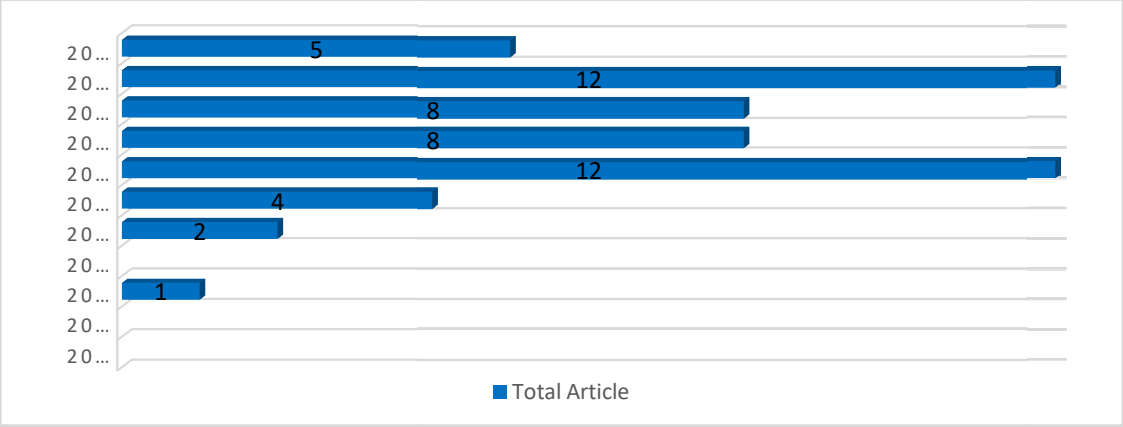
No	Authors	Journal Publication	Rank	Title	Main Findings
					hospitals can ensure the optimal utilization of technology while preserving the human aspects of healthcare.
30	Robin von Haartman et al., 2021[37]	International Journal of Services and Operations Management	Q3	Lean practices and the adoption of digital technologies in production	The study demonstrates that integrating digital technologies such as the Internet of Things (IoT), data analytics, and artificial intelligence can enhanceefficiency, visibility, and flexibility in implementing lean practices.
31	Demeter Krisztina et al., 2021[38]	Journal of Manufacturing Technology Management	Q1	Road to digital manufacturing – a longitudinal case-based analysis	The study elucidates the advancements, challenges, and advantages encountered by these companies during their transition toward digital manufacturing. It underscores the significance of managing change, investing in technology-proficient human resources, and establishing strategic partnerships with technology solution providers.
32	Bolek Vladimir et al., 2021[39]	Ekonomicky Casopis	Q4	The Requirements for Knowledge and Skills of Managers in ICT Modified Fourth Industrial Revolution	The study underscores the need for managers to comprehend contemporary information technology advancements, such as artificial intelligence, data analytics, and cloud computing, in conjunction with leadership skills that empower them to manage teams and projects within a perpetually evolving and dynamic environment.
33	Patricia Riccardo et al., 2021[40]	Safety Science	Q1	WAx: An integrated conceptual framework for the analysis of cyber-socio-technical systems	The WAx framework, which examines the interplay between humans, technology, and social contexts, aids in comprehending the influence of technology on human behaviour, organizational dynamics, and public policy.
34	Eko Bambang Wibowo et al., 2020[41]	International Journal of Advanced Science and Technology	Q4	Industry 4.0: Challenges and Opportunities in Competency Development for Defense Apparatus' Human Resources	The study underscores the necessity of modifying educational and training curricula to equip defence personnel with skills pertinent to advanced technologies such as artificial intelligence, robotics, and cybersecurity.
35	Violeta Sima et al., 2020[42]	Sustainability	Q2	Influences of the Industry 4.0 Revolution on Human Capital Development and Consumer Behavior: A	The study pinpoints that substantial technological shifts, such as artificial intelligence, the Internet of Things, and additive

