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Artificial Intelligence: Present and Future of Human Resources Recruitment and Selection Processes†

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Abstract: Artificial Intelligence (AI) is a broad term that usually refers to a diverse set of computational procedures that can mimic human decisions and/or processes so closely that they appear intelligent, being able, in example, to process with enormous quickly large volumes of data. AI is such a powerful tool, that organizations are increasingly using it in various areas, including Human Resources (HR) Management, especially in recruitment and selection functions. For instance, big data algorithms are highly instrumental in expanding the process of candidates searching. However, there are several key questions that are still open, such as, ethical issues and the reactions and attitudes towards the AI of its users (recruiters, selection managers and potential candidates), being needed a greater empirical and systematic review effort of the literature at this level. In this context, this paper discusses AI and its applications in HR recruitment and selection process, addressing the future trends and challenges defined in the extant literature.

Keywords: Artificial Intelligence; Human Resources; Recruitment; Selection Process; Applications; Challenges.

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1. Introduction

The world of work in this 21st century is strongly linked to the incorporation of information technologies, and its multiple variants and applications, having even pointed out that we are witnessing a fourth industrial revolution [1]. The term fourth industrial revolution was coined by Klaus Schwab [2], founder and executive chairman of the World Economic Forum, to describe the exponential development of the digital revolution (that had been taking shape since the middle of the last century), characterized by a fusion of technologies that blurs the lines and borders between the physical, the digital and the biological [3]. Among all the relevant technological forces in this fourth industrial revolution (e.g., 3D printing, quantum computing, nanotechnology, biotechnology, alternative forms of energy technology and so on) [4], artificial intelligence (hereafter AI) stands out such as an emerging and powerful technology that has received much attention in the popular press, academic research, and industry.

AI is a broad term, coined by John McCarthy in 1955, that usually refers to a diverse set of computational procedures that can mimic human decisions and/or processes so closely that they appear intelligent, being able, in example, to process with enormous quickly large volumes of data, to identify, to relate and to predict patterns [5]. AI is such a powerful tool, that organizations are increasingly using it or considering its use in various areas. 85% of executives surveyed in a global study are projected to invest heavily in AI technologies within the next three years [6]. Furthermore, it has been predicted that this technology would significantly change the business landscape in the 21st century [7]. Numerous white papers and research reports presented the benefits and advantages of implementing AI, claiming that AI could change organizations, industries, and society in

the future [8]. In sum, AI can be regarded as a disruptive technology as it fundamentally will reshape our lives and work [9].

AI has evolved significantly in recent years. There is however a lack of complete and comprehensive understanding of its use, impact, influence, and critical success factors in organizations [10] specifically around Human Resources Management (hereafter HRM) and more concretely in HR recruitment and selection. More than half of the companies using AI do so precisely to improve and optimize such recruitment and hiring processes [11,12]. AI helps organizations with the reduction of costs, especially in terms of time, effort and repeating daily tasks for recruiters, as well as for candidates in reducing the organizations' response time, favouring a positive employer brand [13]. However, the use of AI for HR recruitment and selection purposes is not without controversy and criticism. AI might have also a negative impact, affecting its use to diversity management in organizations [14] and even leading to the substitution or replacement of humans in certain types of tasks and jobs [15]. Moreover, there are open several key questions such as ethical issues and the reactions and attitudes towards the AI of its users (recruiters, selection managers and potential candidates) [1], being needed a greater empirical and systematic review effort of the literature at this level.

In this context, this paper discusses AI and its applications in HR recruitment and selection process, addressing the future trends and challenges defined in the extant literature.

2. AI applications in HR recruitment and selection process

AI was defined in general terms as a diverse set of computational procedures that can mimic human decisions and/or processes so closely that they appear intelligent, being able, in example, to process with enormous quickly large volumes of data, to identify, to relate and to predict patterns [5]. In other words "AI has the ability to make decisions in real time based on pre-installed algorithms and computing technologies constructed based on data analysis to learn and acclimate automatically to offer more refined responses to situations" [16] (p. 1).This description shows its potential, for example, in terms of data processing (e.g., sourcing, refining) and decision-making [17,18], two tasks or processes that are usually present in HR recruitment and selection, so that AI is increasingly being used by organizations.

Wisskirchen et al., [5] described five main applications of AI: (1) Machine Learning (hereafter ML) (or the use of machine and computer programming to optimise a certain performance criterion using example data or past experience [19]); (2) Robotics (the utilization of machines capable of performing automatic tasks or simulating human behaviour); (3) Dematerialisation (or the transformation of traditionally physical products into software); (4) The gig economy (or working on platforms, whether working in teams or on demand through applications); and (5) Autonomous driving (or vehicles that are capable of self-driving using sensors). Among all these possible applications or uses of AI in HR recruitment and selection ML and robotics highlight.

