Mini Review



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# Unveiling the Transformative Effects of Industry 4.0 on Human Resource Management: A Comprehensive Review

# Abstract

**Purpose and Nature:** This review paper aims to analyze the impact of Industry 4.0 on Human Resource Management (HRM) functions. As a critical function in organizations, HRM has been significantly impacted by the digital transformation brought about by Industry 4.0.

**Approach:** To achieve the purpose, this paper reviews 50 articles on the topic and identifies critical factors and challenges HR professionals face in managing the digital transformation of HRM functions. The methodology adopted is a systematic review of the literature on the impact of Industry 4.0 on HRM.

**Key Findings**: The findings suggest that Industry 4.0 has enabled HR professionals to automate and streamline recruitment processes, provide opportunities for remote learning and personalized training, enable real-time monitoring of employee performance, allow for more personalized and flexible compensation packages, provide real-time data on workforce trends, and allow for more objective and data-driven succession planning.

**Challenges and Suggestions:** The use of Technology in HRM also poses challenges, such as reducing the importance of human interaction and decision-making, increased surveillance and stress, and the need for HR professionals to have a better understanding of technology. To cope with these challenges, HR professionals need to balance technology and human interaction, invest in developing digital skills, and ensure that the use of technology is ethical and compliant with privacy laws.

**Implications and Originality:** The paper concludes with implications for HR professionals and future research directions. The study highlights the importance of HR professionals in managing the digital transformation of HRM functions and the need for them to adapt to new technologies. The paper's originality lies in the systematic review of the literature on the impact of Industry 4.0 on HRM and the identification of critical factors and challenges HR professionals face in managing digital transformation.

Keywords: Industry 4.0; HRM functions; Technology; Transformation

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# Introduction

The emergence of Industry 4.0 has brought about significant changes in the way organizations operate and manage their workforce. Industry 4.0 refers to the integration of advanced technologies, such as Artificial Intelligence (AI), the Internet of

Things (IoT), robotics, and automation, into the manufacturing process (Kagermann et al., 2013). This integration has led to the creation of intelligent factories which can optimize the manufacturing process, improve efficiency, reduce costs, and increase productivity. The adoption of Industry 4.0 has profoundly

impacted Human Resource Management (HRM) functions. HRM is

a critical function that manages the organization's workforce and plays a vital role in ensuring the organization's competitiveness and success. In the past, HRM functions were mainly focused on recruiting, training, and retaining employees. Yet, with the advent of Industry 4.0, HRM functions have become more complex and multi-faceted. Integrating advanced technologies has led to new job roles and the transformation of existing ones. Al and robotics have enabled the automation of repetitive and mundane tasks, freeing employees to focus on more complex and value-adding tasks. This has led to new job roles such as data analysts, automation engineers, and machine learning specialists. On the other hand, the transformation of existing job roles has resulted in changes in the skills required for different job roles. HR professionals must know these changes and adapt their HRM strategies to meet the new requirements [1].

The purpose of this review paper is to analyze the impact of Industry 4.0 on HRM functions. The paper will start by providing an overview of Industry 4.0 and its key technologies. It will then examine the impact of Industry 4.0 on different HRM functions, including recruitment and selection, training and development, performance management, and employee engagement. The paper will also discuss the challenges and opportunities of adopting Industry 4.0 in HRM functions. Finally, the paper will conclude by providing recommendations for HR professionals to manage their workforce in the context of Industry 4.0 effectively [2].

The review paper is organized as follows. The first section provides an overview of Industry 4.0 and its key technologies. The second section examines the impact of Industry 4.0 on recruitment and selection processes. The third section discusses the impact of Industry 4.0 on training and development. The fourth section examines the impact of Industry 4.0 on performance management. The fifth section discusses the impact of Industry 4.0 on employee engagement. The sixth section discusses the challenges and opportunities of adopting Industry 4.0 in HRM functions. The seventh section provides recommendations for HR professionals to manage their workforce in the context of Industry 4.0 effectively [3].

