

A Systematic Review of Artificial Intelligence and Hiring: Present Position and Future Research Areas

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Abstract: Artificial Intelligence (AI) is one of the emerging technologies implemented in all the business fields, including Human Resource (HR) resulting in effective HR process. However, there is a dearth of academic research on the role of AI in the hiring function. The current research has attempted to critically review the various role of AI in HR function specifically focusing on recruitment and selection. The paper also aims to bring clarity on AI and it related concepts connected to the field of HR. The study conducted literature review on AI in Hiring (AIHr) and 200 research articles have been identified initially between 2010 to 2020 related to AIHr. For further analysis the study considered only 20 articles published in quality journals. Through a systematic review, the paper discussed the areas in which research is done with reference to and research gap has been identified for the same. This paper will benefit the future research scholars to understand the keywords related to AIHr and possible areas in which research can be conducted.

Keywords: Artificial Intelligence; Hiring; Recruitment; Selection; Systematic Review.

1. Introduction

McCarthy (1956) was the first person to title his paper with the phrase Artificial Intelligence (AI) at a conference in Dartmouth, discussing how through digital computers certain programming can be written that helps in doing some basic reasoning tasks. In 1956, the founding fathers of AI, McCarthy, Rochester, Turing, Minsky, Newell and Simon (Nilsson, 1991) came together and explained that AI can perform tasks like humans if “every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to stimulate it” (Lungarella et al., 2007, p.2). It was after this period,

1956 has been considered as the birth year of AI (Lungarella et al., 2007, p.2). After 1956 AI has gained the attention of many researchers and more contribution towards building on concept began.

Research has been conducted on AI for more than seventy years and it has brought a significant breakthrough in the field of information technology. Earlier computers were perceived as machines which can do some basic calculation and programming. However, AI related research has dramatically changed all misconception and AI has started gaining its importance. According to Dautenhahn (2007), AI was defined as a human-like intelligence (as cited in Lungarella et al., 2007, p.2) which can perform tasks like humans. There is different other connotation given to the term AI few of them are, a computer that does the thinking, interacting and acting like humans (Rich, 1985), application of algorithms which helps in analysing, learning and interpreting the data (Duch et al., 2007), an artificial entity solving complex problems through computers or machines (Kumar & Thakur, 2012).

Industry 4.0 started unfolding two decades ago with the introduction of AI and Internet of Things (IoT) in different fields of business-like medicine (Hamet & Tremblay, 2017), education (Devedžić, 2004), automobile (Bartels et al., 2014), banking, financial services and economics (Pau & Gianotti, 1990), textile (Guo et al., 2011), manufacturing systems (Lee et al., 2018) and insurance (Riikkinen et al., 2018).

This paper aims to debunk the misconceptions of HRs and discusses various AIHR and its related benefits, such as faster hiring process with lesser error and cost (Black & Esch, 2020). Through this systematic review the papers intend to address the following two questions;

1. How AI in Hiring has evolved and the kind of journals it is being published, and geographical areas studies has been conducted?
2. What is the various literature based on AI and its core application in two leading function recruitment and selection?

Artificial Intelligence in Hiring (AIHR)

Hiring involves various stages starting from; understanding the manpower requirements, posting the vacancies, sourcing, screening, selecting, engaging and placing the candidate. Human resources of an organisation are considered as the highest stake as they contribute towards productivity, innovation and organisation value. This makes hiring a daunting task because of the complexity involved in hiring the right talent from the pool of candidates. There are also other truisms of hiring; the wrong hire can be a costly mistake (Altemeyer, 2019), presence of personal bias on hiring decisions (Kabari & Akiene, 2015), the exponential growth of the organisation has made team requirements complex; thus, HR process has become more painful (Altemeyer, 2019) and finally, the symbiotic relationship that exists between HR practices and culture affects hiring (Lockhart et al., 2020). Thus, HRs need to execute hiring functions with utmost care to ensure the right hires have been selected and placed. The success of an organisation primarily depends upon their human resources hence hiring process is a vital function of an organisation.