No	Authors	Journal Publication	Rank	Title	Main Findings
				Systematic Review	manufacturing, have transformed the business landscape and influenced the skills demanded by the workforce, as well as consumer preferences and behaviour.
36	Papetti Alessandra et al., 2020[43]	Journal of Computational Design and Engineering	Q1	A method to improve workers` well-being toward human-centred connected factories	The study underscores the necessity of prioritizing workers' psychological and physical well-being in factory environments increasingly integrated with technology.
37	Joao Barata et al., 2020[44]	Journal of Manufacturing Technology Management	Q1	Evolving manufacturing mobility in Industry 4.0: the case of process industries	The study underscores how technologies like the Internet of Things (IoT), sensing, and data analytics have transformed operational mobility and decision-making within the process industry.
38	Amelia Manuti and Dalila Monachino, 2020[45]	East European Journal of Psycholinguistics	Q2	Managing knowledge at the time of artificial intelligence: An explorative study with knowledge workers	The study underscores the challenges and opportunities that emerge in managing knowledge as AI becomes increasingly integrated into decision-making and data analysis. It pinpoints the significance of collaboration between AI and knowledge workers in harnessing technology to generate more profound insights and practical solutions.
39	Fareri S et al., 2020[46]	Computers in Industry	Q1	Estimating Industry 4.0 impact on job profiles and skills using text mining	The research proposes that this methodology can identify trends and patterns from diverse textual sources, encompassing job descriptions and industry reports, to ascertain the transformations instigated by the Industrial Revolution.
40	Found Paulineet al., 2020[47]	TQM Journal	Q2	Exploring product–service systems in the digital era: a socio-technical systems perspective	The study underscores the intricate interplay between technical and social factors in the design, implementation, and utilization of product-service systems.
41	Nwaiwu Fortuneet al., 2020[48]	Business: Theory and Practice	Q3	Industry 4.0 concepts within the Czech sme manufacturing sector: An empirical assessment of critical success factors	The study pinpoints the factors influencing the adoption and application of Industry 4.0 technology, including technological infrastructure, leadership, organizational culture, and employee competence.

No	Authors	Journal Publication	Rank	Title	Main Findings
42	Verma Anju et al., 2020[49]	Strategic Direction	Q4	Industry 4.0: reshaping the future of HR	The study underscores significant shifts in human resources (HR) duties and responsibilities resulting from the adoption of technologies such as artificial intelligence, data analytics, and digital platforms.
43	Blstakova Jana et al., 2020[50]	Sustainability	Q1	Reflection of digitalization on business values: The results of examining values of people management in a digital age	The study underscores how traditional values in human resource management are reflected and transformed within business digitization. The study pinpoints shifts in values such as flexibility, collaboration, innovation, and employeeengagement in response to digital technology's demands and novel opportunities.
44	Bokrantz Jon et al., 2020[51]	International Journal of Production Economics	Q2	Smart Maintenance: an empirically grounded conceptualization	The study underscores integrating digital technologies, such as the Internet of Things (IoT) and data analytics, with conventional care practices to enhanceefficiency, timeliness, and predictability in maintaining industrial machines and equipment.
45	Santoso Wibowoet al., 2020[52]	Journal of Science and Technology Policy Management	Q2	Talent mapping: a strategic approach toward digitalization initiatives in the banking and financial technology (FinTech) industry in Indonesia	The study underscores the significance of meticulous talent mapping to identify skill requirements pertinent to digital technologies, such as artificial intelligence, data analytics, and programming.
46	Capt Gusrah et al., 2019[53]	International Journal of Recent Technology and Engineering	Q4	Challenges of the Indonesian Bureaucracy in the Industrial Revolution Era 4.0	The study underscores the necessity for structural, policy, and cultural transformations within the bureaucracy to accommodate the shifts driven by digital technology.
47	Li Dan et al., 2019[47]	International Journal of Advanced Manufacturing Technology	Q1	Current and future Industry 4.0 capabilities for information and knowledge sharing: Case of two Swedish SMEs	The study underscores the necessity of integrating digital technologies such as the Internet of Things (IoT) and data analytics with existing knowledge management practices to foster collaboration and innovation among employees and enhance

No	Authors	Journal Publication	Rank	Title	Main Findings
					responsiveness to market fluctuations.
48	Tatyana Kolmykova and Ekaterina Merzlykova, 2019[54]	Economic Annals-XXI	Q3	Human role in the modern robotic reproduction development	The study underscores the significance of collaboration between humans and technology in developing sophisticated robotic systems and the necessity of focusing on ethical considerations and the societal implications of utilizing robots in contemporary societies.
49	Belli Laura et al., 2019[55]	Frontiers in ICT	Q2	Toward Industry 4.0 With IoT: Optimizing Business Processes in an Evolving Manufacturing Factory	The study underscores the application of Internet of Things (IoT) solutions to acquire real-time data, enhance operational visibility, and facilitate faster and more accurate decision-making.
50	Wilkesmann Maximiliane and Walkiesmann Uwe (2018)[56]	VINE Journal of Information and Knowledge Management Systems	Q2	Industry 4.0 – organizing routines or innovations?	The study underscores the intricate nature of implementing IoT technology as a component of the Industry 4.0 transformation, where companies confront the challenge of modifying traditional operational routines while nurturing novel innovations.
51	Stefan Strohmeier (2018)[57]	The International Journal of Human Resource Management	Q1	Smart HRM – a Delphi study on the application and consequences of the Internet of Things in Human Resource Management	The study underscores the potential of the Internet of Things (IoT) to enhance theefficiency of human resources management (HRM) processes, including real-time assessment of employee performance, health and well-being monitoring, and data analysis for more informed decision-making.
52	C Plass ,2016[58]	ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb	Q2	Working in a networked manner: How digitalization and Industry 4.0 change the working world	The research highlights that digital technologies and the Industry 4.0 concept enable more flexible and distributed collaboration among workers, expanding traditional boundaries of the workplace.