# **Literature Review**

Industry 4.0, the fourth industrial revolution, is characterized by integrating advanced technologies such as artificial intelligence, robotics, and the Internet of Things into manufacturing processes. The impact of Industry 4.0 extends beyond production and affects other organizational functions such as human resource management (HRM). This literature review aims to analyze the impact of Industry 4.0 on six essential HRM functions: recruitment, training and development, performance management, compensation and benefits, employee engagement and motivation, and workforce and succession planning, based on a review of 50 articles.

Recruitment is a critical HRM function that has been significantly impacted by Industry 4.0. Advanced technologies such as AI and automation have enabled HR professionals to automate and streamline recruitment processes, resulting in improved efficiency. For instance, AI-powered chatbots can handle initial candidate screening, scheduling of interviews, and sending out interview reminders. This reduces the time and effort required for recruitment [4]. The increased use of technology in recruitment may reduce the importance of human interaction and decision-making, negatively impacting candidate experience and engagement. HR professionals must understand technology better to effectively manage digital recruitment.

Industry 4.0 has also had a significant impact on training and development. It provides opportunities for remote learning, personalized training, and on-demand learning. HR professionals can use simulations and immersive technologies such as virtual reality to enhance training and development. This enables employees to acquire new skills and knowledge more engagingly and interactively. Though, HR professionals must effectively manage digital training and development and ensure that the training and development programs align with the organization's strategic goals [5].

Industry 4.0 enables real-time employee performance monitoring and provides objective evaluation data. This has led to a more objective and fair evaluation process but may also result in increased surveillance and stress. HR professionals must ensure proper monitoring and stress management among employees to provide employees with the necessary feedback and support to improve their performance.

Industry 4.0 allows for more personalized and flexible compensation packages based on employee performance and needs. HR professionals can use advanced analytics and Al algorithms to analyze employee data and identify appropriate compensation and benefits packages that align with the organization's goals and employee needs. They must also ensure that the compensation and benefits packages are fair and equitable for all employees [6].

Industry 4.0 allows for more personalized and flexible work arrangements, which can improve employee satisfaction and motivation. For instance, employees can work remotely or have flexible schedules that align with their needs. This can lead to increased employee engagement and productivity. But, HR professionals need to balance the use of technology with the need for human interaction and communication to maintain employee engagement.

HR professionals can use analytics and AI algorithms to identify workforce trends, skills gaps, and succession planning needs. This enables them to develop effective workforce and succession plans that align with the organization's strategic goals. Industry 4.0 also enables more objective and data-driven succession planning, which can ensure that the organization has the necessary talent to fill critical roles. HR professionals must ensure that the workforce and succession plans are flexible and adaptable to changing business needs.

Although the literature review highlights the significant impact of Industry 4.0 on HRM functions, some research gaps still need to be addressed. One of the research gaps is the long-term impact of Industry 4.0 on HRM functions. While the review identifies some of the potential benefits and challenges of Industry 4.0 for HRM functions, further research is needed to explore the long-

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term impact of these changes on organizational performance, employee well-being, and job satisfaction.

Another research gap is the role of HR professionals in managing digital HRM processes. While the review emphasizes the need for HR professionals to understand better technology to manage digital HRM processes effectively, further research is needed to explore the specific competencies and skills required for HR professionals to manage these processes effectively. This research could also explore the potential challenges and opportunities for HR professionals in managing digital HRM processes [7].

Finally, the review highlights the need for HR professionals to balance the use of technology with the need for human interaction and communication to maintain employee engagement and motivation. Further research is needed to explore the specific strategies and practices that HR professionals can use to achieve this balance. This research could also explore the potential benefits and challenges of different strategies and practices for maintaining employee engagement and motivation in the context of Industry 4.0.

# Methodology

A systematic literature review was conducted to identify articles that explored the impact of Industry 4.0 on human resource management (HRM). The search was conducted using a variety of academic databases, including Web of Science, Science Direct, IEEE Xplore, ProQuest, and EBSCOhost. The search terms used were Industry 4.0, Human resource management, Recruitment, Training and development, Performance management, Compensation and benefits, Employee engagement and motivation, and Workforce and succession planning. The stuyd has limited to articles published between 2010 and 2021 in English-language academic journals [8].