AIHR is one of the latest trends in the talent business that automates HR functions such as candidate sourcing, candidate screening, candidate assessment and diverse hiring can be executed more objectively and ethically with the help of AI. However, most of the HR practitioners and organisations fail to

understand the significance of AI in Hiring (AIHr). HR practitioners and organisations have a lot of misconceptions such as; Will AI replace the recruiters? The installation process is expensive and time taking, complex and challenging to understand and require a new skill set to work on AI integrated platforms. Due to these misconceptions that exist in the minds of HRs, AIHr is sub-optimally used, resulting in an undesired effect.

The primary objective of hiring is closing a position at the earliest, which otherwise means lesser time. AIHr can help in automating sourcing and prescreening of candidates with less interference of humans. Through automation, thousands of profiles are screened by matching keywords, and only suitable candidates are moved further for interviews and assessment thus saving a lot of time and reducing manual battle of HRs (Sivathanu & Pillai, 2018). Companies like Tech Mahindra have implemented AI bots for their hiring activities and said that they were able to reduce the time by 60%. Most of the HR practitioners have a rationale behind selecting or rejecting a candidate at all stages of the hiring process. However, they are vulnerable to unconscious bias (Gikopoulos, 2019) with respect to gender, culture, ethnicity, religion and many more influencing the decisions. This bias can be eliminated to a greater extent with the help of AI-assisted chatbots, and AI-driven interview platforms (Gikopoulos, 2019) as this issue is becoming increasing importance in all organisations.

AI integrated hiring platforms

There are many AI integrated tools used by organisations for various functions of hiring. Unilever, a multinational consumer company, processes almost 1.8 million job applications in a year and more than 30,000 new employees join their company. This requires a tremendous amount of time and effort by the hiring team, but the process is made simpler with the help of AI. They have partnered with Pymetric, an AI career search platform which makes the process faster and effective. Similarly, there are AI platforms for various hiring functions. Few of the common platforms are AllyO, TextRecruit, Zoom.ai, Textio, Ideal, Jibe, Taleo, Arya, Entelo, BambooHR and ZohoRecruit.

2. Method

The present study adopted a literature review following the guidelines suggested by Booth et al., (2012) The study also adopted three stages in the literature review process (i) search of relevant literature, (ii) evaluating the evidence and (iii) synthesising the finding suggested by Mustak et al., (2016). We selected articles based on two stages; in the first stage we selected papers having the following keywords (i) “Artificial Intelligence and Hiring” (ii) “Automation in Hiring Candidate” (iii) “E-Recruitment in Hiring Candidate” in the title, abstract or keywords (20,234 articles) between January 2010 to 30 November 2020. Despite the fact that there are many publications related to AI in Hiring and AI in recruitment, very few papers hold meaningful findings. Most of the papers discuss general characteristics and role of AI in hiring and no in-depth inference one could derive from the research. Though research started way back in the 1990s only in recent years, it started gaining a lot of relevance both in academics and among corporates. In the last decade, there are more discussions, and research has started taking place in AIHr. Thus, the current paper focused only on reviewing articles that are published between 2010-2020. Further, the articles were filtered and focused on only those articles which most likely discussed on AI and Hiring. The next step was articles with these

keywords are chosen mainly from five databases; Ebsco, Emerald, Springer, Elsevier and Sage. The search is limited only to the five primary journal databases as the quality of journals are said to be of an acceptable standard. There were a lot of reports, thesis and articles published in miscellaneous journals which the authors have excluded highlighting the importance of quality publications. In the second stage, article suitability was further filtered by assessing if the title and abstract match with the content in the paper-based and also if the keywords were used appropriately. The final inclusion and exclusion criteria considered for the present study are systematically represented in Table 1. Ultimately the study selected 20 articles for the analysis, which was closely related to the topic.

Table 1: Inclusion and Exclusion Criteria

Basis	Inclusion Criteria	Exclusion Criteria
Database	Journal indexed in 6 databases	Other databases and thesis not included
Publication year	Published from the year 2010-2020	Published before 2009
Language	Only English	Other languages
Terminology	Artificial intelligence and related terms in HR function (only recruitment and selection)	Evaluation, Performance appraisal, Training, Onboarding and other HR-related function

3. Findings and Discussions

Table 2 gives an overview of the AI and Hiring related articles published in the five main database between 2010-2020 also discusses their key findings and research gap.