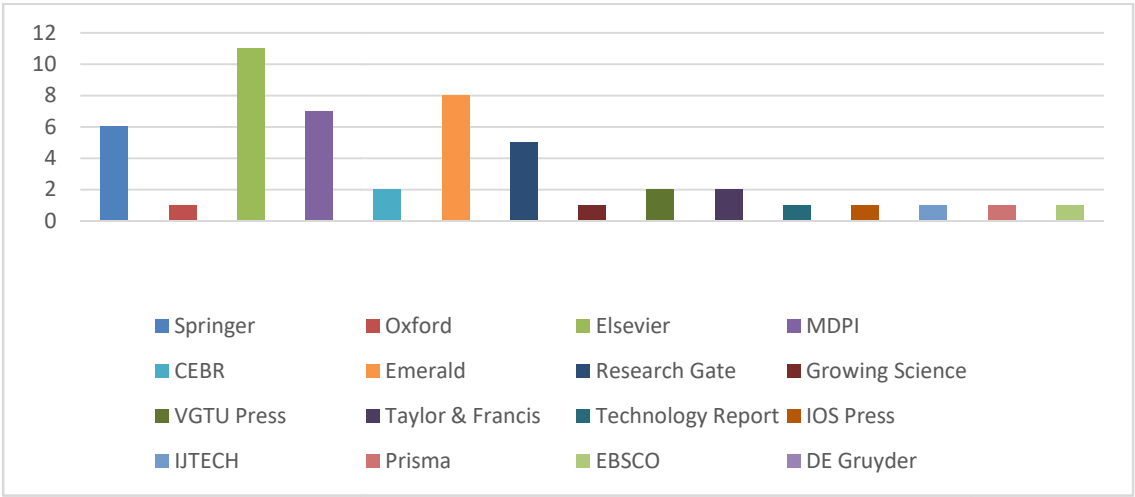
This section will display the bibliometric analysis results, including temporal distribution, journal database, and journal rankings in Scopus. By selecting articles based on journal publications, indexes, and titles, this table provides a solid basis for conducting a Systematic Literature Review regarding the impact of the Industrial Revolution 4.0 digitalization on human resource management. The selected studies cover a wide range of international perspectives and significant, relevant topics, allowing for a comprehensive and in-depth analysis of this issue.



Source: Data processed, 2024

Figure 2. Distribution of Articles Published Each Year

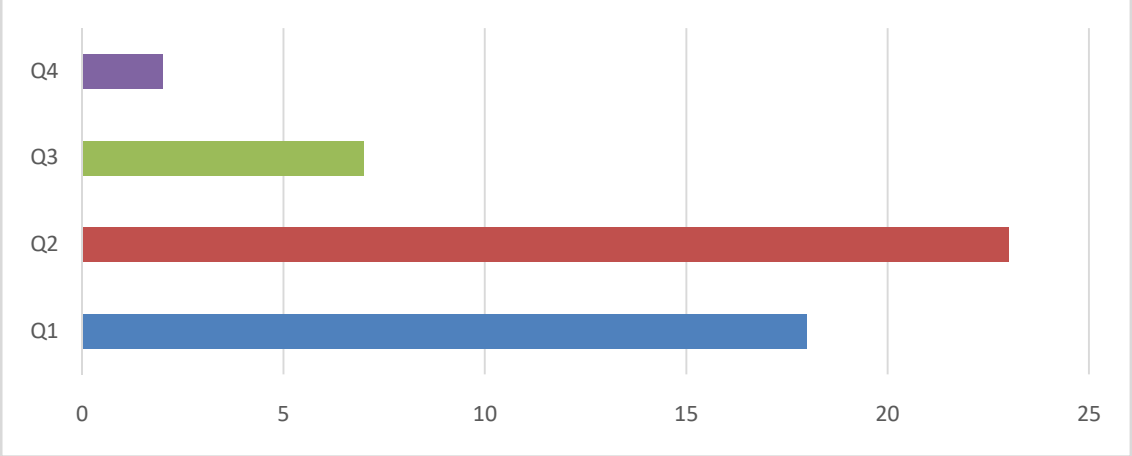
In Figure 2, Based on this data, it can be seen that during the last ten years, articles discussing the digitalization of the Industrial Revolution 4.0 regarding human resource management have only begun to be published again in 2016. Based on this data, the most frequent publications related to the digitalization of the Industrial Revolution 4.0 on human resource management were in 2020 and 2023, with 13 locations each.