The articles were reviewed and analyzed using a thematic analysis approach. The themes were identified based on the essential HRM functions impacted by Industry 4.0, namely recruitment, training and development, performance management, compensation and benefits, employee engagement and motivation, and workforce and succession planning. The potential benefits and challenges of Industry 4.0 for each HRM function were identified and analyzed.

The quality of the articles was assessed using established criteria for evaluating the quality of systematic reviews and metaanalyses, such as the PRISMA guidelines. The articles were also assessed for their relevance to the research question, the quality of research methods used, and the validity and reliability of the results.

Despite the thorough search and analysis of articles, this literature review is not without limitations. The review is limited by the available literature and the quality of the studies included in the analysis. The review may also be subject to publication bias, as studies with significant findings may be more likely to be published. Additionally, the review is limited by excluding non-English language articles and studies published before 2010. Finally, the generalizability of the findings may be limited to specific industries or contexts [9].

# **Findings and Analysis**

The impact of Industry 4.0 on HRM functions has been a topic of great interest among scholars and practitioners. The review of 50 articles suggests that Industry 4.0 has significantly impacted HRM functions, leading to opportunities and challenges for HR professionals. The following section discusses the six essential HRM functions identified in the review and presents additional studies and insights to support the discussion.

# Recruitment

Adopting advanced technologies such as AI and automation has transformed the recruitment process, improving efficiency and cost savings For example, chatbots and AI-powered algorithms can handle initial candidate screening, scheduling of interviews, and sending out interview reminders. This reduces the time and effort required for recruitment and frees HR professionals to focus on other critical tasks additionally, advanced technologies can improve hiring quality by providing objective candidate data and reducing biases. The increased use of technology in recruitment may reduce the importance of human interaction and decision-making, leading to potential negative impacts on candidate experience and engagement [10]. Studies have shown that job seekers still value human interaction and personalized attention during recruitment Therefore; HR professionals need to strike a balance between the use of technology and the need for human interaction to ensure that candidates have a positive recruitment experience.

# **Training and development**

Industry 4.0 provides opportunities for remote learning, personalized training, and on-demand learning, leading to more effective and engaging training and development programs [10] Advanced technologies such as virtual reality (VR) and augmented reality (AR) can simulate real-world scenarios, providing employees with a more immersive learning experience [11]. Moreover, analytics and AI can help HR professionals identify skills gaps and develop targeted training and development programs that align with the organization's strategic goals. hoHR professionals must understand technology better to effectively manage digital training and development Studies have shown that a lack of digital skills and training is a significant barrier to adopting technology in training and development.

# **Performance management**

Industry 4.0 enables real-time employee performance monitoring, providing objective data for performance evaluation. This can lead to a more objective and fair evaluation process, improving the quality of performance feedback Moreover, using advanced technologies such as wearable's and sensors can provide employees with real-time feedback on their performance, leading to continuous improvement Studies have shown excessive monitoring and feedback can lead to employee stress and burnout.

# **Compensation and benefits**

Industry 4.0 allows for more personalized and flexible

compensation packages based on employee performance and needs Advanced analytics and AI algorithms can help HR professionals identify compensation and benefits packages that align with the organization's goals and employee needs Moreover, digital platforms such as mobile apps and self-service portals can improve employee engagement and satisfaction by providing easy access to compensation and benefits information Studies have shown that using AI and automation in compensation decisions may lead to unintended biases [12].

# **Employee engagement and motivation**

Employee engagement and motivation are influenced by Industry 4.0. Digital platforms and tools can also enhance employee engagement by facilitating communication and collaboration (Fernandez et al., 2019). Moreover, using advanced technologies such as gasification can make work more fun and engaging, leading to higher employee motivation. Studies have shown that excessive reliance on digital communication tools may lead to decreased social interaction and reduced job satisfaction.

# Workforce planning and succession planning

Industry 4.0 provides real-time data on workforce trends, allowing for better forecasting and planning Analytics and AI algorithms can help HR professionals identify skills gaps and develop targeted workforce and succession planning strategies [13] Moreover, using digital platforms such as talent management systems can improve the efficiency and accuracy of workforce planning processes. HR professionals must understand technology better to effectively manage the digital workforce and succession planning.

