AMERICAN UNIVERSITY OF BEIRUT

THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE RECRUITEMNT AND SELECTION PROCESSES: A SYSTEMATIC REVIEW

by
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A project
submitted in partial fulfillment of the requirements
for the degree of Master of Human Resources Management
to the Suliman S. Olayan School of Business
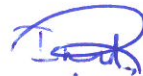at the American University of Beirut

Beirut, Lebanon
April 2019

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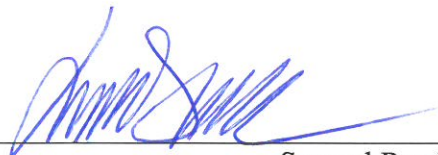
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Date of project presentation: April 17th, 2019

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ACKNOWLEDGMENTS

AN ABSTRACT OF THE PROJECT OF

Lilian Abou Hamdan   for   Master of Human Resources Management
                           Major: Human Resources Management

Title: The role of Artificial Intelligence (AI) in the Recruitment and Selection
       processes: A Systematic Review.

Artificial Intelligence's (AI) scope has rapidly grown in the workplace, playing a strategic role in recruitment and selection by automating various tasks in the processes to identify and reach the talented, skilled and passive job seekers in less time and at a smaller cost, while excluding subjectivity and biases for efficient decision-making.

Screening resumes automatically and matching a vacancy's requirements to the applicant's profile provided significant support in the screening phase, as it decreases the number of errors that may occur when thousands of resumes are manually filtered (Enachescu, 2016). Using AI, recruiters can rank the resumes based on skill and experience, get a deep insight into personality-related assets and better measure the applicant's fit for the job, beyond the traditional resumes in order to successfully match them with available job openings, and avoid biased decisions (Dickson & Nusair, 2010).

Therefore, the aim of our study is to scope out the existing literature around the topic while specifically examining the role of AI technological software in the recruitment and selection processes, hence providing the reader with a practical understanding of the future of human factor in the recruitment and selections processes.

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To

My Beloved Family

CHAPTER I

INTRODUCTION

In the age of technological disruption, human capital is the only constant. Artificial intelligence (AI) has rapidly expanded in the workplace, restructuring Human Resources (HR) functions by automating various tasks and creating a major source of innovation (Ming-Hui & Rust, 2018). Traditionally, organizations used low-tech methods, such as newspaper ads or employee referrals, to attract qualified candidates (Singh & Finn, 2003). Since the late 1990s when the labor market started facing economy challenges and witnessing a high demand for highly skilled candidates, e-recruitment systems grew progressively, surpassing the traditional methods (Enachescu, 2016). Today we are moving toward a gig economy, mostly all fields and jobs have transformed by the combination of AI, big data and enabling technologies; including mechanics, economists, finance, healthcare, education, transportation, marketing, media, HR and many more.

Human resource is an essential asset in a business organization. The selection of talents is part of human resource management process and it must be done very carefully to ensure the achievement of organizational objectives. Decision making related to human resource selection is not an easy task as it is limited to decision makers' computation, foresight, analytical powers, and sometimes to psychosocial biases such as political factors, negative and cost consequence.

- *Analytics and Automation Reshaping the HR Process*

Within the HR system, AI tools are implemented to automate existing processes and functions like recruiting, learning and development, payroll, talent

management and benefits. HR people are implementing digital transformation to help

their firms achieve profitability and market leadership. Some practices include but are

not limited to sifting and screening out resumes, answering questions about the success

of the training programs, evaluating performance by analyzing data in a way that allies

and tracks evolving performance against objectives and understanding the drivers of

employee engagement. Thus, this results in cost efficiencies, reducing time delays,

subjectivity and biased decisions, and diminishing employee data losses.

HR practitioners will be spending less time on administrative repetitive routine

tasks, and more time on strategic tasks and talent development fostering diversified

workforce; all which will contribute towards the efficiency in the HR processes and thus

the firm's competitive advantage.

- *Automated Hiring Process*

Given the competitive business environment and the scarcity of skills, the

recruitment function plays a vital role in attracting and matching qualified candidates

with the available job vacancies, thus enhancing the organizational persistence and

success. It is very challenging for job seekers to identify all the available job vacancies

from different companies, to then apply to those that really fit their profile. Therefore,

even though candidates often have the required skills and abilities, they might not be

aware of the position even exists. Organization's power to attract and retain skilled

employees may today be the single most important element of organizational

effectiveness. With a rapidly changing workforce ecosystem, the recruiter's challenge is

to recruit today for jobs that might not exist in the future (Dickson & Nusair, 2010).