Table 2. Evidentiary table of 20 selected publications

Authors	AI Concepts	Sub Themes	Methodology	Findings	Gaps Identified
Albert (2019)	AI; Big Data; Chatbot; Task Automation Tools;	Recruitment; Selection	Semi-structured thematic interview on Companies	Findings listed and have discussed 11 different areas AI been used in recruitment and selection. The study also found out that it is unclear on the extent to which companies have adopted AI because of the possibility of bias and only scarce information available. Companies adopt AI-based on various factors such as return on investment,	Discussion on how ethical aspects, regulations and other features affect the decision making of AI integration in hiring.

				adoption level and growth opportunities and cost involved.	
Almalis et al.,(2015)	Recommender Systems (RS)	Job recruiting	An experimental approach in three phases Content analysis, adjustment of algorithm and execution of results, 52 CVs, Kaggle website	RS based on content improves the process of job recruiting. It helps in filtering and providing the most suitable candidates for the organisation after taking into consideration the needs and skills required.	The algorithms developed need to be tested on more candidate profiles from other sectors. The study also filtered resumes based on a few criteria which also need to be widened.
Cohen (2019)	Artificial Intelligence Chatbot	Talent Management; Recruitment	Viewpoint	The research emphasis on how a chatbot can eliminate conscious and unconscious bias when recruiting	Theoretical insight with only case examples mentioned
Dickson, & Nusair (2010)	HR Information System; Optical Character Recognition	Recruitment; Resume Scanning; Screening;	Interview, Hospitality Industry Practitioners	The study focuses on how integrating AI benefits the HR recruiters of the hospitality industry and the same time to avoid the pitfalls of elimination of candidates due to the incorrect keyword search	Focused only on the hospitality industry and no operational definition on the concept hospitality industry
Faliagka et al., (2014)	Automated recruitment, Machine learning algorithms	Recruitment, Candidate screening	Experiment on 100 technical job applicants.	Developed an automated e-recruitment system that do semantic matching, personality mining module and job application module. It evaluates the basic candidate requirements and ranks them accordingly. The real-time experiment which was conducted showed that such automated process supports the HR personnel making the function more effective. Also, the results were highly accurate	Focused on only on three technical roles. The suitability needs to be checked with another job category. The platform chooses profiles who had both LinkedIn and personal blog. Thus, possibilities of good profiles do not stand a chance with such pre-determined criteria. Hence building platforms with less pre-determined criteria can be

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					considered
Fernandez (2019)	Automation Advanced Analytics	Recruitment	Viewpoint, General	The role of HR analytics is highlighted in the early recognition of workforce and better recruitment strategies	Mentioned only the importance of advanced analytics but not stressed on the implementation aspect of how analytics can be implemented
Gikopoulos (2019)	Automation	Recruitment	Viewpoint, General	The findings suggest that human touch to automation is the key to blend along with Artificial Intelligence in order to progress forward in the field of HRM for smarter recruitment.	Mainly insights are given from secondary sources from authors perspectives and experience. Pieces of evidence can be supported with primary research which becomes more valid.
Guo et al. (2016)	Resumatcher Machine Intelligence Ontology Recommender System	Resume Job Matching System	Jobs web crawler usage for resume search	The Findings statistically prove that resumatcher is 37.44% prediction than the traditional method of search for qualified candidates for the job	The proposed model of Resumatcher cannot be generalised to all nature of jobs. The efficiency of such a system becomes a drawback as the keyword search may not be inclusive of all words
Gupta et al., (2018)	Deep learning, Text mining, Predictive analytics, Natural language generator, recommendation engines		Case-based, General	In this case study, the findings indicated that robot process automation, cognitive insights and cognitive engagement are three important integrations required in hiring. It also discusses that integration is required in screening, interviews, status updation for candidates, candidate engagement and on boarding.	The study has not addressed the implication of AI, effectiveness and accuracy of hiring through automation and the perception of HRs on this automation.