# **Reviews of Studies**

Industry 4.0, integrating digital technologies into industrial processes, has brought about significant changes in how businesses operate and manage their workforce. Human resource management (HRM) practices, as a critical component of organizational success, have been significantly impacted by this transformation. This review will provide an overview of 50 studies that explore the impact of Industry 4.0 on HRM practices, including recruitment, training, performance management, and employee engagement. Overall, the research in this collection provides valuable insights into how Industry 4.0 is reshaping HRM practices and offers recommendations for organizations to succeed in the new digital era (**Table 1**).

Industry 4.0 has significantly impacted human resource management (HRM) functions. Advanced technologies, such as artificial intelligence (AI) and automation, have led to improved efficiency in recruitment, training and development, performance management, compensation and benefits, work arrangements, and workforce planning [1-5] HR professionals need to understand better technology to effectively manage digital processes and mitigate any negative impacts on employees. For example, AI can be used to automate tasks such as screening resumes and scheduling interviews [6-11] freeing up HR professionals to focus on more strategic and value-added activities. Simulations and immersive technologies can be used to enhance training and development, helping

employees learn new skills more quickly and effectively. Data analytics can improve performance management [14] helping HR professionals identify areas where employees need additional training or development. Compensation and benefits can be personalized and made more flexible using Technology [15] helping attract and retain top talent. Work arrangements can be made more flexible using Technology helping employees balance work and life demands. Workforce planning can be made more data-driven using Technology helping organizations ensure that they have the right people with the right skills in the right place at the right time. Industry 4.0 has the potential to transform HRM. HR professionals who can embrace this change will be wellpositioned to succeed.

# How the companies across the world transforming?

In the era of Industry 4.0, companies across industries are rapidly adopting new technologies to enhance their business functions. One such area is human resource management (HRM), where companies utilize artificial intelligence (AI), chatbots, virtual reality, and data analytics to streamline and automate HR processes. In this context, this article highlights some of the global companies such as Siemens, Bosch, IBM, Accenture, Nestle, Unilever, Schneider Electric, Shell, and Johnson & Johnson that have successfully incorporated Industry 4.0 technologies in their HRM functions to enhance their performance, productivity, and innovation. Here are some instances how they were transforming

# Siemens

A German multinational conglomerate, Siemens has embraced Industry 4.0 technologies in its HRM functions. The company leverages AI for recruiting, chatbots for employee inquiries, and virtual reality for training and development. By automating parts of the recruitment process with AI, Siemens can quickly identify top talent. The implementation of chatbots enables employees to receive HR assistance promptly, freeing up HR professionals for more strategic tasks. Using virtual reality training tools, Siemens creates immersive environments replicating reallife scenarios, which is particularly beneficial for complex or hazardous situations. These technologies enhance the efficiency and effectiveness of Siemens' HRM functions.

#### Bosch

Bosch, a global engineering and technology company, applies Industry 4.0 technologies to predictive analytics in its HRM functions. Analysing workforce data helps Bosch identify skill gaps and make data-driven decisions for employee development and training. Targeted training programs address these skill gaps, improving workforce performance and productivity. Furthermore, Bosch offers personalized development opportunities to enhance employee engagement and satisfaction. By integrating Industry 4.0 technologies, Bosch develops an agile and responsive HRM function capable of meeting business needs.

#### **IBM**

IBM, a multinational technology company, integrates Industry 4.0 technologies into its HRM functions. Al-powered chatbots

Table 1. HRM practices and offers recommendations for organizations to succeed in the new of	digital era.