Today, Artificial intelligence (AI) and the associated subfields of big data, data

mining and machine learning have empowered employers to meet the workforce

challenges in recruiting talent and managing diversity (Dalenberg, 2018). Eventually,

AI might be resorted to more frequently and be more involved as job recruitment today is not just about hiring a suitable candidate, but rather about finding the right candidate for the role and for the company, now and in the future, thus (Leong, 2018) creating added-value in terms of efficiency by accelerating the recruitment process and in terms of significant time-cost savings (Enachescu, 2016).

- *Enhancing Recruitment Efficiency*

Using technology would help in boosting the recruitment process' efficiency. Screening resumes automatically and matching a vacancy's requirements to the applicant's, provided significant support in the screening phase, by decreasing the number of errors that may occur when thousands of resumes are manually filtered (Enachescu, 2016).

Additionally, the use of technology gave recruiters access to candidates' full information, accelerated the reference check process and enriched the screening interview (Dickson & Nusair, 2010).

Through AI, recruiters can rank the resumes based on skills and experience, get an insight at personality-related asset and better measure the applicant's suitability for the job, beyond the traditional resumes to successfully match them to available job openings, avoiding biased decisions (Dickson & Nusair, 2010).

- *Downside of AI*

As technology continues to transform the world, HR clearly must be part of that change, embracing automation and other technological software in its recruitment and selection processes. Nevertheless, HR practitioners must be aware of both the benefits and the cost of introducing AI tools in their recruitment processes which not only comes at the cost of systems and software, but above all, at that of evading human oversight (Dickson & Nusair, 2010) especially that AI tools should be adjusted with the adequate

parameters to prevent unconscious bias (Upadhyay & Khandelwal, 2018).

Throughout this paper, we will explore the integration of technological software – AI, in the recruitment and selection processes, as well as tackle the question of knowing whether technology would enhance the efficiency of the talent acquisition function and optimize the recruitment and selection processes or would this automated hiring process take away the control from the hands of human resources practitioners.

Research Goal

The aim of our review is to scope out the existing literature regarding the applications of Artificial Intelligence (AI) in the recruitment and selection processes while specifically providing readers with a practical understanding of the technology implications through each phase of the process. We operationalized this through a systematic review of the literature on AI and on recruitment and selection. The following research question guided our search: "What is the role of Artificial Intelligence(AI) tools in the recruitment and selection processes?"

CHAPTER II

METHODOLOGY

Procedure

We conducted the search using 3 online databases namely ABI/INFORM

Collection, Business Source Ultimate and Scopus, not limited it to any publication date.

 We then narrowed down the search to include articles that:

- were published in peer-reviewed journals using UlrichsWeb (Periodicals

Directory).

- English-only studies

We used the ''general search'' option to rapidly obtain consistent results in

consecutive searches (Dwi-vedi, 2009). We also used the ''advanced search'' option to

further find research focusing on AI. We screened titles and their corresponding

abstracts twice by two independent researchers for the following keywords:

- 'artificial intelligence' OR 'robotics' OR 'machine learning' AND

'recruitment'

- 'artificial intelligence' OR 'robotics' OR 'machine learning' AND

'selection 'OR 'hiring' OR 'employment'

- 'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'talent

acquisition'

- 'artificial intelligence' OR 'robotics' OR 'machine learning' AND

'interviews'

- 'artificial intelligence' OR 'robotics' OR 'machine learning' AND

'assessment tools'

Our aim was to guarantee a more efficient comparison between the articles included in the final list of studies analyzed in this review.

Then, we excluded articles that described findings based on:

- human resources functions foreign to recruitment and selection

- artificial intelligence tools not related recruitment and selection processes.

Finally, we saved full text articles for complete screening and in order to simplify the analysis, we charted all the key information of each study in a structure that included objective(s), design, methodology, sample, variables, hypotheses, findings, and limitations.

CHAPTER III

RESULTS

Descriptive Statistics

The preliminary search yielded 4,591 articles (1,027 Business Source Ultimate, 1,431 in Scopus and 2,133 in ABI/INFORM Collection). After removing duplicate articles, we ended up with 3,849 articles, of which we removed 3,610 articles unrelated to our research. We retrieved the remaining 239 articles for full inspection and only 15 met the abovementioned research criteria. The articles identified from three different databases are captured in Table 1, which constitutes the descriptive statistics. The numbers of duplicates in the table are to validate and illustrate the results. Also, number articles selected based on titles have been added in the below table to support the results.