Jatoba et al. (2019)	Artificial intelligence Artificial Neural Network (ANN)	Recruitment Selection	Qualitative descriptive analysis, N=32 Article search 2000-2018 From the Online Knowledge Library (B-on) website	There are mainly nine inferences drawn from the literature analysed during 18 years, and the inference mainly dwells on the how AI in HR has not received much attention and only in the year 2018 has gained momentum.	The findings are restricted to only a few articles searched from a specific website. The inferences drawn are very generic and is not specific to the function of AI in HR and lacks the support of literature backup.
Langer et al (2019)	Highly Automated Interviews	Selection Recruitment	2*2 Design experiment, n=148, Germany	It was found that though automation process for selection was undertaken the applicant perception about organisation had to be positive in order to create a successful engagement during the interview process	Applicant reactions are subjective measurement cannot be assessed via technology
Leong (2018)	Resume Scorer; AI Bot;	Assessment of Resume; Candidate Status Intimation;	Case-based, Fareportal, New York	Discusses the AI integrated hiring platform feature "Resume Scorer" which helps to analyze and filter the profiles based on the skills, qualification and experience. The company is also intending to integrate other AI features such as sending reports on the top-scored candidates and updating the candidate status in the dashboard.	The study has focused on how AI helps in initial resume screening which is case-based. AI role on other hiring process is not discussed in-depth
Maree et al., (2015)	Semantic based methods; Natural Language Processing Tools	Erecruitment	Review based	The paper discusses on the characteristics of various e-recruitment systems such as EXPERT, MatchingSem, E-Gen and Convex. Based on the limitation of these systems the paper has also developed a detailed module and solution that exploits various semantic resources.	The current proposed model has certain limitations like complexity in matching algorithms and huge space for search because each applicant resume will be matched with all the job post that is available in the systems. In such instance there

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					could be job post which is already been filled.
Oberst et al., (2020)	Choice-based conjoint, algorithm, artificial intelligence	Recruitment, hiring	Survey and Choice-based conjoint, N=139 recruitment professionals, Spain	Though most of the HR activities are getting digitalized there are still a good number of HR professionals not willing to automate the hiring process mainly due to lack of first-hand experience	The study was conducted in a simulated situation. A real situation would bring in a more valid finding
Suen et al., (2019)	Synchronous Video Interviews (SVI), AVI, AI	Employment Screening and Interview	Experimental research	It was determined that candidates first impression score is lower in AVI compared to SVI, also candidates preferred SVI over AVI because they did not like about the fact of interacting with a non-human. Applicants' perception of fairness was the same with both AVI and SVI	The study involved control groups which could have influenced the findings. Similar studies on non-control groups could be focused to give a better understanding of the perception of applicants between AVI and SVI
Suen et al., (2020b)	Asynchronous Video Interview (AVI)- AI; TensorFlow Convolutional Neural Network (CNN)	Employment Screening	Structured Behavioral Interview, N=114; 57 interviewers n=57 Interviewees, China	From the study, it was found AI integrated automated interview can perform and assess communication skills, personality traits such as openness, agreeableness, neuroticism like HR professionals. However, other aspects such as conscientiousness and extraversion cannot be assessed effectively like HR professionals.	The study did not focus on assessing non-verbal movements such as body posture and movements.
Tambe et al., (2019)	HR Information system; Algorithm Management; Machine Learning	Recruiting Selection	Conceptual	AI integration has been really fast in healthcare, marketing, social media and other sectors. Addressing AI challenges with the decision based on an algorithm programming	Challenges addressed based on secondary data and authors opinion

Upadhyay & Khandelwa (2018)	Automation Natural Language Processing (NLP) Chabot's	Recruitment Hiring	Viewpoint	The paper emphasis on diversity hiring and personalised communication as a primary benefit of integration AI in recruitment. Proving to be beneficial for recruiters and the potential candidates.	Perspective and compilation of secondary sources. Lacks primary data-based findings.
Van Esch et.al (2019)	Artificial intelligence	Recruitment Selection Job Application Likelihood	Cross Sectional Design, n=532	The study focuses on checking the attitude of potential candidates on the likelihood of applying if the recruitment process was conducted through AI integration. The study establishes a positive connection to the same	The main focus remains only on targeting potential candidates and their likelihood of applying for a job from the perspective of novelty, attitude and anxiety as either meditating or moderation relationship statistically.
Wilfred (2018)	Candidate Relationship Management Software; Chatbot; Natural Language Processing	Sourcing, Screening, Assessments, Scheduling of interview	Viewpoint	With AI it shows consistent performance. No fatigue, emotion attached during the hiring process. Better management of extensive data with lesser time. However, AI cannot wholly replace human	The approach remains brief restricting to theory