ML can be distinguished from deep learning (hereafter DL), a more advanced form of ML. Both are based on a set of algorithms that try to model high-level abstractions in data, but the main difference between the two of them is that in DL the algorithms are based on artificial neural networks aimed at making the machine learn on its own [19]. The algorithms contained in ML make it possible for computers to conduct specific tasks autonomously (i.e., without the need to be programmed) that mainly have to do with identifying patterns in large data sets to make predictions. For example, techniques such as Natural Language Processing (NLP) can collect and analyze data sources in an automated and rapid way [20]. These techniques are therefore an essential part of Big Data, and although it is not unusual to understand them as synonymous with so-called data mining, it is their ability to reproduce patterns and make predictions based on them that distinguishes them from data mining (more exploratory and descriptive in nature). Depending on the goal pursued when using ML/DL, it is possible to distinguish several types

of algorithms to be used such as supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning [21]. As Rogers et al., [16] noted detailed key cases of ML and DL in an HR recruitment and selection context might include anomaly detection, background verification, content personalization, as well as questions of ethics and data management for HRM practitioners, such as images, video, and speech recognition.

Robotics can be described in general terms as the use of robotic machines that have the capacity (depending on their software that can include ML/DL [22]) to perform automatic tasks or even simulate human behaviour. It is important to distinguish among bots (or computer programmes that include rules executed repetitively on the internet, which allow them to perform certain actions autonomously), co-bots (or collaborative bots) and chatbots (or specialised bots created to carry on conversations and provide preconceived responses). IA applications for HR recruitment and selection purposes usually involve the use of tools such as bots and chatbots. For example, bots can define quickly the most suitable profiles for a specific position, shortening the time frame, for example in the preselection phase. Chatbots can initiate a real time communication with applicants for the job in the form of a screening interview, reducing the organizations′ response time and improving their experience as candidates [23]. Fraij and László [24] summarized in their recent review some of chatbots used by big companies such as Ikea or Amazon, in example Xor (www.xor.ai) and Talkpush (http://www.talkpush.com/). In short, AI offers techniques and tools that can support and optimise several tasks in the HR recruitment and selection process [25]. Table 1 summarises some of the main applications of AI in such HR recruitment and selection tasks.

Table 1. HR recruitment and selection process: Tasks and IA applications.

HR PROCESS	TASKS	IA APPLICATION
RECRUITMENT	Job advertisement	ML and NLP can help recruiters by identifying the keywords that the advertisement should contain, and the right channels for its communication.
	Job application	Intelligent digital assistants (often based on DL) can take over the task of writing the job application for the applicant. This allows all data to be available online, so that such intelligent digital assistants can collect, prepare, and send the data to the applicant management system. The competences and skills identified can furthermore be compiled and verified (e.g., via Open Badges).
	Organization response Communication	Self-learning chatbots capable of interacting in a way that can answer frequently asked questions from applicants and guide them in some directions.
SELECTION	Pre-selection/evaluation	Automated pre-selection (depending on the programming of its software) can recognize both hard and soft skills, and even personality traits do not clear in the candidate's CV or presentation videos. Preliminary interviews through chatbots

* Adapted from Laurim et al., [25].

3. AI trends and challenges in recruitment and selection process

The use of AI and its applications in HR recruitment and selection has numerous advantages. These include more reduced costs in terms of time, effort, money, and human

resources [13,26]. HR professionals could focus on those tasks that have more to do with reasoning, reviewing and monitoring the process, making decisions, interacting and communicating with candidates. AI brings a greater accessibility to numerus forms of data (e.g., large volumes of resumes, social media content), previously burdensome and more difficult to analyze, due to its power to manage enormous quantities of data [26]. In doing so, another advantage of AI is its potential to increase talent [27] and diversity [28] within the organization, as well as predictive accuracy [26]. On the one hand, recruitment may be enhanced using ML, as noted above, in the first stages of the recruitment process. On the other hand, its use can drop potential biases in the selection process (related for example to characteristics such as gender, and/or age).

However, these potential advantages may also be some of AI main risks and drawbacks, becoming challenges to cope and trends for the future. Gónzalez et al [26] summarized the actual potential limitations of AI and its applications, such as ML in four: Data quality, "black box" predictions, ethical and legal issues and users' reactions (recruiters, selection managers and potential candidates) toward AI. For example, it has been pointed out that the use of AI as a decision support element may lead HR managers to perceive that they have less autonomy in their jobs, and that the selection decision was already predetermined, thus becoming less accountable for their own decision-making [29]. Moreover, AI learning databases can be biased, reproducing and maintaining initially discriminatory algorithms, as well as unconscious biases and stereotypes of AI designers may cause discriminatory behaviors [30] in its application for HR recruitment and selection purposes. In this vein, some recent proposals such as Rodgers et al., [30] could be useful. The authors proposed a model of HR selection decision making using AI, which shows how employing certain strategies to build the algorithms (e.g., creating a diversified multi-stakeholder expert advisory board, respecting differences of opinion, to ethically guide the AI) can support ethical AI use.