Table 1: *Descriptive Statistics*

Keywords	Databases		
	Business source Ultimate	**Scopus**	**ABI/INFORM Collection**
'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'recruitment'	*Counted Articles: 458*	*Counted Articles: 63*	*Counted Articles: 614*
	Duplicates: 17	*Duplicates: 6*	*Duplicates: 28*
	Titles:21	*Titles:5*	*Titles:42*
'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'selection 'OR 'hiring' OR 'employment'	*Counted Articles: 124*	*Counted Articles: 68*	*Counted Articles: 533*
	Duplicates: 0	*Duplicates: 0*	*Duplicates: 9*
	Titles:5	*Titles:2*	*Titles:11*

"Table 1

Continued"

Keywords	Databases		
	Business source Ultimate	**Scopus**	**ABI/INFORM Collection**
'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'talent acquisition'	*Counted Articles: 142*	*Counted Articles: 226*	*Counted Articles: 366*
	Duplicates: 4	*Duplicates: 0*	*Duplicates: 12*
'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'interviews'	*Titles:10*	*Titles:8*	*Titles:5*
	Counted Articles: 60	*Counted Articles: 193*	*Counted Articles: 326*
	Duplicates: 0	*Duplicates: 0*	*Duplicates: 13*
	Titles:2	*Titles:7*	*Titles:13*
'artificial intelligence' OR 'robotics' OR 'machine learning' AND 'assessment tools'	*Counted Articles: 243*	*Counted Articles: 881*	*Counted Articles: 294*
	Duplicates: 44	*Duplicates: 10*	*Duplicates: 6*
	Titles:21	*Titles:2*	*Titles:5*
Total number of articles/database	*1027*	*1431*	*2133*
Total number of articles retrieved from all databases	*4591*		
Duplicates	*742*		
Articles to review	*3849*		
Titles	*222*		
Abstract - Skimming	*45*		
Final articles to review	*15*		

Design of Included Studies

As illustrated in Table 2, most of the studies (33.3%) relied on descriptive designs and (20%) on correlational while (20%) employed experimental designs.

Moreover, (13.3%) relied on surveys and interviews with an equal (13.3%) share for literature review design. The majority of these studies are empirical

researches (66.6%) while the remaining (33.3%) are conceptual.

Table 2: *Design of included studies*

Design	Count	Percentage
Descriptive	5	33.3%
Correlational	3	20%
Experimental	3	20%
Surveys and interviews	2	13.3%
Literature Review	2	13.3%
Total	**15**	**100%**
Type	**Empirical /Conceptual**	**Percentage**
Conceptual	5	33.3%
Empirical	10	66.6%
Total	**15**	**100%**

Outcome Themes

The analysis of the 15 articles yielded 2 main themes: CV Sifting and Pre-Screening, and a total of 6 sub-themes. Under CV sifting theme we examined four subthemes as follows; "Recruitment Using AI", three articles (Upadhyay & Khandelwal, 2018) (Gupta, Fernandes, & Jain, 2018) , and (Dalenberg, 2018) examined generally the automation of the recruitment process and its implications to enhance diversity in the workforce and prevent unconscious biases. We categorized the 5 articles out of the 15; (Humphrey, 2014), (Enachescu, 2016), (Hoang, Mahoney, Javed & McNair, 2018), (Faliagka, Iliadis, Karydis, Rigou, Sioutas, Tsakalidis & Tzimas, 2014) and (Faliagka, Tsakalidis & Tzimas, 2012) under the second sub-theme "Matching Applicants 'skills with the job requirements". Which revolved around AI software that can be used by recruiters to match the candidate's profile to the job

vacancy. 3 articles (Leong, 2018) , (Dickson & Nusair, 2010) and (Singh & Finn, 2003) examined the third sub-theme AI role in screening CV's. The last two articles (Fernandez, 2019) and (Daugherty, Wilson & Chowdhury, 2019) assessed how AI can be used by recruiters to promote diversity in the workplace. We identified two main sub-themes related to "Pre-Screening" theme.

Two articles examined AI tools for skills' assessment (Bersin & Chamorro-Premuzic, 2019) and (Faliagka, Tsakalidis & Tzimas, 2012). Additionally, another article under this theme was identified (Suhailan, Fadhilah, Syarifah Nurulhusna, Fatimah, & Fadzli, 2012) namely Screening Interviews. The analysis of the final 15 articles tackled phases of the recruitment and selection process, which ends with the selected qualified applicants that match the job requirements, and that are consequently called to take part in the face-to-face interview process.