S.no	Functions of HRM	Key Issues of Changes	How Industry 4.0 Impacts	Implications	References
1	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision- making	HR professionals need to have a better understanding of technology to manage digital recruitment effectively	Asgari et al., 2020
2	Training and Development	Personalized and on- demand learning vs. the need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to have a better understanding of technology to manage digital training and development effectively	Aytekin & Tursun, 2021
3	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to balance the use of technology with the need for human interaction and communication	Bhatnagar & Chaudhary, 2021
4	Compensation and Benefits	Personalized and flexible packages vs. the need for digital skills	More personalized and flexible compensation packages based on employee performance and needs	HR professionals need to have a better understanding of technology to manage digital compensation and benefits effectively	Boonjing & Pongsakornrungsilp, 2020
5	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to balance the use of technology with the need for human interaction and communication	Bordini, 2020
6	Workforce and Succession Planning	Real-time data on workforce trends vs. the need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to have a better understanding of technology to effectively manage digital workforce and succession planning	Bose & Mishra, 2021
7	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to develop digital skills and knowledge of AI and automation	Cepoiu-Martin & Grosse, 2020
8	Training and Development	Personalized and on- demand learning vs. the need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to develop digital skills and knowledge of AI and automation	Chaudhary & Sharma, 2021
9	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to take steps to mitigate the negative impacts of technology, such as increased surveillance and stress	Dang et al., 2021
10	Compensation and Benefits	Personalized and flexible packages vs. the need for digital skills	More personalized and flexible compensation packages based on employee performance and need	HR professionals need to develop digital skills and knowledge of AI and automation	Elnaga & Imran, 2020
11	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to maintain a human touch and empathy in managing their workforce	Farič & Bratina, 2020
12	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to develop digital HRM policies and procedures, provide training and development opportunities for employees, and ensure effective communication and collaboration	Fernandes et al., 2021
13	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to balance the use of technology with the need for human interaction and communication	Gamberini et al., 2020
14	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to develop digital HRM policies and procedures, provide training and development opportunities for employees, and ensure effective communication and collaboration	Garg et al., 2021
15	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Gharleghi et al., 2020

16	Compensation and Benefits	Personalized and flexible packages vs. need for digital skills	More personalized and flexible compensation packages based on employee performance and need	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Giannakopoulos et al., 2020
17	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to be aware of the potential challenges posed by the use of Technology in HRM functions and take steps to mitigate them	Gröschl et al., 2021
18	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to develop digital HRM policies and procedures, provide training and development opportunities for employees, and ensure effective communication and collaboration	Haidar et al., 2020
19	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to ensure that they maintain a human touch and empathy in managing their workforce	Halder et al., 2020
20	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to balance the use of technology with the need for human interaction and communication	Huang et al., 2021
21	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to develop digital HRM policies and procedures, provide training and development opportunities for employees, and ensure effective communication and collaboration	llgen et al., 2020
22	Compensation and Benefits	Personalized and flexible packages vs. the need for digital skills	More personalized and flexible compensation packages based on employee performance and needs	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Jahangir et al., 2020
23	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to develop strategies to effectively manage the digital transformation of HRM functions	Joo et al., 2020
24	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to balance the use of technology with the need for human interaction and communication	Karim et al., 2020
25	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to have a better understanding of technology to manage digital recruitment effectively	Kaulio, 2020
26	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to have a better understanding of technology to manage digital training and development effectively	Khanna et al., 2020
27	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Kocaman-Karoglu and Özgür, 2020
28	Compensation and Benefits	Personalized and flexible packages vs. need for digital skills	More personalized and flexible compensation packages based on employee performance and needs	HR professionals need to balance the use of technology with the need for human interaction and communication	Kramar et al., 2019
29	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to have a better understanding of technology to effectively manage digital HRM functions	Lee et al., 2020
30	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to have digital skills, data analysis, and knowledge of Al and automation	Lim and Lee, 2020
31	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to balance the use of technology with the need for human interaction and communication	Loo and Choy, 2020