It will become increasingly necessary in HR recruitment and selection process to collaborate with automated systems. Therefore, it is necessary to adopt broader frameworks of analysis that consider how the changes arising from the use of AI can be realized, with a view to designing and implementing such systems in the optimal way for organizations as well as for individuals. Progress in this direction is needed not only at an empirical level, but also strengthening the collaboration among HR professionals, AI designers, electronic scientists, legal scholars, and members of other professional disciplines important in the development, implementation, and evaluation of AI applications in organizational contexts.

4. Conclusion

This paper discussed AI and its applications in HR recruitment and selection process, addressing the future trends and challenges defined in the extant literature. AI and its applications for HR recruitment and selection purposes (e.g., ML, DL, PNL, bots, chatboots) have evolved significantly in recent years. Moreover, this use will be growing due to its potential advantages (e. g., more reduced costs in terms of time, effort, money, and human resources [13,26]). However, these potential advantages may also be some of AI main risks and drawbacks, becoming challenges to cope and trends for the future (e.g., ethical and legal issues, diversity, equity and inclusion (DE&I), and users' reactions toward AI). Therefore, it is needed to progress not only at an empirical level, but also strengthening the collaboration among HR professionals, AI designers, electronic scientists, legal scholars, and members of other professional disciplines important in the development, implementation, and evaluation of AI applications in organizational contexts.

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References

1. World Economic Forum. *The future of Jobs Report 2018*. Available online: WEF_Future_of_Jobs_2018.pdf (weforum.org) (accessed on 30 July 2023).
2. Xu, M.; David, J.M.; Kim, S.H. The fourth industrial revolution: Opportunities and challenges. *International journal of financial research* **2018**, *9*, 90-95. https://doi.org/10.5430/ijfr.v9n2p90
3. Schwab, K. *The Fourth Industrial Revolution*. Crown Business: New York, USA, **2017**.
4. O´Reilly, J.; Ranft, F.; Neufeind, M. Identifying the challenges for work in the digital age. In *Work in the Digitak Age: Challenges of the Fourth Industrial Revolution*; Neufeind, M., O´Reilly, J. Ranft, F., Eds.; Rowman & Littlefield: Mariland, United States, **2018**; pp. 1-24.
5. Wisskirchen, G.; Biacabe, B.T.; Bormann, U.; Muntz, A.; Niehaus, S.; Soler, G.J.; von Brauchhitsch, B. *Artificial Intelligence and Robotics and Their Impact on the Workplace*; IBA Global Employment Institute: London, UK, **2017**.
6. Pallathadka, H.; Ramirez-Asis, E.H.; Loli-Poma, T.P.; Kaliyaperumal, K.; Ventayen, R.J.M.; Naved, M. Applications of artificial intelligence in business management, e-commerce, and finance. *Materials Today: Proceedings* 2023, *80*, 2610-2613. https://doi.org/10.1016/j.matpr.2021.06.419
7. Pereira, V.; Hadjielias, E.; Christofi, M.; Vrontis, D. A systematic literature review on the impact of artificial intelligence on workplace outcomes: A multi-process perspective. *Hum. Resour. Manag. Rev.* **2023**, *33*, 100857. https://doi.org/10.1016/j.hrmr.2021.100857
8. Lee, M.C.; Scheepers, H.; Lui, A.K.; Ngai, E.W. The Implementation of Artificial Intelligence in Organizations: A Systematic Literature Review. *Inf. Manag.* **2023**, *60*, 103816. https://doi.org/10.1016/j.im.2023.103816
9. Păvăloaia, V.-D.; Necula, S.-C. Artificial Intelligence as a Disruptive Technology—A Systematic Literature Review. *Electronics* **2023**, *12*, 1102. https://doi.org/10.3390/electronics12051102
10. Collins, C.; Dennehy, D.; Conboy, K.; Mikalef, P. (2021). Artificial intelligence in information systems research: A systematic literature review and research agenda. *Int J Inf Manage* **2021** *60*, 102383. https://doi.org/10.1016/j.ijinfomgt.2021.102383
11. Kshetri, N. Evolving uses of artificial intelligence in human resource management in emerging economies in the global South: some preliminary evidence. *Manag. Res. Rev.* **2021**, *44*, 970-990. https://doi.org/10.1108/MRR-03-2020-0168
12. Littler Mendelson, P.C. (2019). *The Littler® Annual Employer Survey* 2022 Report. Available online: The Littler Annual Employer Survey 2022 | Littler Mendelson P.C. (accessed on 01 August 2023)
13. Horodyski, P. Applicants' perception of artificial intelligence in the recruitment process. *Comput. Hum. Behav. Reports* **2023**, 11, 100303. https://doi.org/10.1016/j.chbr.2023.100303
14. Cachat-Rosset, G.; Klarsfeld, A. Diversity, Equity, and Inclusion in Artificial Intelligence: An Evaluation of Guidelines. *Applied Artificial Intelligence 2023*, *37*, 2176618. https://doi.org/10.1080/08839514.2023.2176618
15. Figueroa-Armijos, M.; Clark, B.B.; da Motta Veiga, S.P. Ethical perceptions of AI in hiring and organizational trust: The role of performance expectancy and social influence. *J. Bus. Ethics* **2023**, *186*, 179-197. https://doi.org/10.1007/s10551-022-05166-2
16. Rodgers, W.; Murray, J.M.; Stefanidis, A.; Degbey, W.Y.; Tarba, S.Y. (2023). An artificial intelligence algorithmic approach to ethical decision-making in human resource management processes. *Hum. Resour. Manag. Rev.* ***2023***, *33*, 100925. https://doi.org/10.1016/j.hrmr.2022.100925
17. Tiwari, S. Artificial Intelligence Implications in Engineering and Production. *Eng. Proc.* **2023**, *31*, 16. https://doi.org/10.3390/ASEC2022-13823
18. Shrestha, Y. R.; Krishna, V.; von Krogh, G. Augmenting organizational decision-making with deep learning algorithms: Principles, promises, and challenges. *J Bus Res* **2021**, *123*, 588-603. https://doi.org/10.1016/j.jbusres.2020.09.068
19. Alpaydin, E. *Introduction to machine learning*, 4th ed. MIT press: Massachusetts, USA, **2020**.
20. Janiesch, C.; Zschech, P.; Heinrich, K. Machine learning and deep learning. *Electronic Markets* **2021**, *31*, 685-695. https://doi.org/10.1007/s12525-021-00475-2
21. Mohammed, M.; Khan, M.B.; Bashier, E.B.M. *Machine learning: algorithms and applications*. Crc Press: Florida, USA, **2017**.
22. Soori, M.; Arezoo, B.; Dastres, R. Artificial intelligence, machine learning and deep learning in advanced robotics, A review. *Cognitive Robotics* 2023, 3, 54-70. https://doi.org/10.1016/j.cogr.2023.04.001
23. Hmoud, B.; Laszlo, V. Will artificial intelligence take over human resources recruitment and selection. *Netw. Intell. Stud.* **2019**, *7*, 21-30.
24. FraiJ, J.; László, V. (2021). A literature review: artificial intelligence impact on the recruitment process. *IJEMS* **2021**, *6*, 108-119. https://doi.org/10.21791/IJEMS.2021.1.10.