The themes and categories identified through the review of the 15 articles are captured in Table 3, which constitutes the thematic template. The titles of the articles in the table are to endorse and demonstrate the themes.

Table 3 : *Thematic Template*

Theme	Sub-themes	Article(s)	Author(s)
CV Sifting	**1. Recruitment Using AI**	1. Applying artificial intelligence: implications for recruitment 2. Automation in recruitment: a new frontier 3. Preventing discrimination in the automated targeting of job advertisements	• (Upadhyay & Khandelwal, 2018) • (Gupta, Fernandes, & Jain, 2018) • (Dalenberg, 2018)

"Table 3

Continued"

Theme	Sub-themes	Article(s)	Author(s)
CV Sifting	**2. Matching Applicants 'skills with the job requirements**	1. Recruiters and applicants: An exchange of words 2. A prototype for an e-Recruitment Platform using Semantic Web Technologies 3. Large Scale Occupational Skills Normalization for Online Recruitment 4. On-line consistent ranking on e-recruitment: Seeking the truth behind a well-formed CV 5. An integrated e-recruitment system for automated personality mining and applicant ranking	• (Humphrey, 2014) • (Enachescu, 2016) • (Hoang, Mahoney, Javed & McNair, 2018) • (Faliagka, Iliadis, Karydis, Rigou, Sioutas, Tsakalidis & Tzimas, 2014) • (Faliagka, Tsakalidis & Tzimas, 2012)
	3. Screening CV's	1. Technology & recruiting 101: how it works and where it's going. 2. An HR perspective: the global hunt for talent in the digital age 3. The Effects of Information Technology on Recruitment	• (Leong, 2018) • (Dickson & Nusair, 2010) • (Singh & Finn, 2003)
	4. Using AI in Recruitment for diversity and biases prevention	1. The ball of wax we call HR analytics 2. Using Artificial Intelligence to Promote Diversity	• (Fernandez, 2019) • (Daugherty, Wilson & Chowdhury, 2019)
Pre-Screening	**5. Assessment Tools**	1. New Ways to Gauge Talent and Potentia 2. An integrated e-recruitment system for automated personality mining and applicant ranking l	• (Bersin & Chamorro-Premuzic, 2019). • (Faliagka, Tsakalidis & Tzimas, 2012)
	6. Screening Interviews	1. Automatic text interview assessment using IM decision support system	• (Suhailan, Fadhilah, Syarifah Nurulhusna, Fatimah, & Fadzli, 2012)

CV Sifting

Recruitment Using AI

        The three articles (Upadhyay & Khandelwal, 2018) (Gupta, Fernandes, & Jain,

2018) and (Dalenberg, 2018) examined the role of AI in the recruitment process.

begining with the identification of a vacancy, after which the recruiter sets the required

knowledge, skills, ability, and experience for a candidate to execute the job efficiently. An organization's culture and environment may also be considered by the recruiter as a factor to assess a candidate's required skills (Gupta *et al.*, 2018).Nevertheless, human capital selection is no easy task as it is controlled by decision-makers' perception and biases, such as gender, age, ethnic or political factors (Singh & Finn, 2003; Suhailan *et al.*, 2012). Traditionally, advertising was done by a human advertiser through flyers, newspaper, television or radio ads. Employers would ask advertisers to target a specific audience like males only or to change the content, channel and timing of the advertisement (Dalenberg, 2018). Today, advertisers have the flexibility to apply different advertising strategies to adequately reach their target audience by setting and modifying all kinds of variables. Online advertising platforms like Facebook and Google have become the largest and main advertising channels (Dalenberg, 2018). These platforms have their own advertising software that helps target decisions and judge results based on preprogrammed and self-learned strategies. "Adext AI" is an AI software that identifies the most relevant audience for Google and Facebook ads, at the right time and place. This software is connected through multiple Application Programming Interfaces (APIs) with third party software. For example, Facebook has Facebook Business Manager which has the most widespread and far-reaching settings, acquiring as much relevant applications as possible for each campaign (Dalenberg, 2018). Therefore, to push the human resources' evaluation or selection process quality forward, some companies are using web-based pre-screening tools or AI software such as applicant tracking programs, web-based prescreening interviews, and online assessment methods. These tools can help recruiters carry out an initial review of an applicant, that might be considered accordingly a "potential fit" in the organization (Singh & Finn, 2003).