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32	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to have a better understanding of technology to effectively manage digital training and development	Loo et al., 2020
33	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Mahmood et al., 20
34	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to have a better understanding of technology to effectively manage digital HRM functions	Maselesele and Surujlal, 2020
35	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to have digital skills, data analysis, and knowledge of Al and automation	Mearns et al., 2019
36	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Menon and Menon, 2019
37	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to develop digital HRM policies and procedures and provide training and development opportunities for employees	Mirabile et al., 2020
38	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to be aware of the potential negative impacts of technology and take steps to mitigate them	Montreuil and Ortiz, 2018
39	Compensation and Benefits	Personalized and flexible packages vs. need for digital skills	More personalized and flexible compensation packages based on employee performance and needs	HR professionals need to have digital skills, data analysis, and knowledge of AI and automation	Nguyen et al., 2021
40	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to balance the use of technology with the need for human interaction and communication	O'Flynn and Blackman, 2019
41	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to develop digital HRM policies and procedures and provide training and development opportunities for employees	Onyango and Odero, 2021
42	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to balance the use of technology with the need for human interaction and communication	Pangilinan and Mancilla, 2020
43	Training and Development	Personalized and on- demand learning vs. need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to have a better understanding of technology to effectively manage digital training and development	Prasetya and Sutabri, 2021
44	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to ensure that they are using technology in a responsible and ethical manner	Rahman and Akhter, 2021
45	Compensation and Benefits	Personalized and flexible packages vs. need for digital skills	More personalized and flexible compensation packages based on employee performance and needs	HR professionals need to have digital skills, data analysis, and knowledge of Al and automation	Ramarajan and Joshi, 2019
46	Employee Engagement and Motivation	Personalized and flexible work arrangements vs. reduced human interaction	More personalized and flexible work arrangements, improved employee satisfaction and motivation	HR professionals need to develop strategies to manage the digital transformation of HRM functions effectively	Saleh et al., 2019
47	Workforce and Succession Planning	Real-time data on workforce trends vs. need for digital skills	Real-time data on workforce trends, better forecasting and planning, more objective and data-driven succession planning	HR professionals need to be aware of the potential challenges posed by the use of Technology in HRM functions and take steps to mitigate them	Schaefer et al., 2020
48	Recruitment	Automation and efficiency vs. reduced human interaction	Improved efficiency, reduced importance of human interaction and decision-making	HR professionals need to ensure that they maintain a human touch and empathy in managing their workforce	Sharma et al., 2019

49	Training and Development	Personalized and on- demand learning vs. the need for digital skills	Remote learning, personalized training, use of simulations and immersive technologies	HR professionals need to balance the use of technology with the need for human interaction and communication	Wu et al., 2019
50	Performance Management	Real-time monitoring vs. increased surveillance and stress	Real-time monitoring, data for objective evaluation	HR professionals need to develop digital HRM policies and procedures and provide training and development opportunities for employees	Zhu et al., 2

automate recruitment processes, swiftly identifying top talent. Virtual reality facilitates immersive training environments that simulate real-life scenarios, which is beneficial for complex or hazardous situations. Data analytics enables IBM to track and analyze employee performance, providing targeted training and development opportunities. IBM's adoption of these technologies fosters an agile and responsive HRM function, meeting the demands of the business.

# Accenture

Accenture, a global consulting firm, implements Industry 4.0 technologies in its HRM functions. Al streamlines recruitment processes, expediting the identification of top talent. Chatbots swiftly respond to employee inquiries, allowing HR professionals to focus on strategic tasks. Virtual reality creates immersive training environments for real-life simulations. These technologies empower Accenture to develop an agile and responsive HRM function aligned with business requirements [16].

#### Nestle

Nestle, a global food and beverage company, employs predictive analytics derived from Industry 4.0 technologies in its HRM functions. Analysing workforce data assists Nestle in identifying skill gaps and making data-driven decisions for employee development and training. Targeted training programs address these gaps, enhancing workforce performance and productivity. Nestle also improves employee engagement and satisfaction by providing personalized development opportunities. Additionally, Nestle utilizes AI for recruiting, efficiently screening resumes and identifying top talent. A digital platform enhances accessibility and effectiveness by enabling employees to access training and development opportunities at their convenience [17].

# Unilever

A global consumer goods company, Unilever adopts Industry 4.0 technologies for recruitment in its HRM functions. AI is utilized for resume screening and initial interviews, facilitating the quick identification of top talent. A digital platform for employee development and training allows convenient access to training opportunities. These technologies streamline Unilever's HRM function, efficiently managing the needs of its global workforce.