25. Laurim, V.; Arpaci, S.; Prommegger, B.; Krcmar, H. Computer, Whom Should I Hire?–Acceptance Criteria for Artificial Intelligence in the Recruitment Process In *54th Hawaii International Conference on System Sciences*, Honolulu, Hawaii (4-8, January, 2021).
26. Gonzalez, M.F.; Capman, J.F.; Oswald, F.L.; Theys, E.R.; Tomczak, D.L. "Where's the IO?" Artificial intelligence and machine learning in talent management systems. *Personnel Assessment and Decision* **2019,** *5*, 33-44. https://doi.org/10.25035/pad.2019.03.005
27. Chowdhury, S.; Dey, P.; Joel-Edgar, S.; Bhattacharya, S.; Rodriguez-Espindola, O.; Abadie, A.; Truong, L. Unlocking the value of artificial intelligence in human resource management through AI capability framework. *Hum. Resour. Manag. Rev.* **2023**, *33*, 100899. https://doi.org/10.1016/j.hrmr.2022.100899
28. Chauhan, P.S.; Kshetri, N. The role of data and artificial intelligence in driving diversity, equity, and inclusion. *Computer* **2022**, *55*, 88-93. https://doi.org/10.1109/MC.2022.3149017
29. Langer, M.; König, C.J.; Busch, V. Changing the means of managerial work: effects of automated decision support systems on personnel selection tasks. *J Bus Psychol.* **2021,** *36*, 751-769. https://doi.org/10.1007/s10869-020-09711-6
30. Cachat-Rosset, G.; Klarsfeld, A. Diversity, Equity, and Inclusion in Artificial Intelligence: An Evaluation of Guidelines. *Appl Artif Intell* **2023**, *37*, 2176618. https://doi.org/10.1080/08839514.2023.2176618