Matching Applicants' Skills with the Job Requirements

In this paper, different systems are reviewed from the five articles (Humphrey, 2014), (Enachescu, 2016), (Hoang, Mahoney, Javed & McNair, 2018), (Faliagka, Iliadis, Karydis, Rigou, Sioutas, Tsakalidis & Tzimas, 2014) and (Faliagka, Tsakalidis & Tzimas, 2012) to automate pre-screening and ranking in the recruitment process. Subsequently, they increase the recruitment process' efficiency by limiting interviewing to only the best candidates identified by the system. Nevertheless, the system is identified with the intention of being incorporated within the companies' Human Resource Management structure, in an effort to support and not replace the recruiters in their decision-making.

E-Gen system (Faliagka *et al.*, 2014) job portals could offer semantic matching services which would identify and analyze the information which is semantically linked between job postings and applicants' profiles, basing itself on how different terms are related. For example, "if certain programming skills such as "JAVA" are essential for a certain job and an applicant has skills in "Delphi", the matching algorithm would suppose this person's profile a better match than someone else's who has the skill SQL, since Delphi and Java are more closely related than SQL and Java."

CommOn framework (Faliagka *et al.*, 2014) applies Semantic Web technologies in the HR Management field to fit applicant profiles with job positions through an online questionnaire to assess the candidate's behavior traits and match them to job requirements. Another e-recruitment platform in the articles we identified was a "*Java-based mobile application*". In this application, the job seeker and the recruiter can create their own profile on the platform and provide information or post a job advertisement. Once the company has advertised a new job offer, it can access the list of all candidates registered on the system, to assess if their skills matches the job

requirements (Enachescu, 2016). Last, the e-recruitment system that was examined in (Faliagka *et al.*, 2012), implements automated candidate ranking based on rational criteria that can be obtained from the applicant's LinkedIn profile once they log into the system with their account credentials. Each applicant will be ranked according to how much their profile fits the job requirements, a score based on *Analytical Hierarchy Process (AHP),* while their relative significance (weight) is controlled by the recruiter who can review and re-rank the candidates accordingly. Moreover, automated skill systems can also be used in job matching and recommendation systems to better match candidates to jobs and reduce unemployment. However, despite the value they add to the recruitment process, these methods wouldn't function properly when there are discrepancies in CV formats, structures and contextual information. Additionally, resume style and coherence are not evaluated. Hence, an effective skill system should be able to identify skills required from both job postings and applicants' resumes, understand name variations (for example artificial intelligence can put in the plural form "artificial intelligences" as well as an acronym "AI)", control semantic context to recognize unspecified skill entities and control incorrect skills with different meanings (for example, the term "stock," has two meanings in the context of food preparation and the context of finance).

The SKILL system, aims to address the abovementioned challenges (Hoang *et al.*, 2018).

Screening CVs

Three articles (Leong, 2018) , (Dickson & Nusair, 2010) and (Singh & Finn, 2003) revolved around AI tools for screening CV's. "Resume Scorer" is a tool that examines skills or experience required for a certain job and compares it to an applicant's resume, thus, screening out candidates that don't meet the requirements, and

accordingly saving time for hiring managers to gather real-time feedback from employees, regarding their thoughts and opinions about the company (Leong, 2018). The candidates filtered by Resume Scorer will receive a link by the automated system to complete technical assessments required for the position. The AI bots could then score the technical test, conduct an initial screening and schedule interviews for the recruiters. Besides, AI will also help with reports, dashboards and analytics for the recruitment team including the scoring of resumes, assessments and feedback from applicants on their overall experience.

There is also a second online application for the screening process that is examined in this review and that is a resume scanning system which uses optical character recognition (OCR) (Dickson & Nusair, 2010) to search for keywords and match between applicants' qualifications and job requirements. Resumes are ranked based on the number of matches and a report is generated. The resume is scanned into the computer as an image, then OCR (optical character recognition) goes through the image to recognize every character, symbol, and number, to creates a text file (ASCII) (Dickson & Nusair, 2010).AI scans the text and searches for keywords such as name, address, education, skills, qualifications, and experience that match the job requirements, to finally select a few candidates from the thousands of applicants (Dickson & Nusair, 2010) and that best fit the criteria established by the recruiter.The system also ranks all resumes and saves the ones that don't match the requirements in the database for future vacancies. Those resumes are then saved in the system for a defined period of time to reduce resume duplicates.

Using AI in Recruitment for Diversity and Biases Prevention

Machine learning and artificial intelligence programs are rule-driven, which makes some AI-powered tools capable of detecting and mitigating biases in hiring.