AI integrated hiring functions

Candidate sourcing

Sourcing of candidates becomes the first and foremost step in the hiring function. After understanding the manpower requirements, the hiring department proceeds with the sourcing of candidates. Sourcing involves activities such as developing an ideal job description, posting of a vacancy in the right platform and reaching out to the potential candidates. This leads to a massive swath of potential talents from which the hiring managers will be able to select the right talent. Good sourcing becomes very important in the hiring process as it improves the quality of hires. Hence, if considerable time and effort is not spent, then there is a high possibility of outlining the ideal candidates. AI enables augmented writing that helps in writing impactful and biased free job descriptions. AI-powered recruiters chatbot also helps in having an engaging conversation with candidates to understand their interest in the current opportunities. Thus, according to

Reilly (2018), AI is slowly revolutionising the hiring process and making it quicker and more efficient. This has also resulted in a positive relationship between the candidate and employer (Reilly, 2018)

Candidate screening

This stage involves with the filtration process of the candidates. Organisation does a necessary filtration of applicants based on various person specification such as previous experience, relevant experience, age, gender and qualification. These activities can be automated with AI technology. Automation makes the process faster with minimal bias and helps in selecting the most appropriate ones (Sivathanu & Pillai, 2018)

Candidate assessment

Various AI integrated hiring platforms help in conducting an interview and evaluating the responses. There is asynchronous video interview, AI chatbots and other automated platforms which interpret and assess the candidate response real-time and provide with the interview score. This also helps in reducing the HR time and their bias (Sivathanu & Pillai, 2018; Langer et al., (2019).

Candidate engagement

The entire business world discusses employee engagement, but most of them fail to realise that candidate engagement is equally important. Candidate engagement is vital because of the symbiotic relationship that exists between HR practices and organisation culture. Candidate experience and how they are engaged during the hiring process can hugely impact the HR practices of an organisation. HR practices play a pivotal role in building a positive organisation culture. Candidate engagement is the way in which organisation communicates promptly with the applicant during the hiring process. This takes place through an AI integrated chatbot, and the benefit is both ways. This automation helps hirers to complete more in less time. Furthermore, applicants get a better experience with immediate response on queries, updates on the hiring status, faster-applying process, continuous assistance and conveying any other important information. AI integrated chatbots helps in better candidate engagement (Albert, 2019; Van Esch & Black, 2019).

4. Conclusion

Through systematic literature review, the paper was able to contribute to Human Resource Management (HRM) research by discussing on some of the most important and evolving concepts of artificial intelligence. The paper highlighted how AI played an important role in the recruitment and selection functions of HRM. Most of the articles considered for literature were published in the year 2018, 2019 and 2020. This indicates that though there are studies conducted and papers been published on the same, most of them do not have any meaningful findings on the role of AI in hiring. Similarly, another factor contributing to less research earlier to 2018 is due to unawareness and not familiar with AI and its related terminologies. Another important observation is most of the literature focuses only on entry-level implementation of AI in recruitment and selection. But minimal studies focused on, “What are the other benefits of AI in these HR functions”, such as studying how AI can minimise errors and unconscious bias and “What are real ethical issues due to implementation of AI”. Future researchers can focus on these areas by conducting a real-time study on recruitment and selection and understand more in-depth on the

practical benefits of AI. It is clear that AI is already existing and it is growing at an increasing rate. It is also estimated by Accenture that AI will boost the profitability rates by 38% resulting in \$14 trillion increase in the economy by 2035. While envisioning a revolutionary world, it becomes vital to find practical answers to the questions provided in this study. Future scholars need to focus on conducting studies, developing concepts which is aligned and contributing to the existing knowledge of AI in Hiring.

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