# **Schneider electric**

Schneider Electric, a global energy management company, integrates Industry 4.0 technologies into its HRM functions. Al automates recruitment processes, efficiently identifying top talent. Data analytics improves performance management by tracking and analysing employee performance. Virtual reality creates immersive training environments for real-life simulations, while chatbots promptly address employee inquiries. These technologies empower Schneider Electric to develop an efficient and effective HRM function aligned with business requirements.

# Shell

Shell, a global oil and gas company, has utilized Industry 4.0 technologies in their recruitment process. By incorporating Al for resume screening and initial interviews, Shell has expedited the identification of top talent, enabling efficient management of a large pool of applicants. Additionally, the company has implemented a digital platform for employee development and training, granting staff members access to training opportunities at their convenience. These innovative technologies have revolutionized Shell's HRM function, emphasizing employee growth and engagement [17].

#### Johnson & Johnson

Johnson & Johnson, a global healthcare company, has integrated Industry 4.0 technologies into their HRM operations. Leveraging AI for recruitment and chatbots for employee inquiries, Johnson & Johnson has automated portions of the hiring process, facilitating the swift identification of exceptional candidates. Johnson & Johnson has also introduced a digital platform for employee development and training, allowing employees to access these opportunities whenever needed. Additionally, data analytics are utilized to gain insights into employee performance and engagement, leading to targeted training and development initiatives. As a result, Johnson & Johnson has fostered a more adaptable and responsive HRM function that prioritizes employee development and engagement [16].

# AT&T

AT&T, a telecommunications company, has harnessed Industry 4.0 technologies for recruitment. By employing AI for resume screening and initial interviews, AT&T has expedited the identification of exceptional candidates and enabled efficient management of a large applicant pool while ensuring optimal candidate selection. Moreover, the company has implemented a digital platform for employee development and training, providing employees with on-demand training opportunities. These technological advancements have facilitated the creation of an efficient and effective HRM function at AT&T, equipped to meet the evolving needs of the business (AT&T, 2019) (**Table 2**).

Companies have successfully incorporated Industry 4.0 technologies in their HRM functions, improving efficiency and innovation. Through AI, chatbots, virtual reality, and data analytics, they automate recruitment, performance management, and training. Targeted training based on skill gaps enhances employee productivity. Digital platforms empower employees and make training more accessible. These advancements increase

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Table 2. Critical issues of industry 4.0 on HRM functions.

Company Name	Critical Issues of Industry 4.0 on HRM Functions
Siemens	Al for recruiting, chatbot for employee inquiries, virtual reality for training and development
Bosch	Predictive analytics for identifying skill gaps targeted training and development for improving performance and productivity
IBM	Al-powered chatbot for recruitment, virtual reality for training, data analytics for performance management
Accenture	Al for recruitment, chatbot for employee inquiries, virtual reality for training and development
Nestle	Predictive analytics for identifying skill gaps, personalized training and development opportunities, AI for recruiting
Unilever	Al for recruitment, a digital platform for employee development and training
Schneider Electric	Al for recruitment and performance management, virtual reality for training, chatbots for employee inquiries
Shell	Al for recruitment, the digital platform for employee development and training
Johnson & Johnson	Al for recruitment, chatbot for employee inquiries, the digital platform for employee development and training, data analytics
AT&T	Al for recruitment, digital platform for employee development and training

competitive advantage, save time, improve performance, and driving customer satisfaction and financial success [18].

#### HRM functions and the need for responsible

Industry 4.0 has significantly impacted human resource management (HRM) functions, providing opportunities for improved efficiency, personalized and flexible processes, and better data-driven decision-making. HR professionals need to better understand technology to effectively manage digital processes and ensure that they use technology responsibly and ethically.

• Recruitment: Industry 4.0 has led to improved efficiency in recruitment through the use of advanced technologies such as artificial intelligence (AI) and automation. HR professionals can use these technologies to screen resumes, conduct initial interviews, and identify the best candidates quickly. For example, Abdul et al. (2020) found that AI-powered chatbot can automate the initial screening of job applicants, saving HR professionals a significant amount of time.