Source: Data processed in 2024

Figure 3. Distribution Based on Database

In Figure 3, from the data processing results related to the publication of articles based on data-based journals, the results obtained were that Elsevier had eleven publications associated with the digitalization of the industrial revolution 4.0 towards human resource management. Furthermore, Emerald has eight publications, MDPI has seven, and Springer has six. Apart from that, Research Gate, VGTU Press and Taylor & Francis, Technology Report, and IOS Press, Oxford, CEBR, IJTECH, Prisma, EBSCO, and DE Gruyter each published no more than five articles.



Source: Data processed, 2024

Figure4 . Distribution of Articles Based on Journal Ranking

In Figure 4, the processed article distribution data results based on journal rankings show that articles with a Q2 ranking are the most numerous, with twenty-three published articles. Next is the Q1 ranking with eighteen published articles, and finally, the Q3 ranking with seven publications and Q4 with four published articles.

CONCLUSION

The research findings underscored the significance of comprehending the impact of Industrial Revolution 4.0 digitalization on human resource management (HRM). A qualitative research approach, employing a systematic literature review, was utilized within this context to investigate this topic meticulously. The article delves into several noteworthy findings derived from the research results:

1. The study underscores the necessity of confronting the challenges and opportunities of Industrial Revolution 4.0 within human resource management. Enhancing efficiency and productivity constitutes one of the primary opportunities afforded by the digitalization of this industry. Nevertheless, challenges such as shifts in workforce competency and skill demands necessitate careful consideration.

2. Integrating technology within human resource management facilitates faster and more accurate decision-making. This signifies a transition towards utilizing digital tools and systems for diverse facets of HRM, encompassing recruitment, training, and performance management.
3. Utilizing technology within human resource management is linked to ethical challenges. This underscores the necessity of considering ethical aspects during technology implementation in HRM processes to safeguard employee interests.
4. The study underscores the significance of prioritizing the role of humans in collaborating with technology. Despite theescalating technological advancement, human resources remain invaluable assets within every organization. Consequently, it is imperative to embrace these transformations and capitalize on emerging opportunities by focusing on the role of humans within the context of industrial digitalization.

The study further revealed that beyond technology, human resource management development is indispensable for realizing Industry 4.0 [11]. The digitalization of the Industrial Revolution 4.0 has significantly influenced the development of human resource management and the formation of solid and sustainable human resources [10]. Beyond its influence on human resource management, the digitalization of the Industrial Revolution 4.0 also substantially impacts organizational transformations [22].

Additionally, the bibliometric analysis results demonstrated that these articles were disseminated across diverse journal databases, with a preponderance of articles categorized as Q1, signifying the quality and relevance of this research within an academic context. In summary, this research furnishes valuable insights into the impact of Industrial Revolution 4.0 digitalization on HRM. It underscores the significance of comprehending the challenges and opportunities associated with this transformation within human resource management:

1. The article concludes that the digitalization of the Industrial Revolution 4.0 has transformed the paradigm of human resource management (HRM), with technology integration becoming an indispensable component of HRM.
2. Key findings underscore challenges such as the need for altered competencies and skills and opportunities to increaseefficiency and productivity. Technology integration facilitates faster and more informed decision-making but also presents ethical challenges that must be addressed. Despite the advancement of technology, human capital remains invaluable, a factor that needs to be considered within the context of industrial digitalization.
3. Furthermore, the impact of Industry 4.0 digitalization extends to the organization. Bibliometric analysis reveals a growing interest in the literature on this topic, with significant contributions from various countries.

4. Overall, this article provides valuable insights into the impact of the digitalization of the Industrial Revolution 4.0 on HRM, highlighting the challenges and opportunities associated with this transformation within the realm of human resource management.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Ayu Nurfadilah: Conceptualization, Supervision, Data Curation, Formal Analysis, Project Administration, Writing-original Draft, and Writing-review Editing. **Dwi Dian Pratiwi**: Conceptualization, Resources, Software, Validation, Visualization, and Writing-review Editing. **Grace T. Pontoh, and Aini Indrijawati**: Funding Acquisition, Investigation, Writing-original Draft, and Writing-review Editing.

DECLARATION OF COMPETING INTEREST

The author declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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