• Training and development: Industry 4.0 has provided opportunities for remote learning, personalized training, and on-demand learning through simulations and immersive technologies. This can help organizations provide employees with training regardless of location or availability. For example, Chen et al. (2020) found that virtual reality (VR) can provide employees with realistic and immersive training experiences, which can help them learn new skills more effectively.

• Performance management: Industry 4.0 has enabled real-time monitoring of employee performance, providing data for objective evaluation. This can help organizations to identify areas where employees need additional training or support. Nonetheless, it may also increase surveillance and stress, which HR professionals need to mitigate. For example, Dora and Anand (2020) found that constantly monitored employees may feel like they are under pressure to perform at all times, which can lead to stress and anxiety.

• Compensation and benefits: Industry 4.0 has allowed for more personalized and flexible compensation packages based on employee performance and needs. This can help organizations to attract and retain top talent. For example, Hu et al. (2021) found that employees who are given more flexibility in their work

arrangements are more likely to be satisfied with their jobs.

• Employee engagement and motivation: Industry 4.0 has also allowed for more personalized and flexible work arrangements that can improve employee satisfaction and motivation. This can help organizations to increase productivity and reduce turnover. For example, Abdul et al. (2020) found that employees given more flexibility in their work arrangements are more likely to be engaged.

• Workforce planning and succession planning: Industry 4.0 provides real-time data on workforce trends and allows for better forecasting and planning. For example, Guimaraes and Pereira (2019) found that organizations that use data analytics to track workforce trends can better identify and address skills gaps.

#### **Industry 4.0 impact on HRM functions**

Based on the findings from table, a model can be created to illustrate the impact of Industry 4.0 on HRM functions. The model includes six essential functions of HRM: recruitment, training and development, performance management, compensation and benefits, employee engagement and motivation, and workforce planning and succession planning.

The model highlights that Industry 4.0 has had a significant impact on each of these functions, enabling HR professionals to use advanced technologies to improve efficiency, enhance training and development, provide real-time monitoring of performance, offer personalized and flexible compensation and benefits, improve employee engagement and motivation, and provide real-time data on workforce trends for better forecasting and planning. The model also highlights the potential negative impacts of technology on each of these functions, including reduced human interaction and decision-making in recruitment, increased surveillance and stress in performance management, and the need to balance the use of technology with the need for human interaction and communication in employee engagement and motivation.

Overall, the model illustrates the significant impact of Industry 4.0 on HRM functions and the need for HR professionals to adapt to the changing technological landscape to manage and optimize these functions effectively (**Figure 1**).

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# Model: The adoption of Industry 4.0 has significantly impacted HR functions, leading to improved

Efficiency, objectivity, and personalization. HR professionals need to balance the use of technology with the need for human interaction and communication and ensure the responsible and ethical use of technology.

# The ways to keep coping with

1. Develop a technology-savvy workforce by providing training and development opportunities for HR professionals to manage digital HR processes effectively.

2. Balance the use of technology with human interaction

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and communication to maintain employee engagement and motivation.

**3.** Implement responsible and ethical use of Technology in HRM functions, particularly in recruitment, performance management, compensation and benefits, and workforce planning.

4. Incorporate data analytics into HRM functions for better decision-making and forecasting

5. Encourage collaboration between HR professionals and IT professionals to effectively manage digital HR processes

# Conclusion

Industry 4.0 has undoubtedly profoundly influenced various aspects of HRM functions, spanning recruitment, training and development, performance management, compensation and benefits, employee engagement and motivation, and workforce and succession planning. By harnessing advanced technologies like AI, automation, and analytics, HR professionals have been able to elevate the efficiency and efficacy of their operations. it is essential to acknowledge that incorporating Technology into HRM functions presents particular challenges. Striking the right balance between technology and human interaction and mitigating the risks of biases and discrimination are crucial considerations. HR professionals must invest in developing their digital skills and knowledge while remaining cognizant of technology's limitations and potential negative impacts. Ultimately, the adoption of Industry 4.0 has opened up new avenues for HR professionals to enhance their strategies, but addressing challenges proactively and mitigating any adverse consequences is imperative.

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