Intelligent text editors like "Textio" can modify job descriptions to reach different candidates from groups that aren't well represented. Using Textio, some companies like "Atlakessian" were able to increase the percentage of females among its new hires by 47%, as mentioned in (Daugherty *et al.*, 2019).Moreover, recruiters may also use AI technology to detect biases in their past hiring decisions. Using an AI-based service such as "Mya" through deep neural networks that match the human ability to spot patterns in data, recruiters may analyze their hiring records and see if they have hired candidates with, for example, specific gender or skin color (Daugherty *et al.*, 2019). Yet, how can employers trust the results of AI in recruitment and selection tools when even the largest and most resourceful tech companies have failed? It was lately reported that Amazon scuffled its AI recruiting tool that showed bias against women (Fernandez, 2019). Furthermore, AI systems are created, guided and trained by humans. So what if, intelligent machines were trained to ignore criteria related to ethnicity, gender, sexual orientation, and other characteristics that aren't applicable to the decisions at hand (Fernandez, 2019)?

On the flip side, AI systems might need to be further developed to process more images. For example, commercial facial recognition applications face many accuracy problems when working with minorities: "The error rate for identifying dark-skinned women is 35%, compared with 0.8% for light-skinned men" (Daugherty *et al.*, 2019).

Pre-Screening

Assessment Tools

Under the pre-screening theme, we identified sub-theme entitled "Assessment Tools". This theme involved two articles (Bersin & Chamorro-Premuzic, 2019) and

(Faliagka *et al.*, 2012) that tackle 3 different assessment methods using AI and machine learning.

In this review, we identified the role of AI in three assessment methods that are capable to detect new signals of talent as an indicator of performance potential with a strong correlation between candidates' scores and subsequent job performance.

Gamified Assessments are psychometric tests used in high-volume hiring environments that assess the candidate's personality traits and competencies and provide a more enjoyable assessment experience linking the candidate's game scores to their job performance. For example, HireVue's MindX uses gamified cognitive-ability tests that predict IQ by asking candidates to play games— think Nintendo's Brain Age (Bersin & Chamorro-Premuzic, 2019). Despite the benefits of gamification, this approach to talent identification has two disadvantages. First, the more interesting and enjoyable the assessment experience, the less predictive it tends to be. Second, people play games for fun and will probably not take it seriously and the score will not be perfectly accurate to predict their job performance and as a result costs will increase (Bersin & Chamorro-Premuzic, 2019).

Digital Interviews are also used as a talent identification tool; replacing face–to-face interviews and spontaneous interpretations with data-driven sorting and ranking through AI and algorithms to identify candidates' talent signals such facial expressions, tone of voice, emotional language, speed and focus. Companies such as JP Morgan Chase and Walmart do thousands of video interviews each year. These can increase the accuracy of job interview findings while reducing costs; however, like any other interviewing process, there is a tendency to replicate and emphasize biases. The only solution would be to score more productivity and revenue numbers and focus less on individual traits. Additionally, another option would be training algorithms to disregard

the signals that predict human bias (such as gender, age, social class, and ethnicity) and focus truly on job performance. For example, tool providers like HireVue are implementing this to eliminate the impact of skin color on hiring decisions (Bersin & Chamorro-Premuzic, 2019).

Another assessment tool identified in the second article was the TraitSet program. The latter can be used by recruiters to screen potential candidates for fit to the job prior to the interview process. It used consistent questions to assess all potential candidates' various personality traits that are preselected with regard to the job qualifications and the criteria chosen by the recruiters (Dickson & Nusair, 2010).However, when using any of the tools for talent assessment and recruitment, organizations must consider people's privacy and comply with ethical guidelines.

Personality Data Mining; studies showed that there is a link between one's social media activity and key job-related skills (Bersin & Chamorro-Premuzic, 2019). For example, many hiring managers find it very efficient to examine their candidates using the information on their social media pages such as LinkedIn and Facebook, which represent true peer feedback and character traits as they can for example show they are more or less extroverted or easy-going. LinkedIn and Facebook can provide tools and data that do this automatically for recruiters, by giving them a range of scores and useful information to help evaluate candidates in their potential fit for a job or role. Likewise, additional character behaviors can be detected from Facebook behavior and the words people use on other social media platforms like Twitter and in blogs are good indicators of abilities, likability, and drive.

The Linguistic Inquiry and Word Count (LIWC) tool was created as an automated technique for data mining. It examines text samples of different university students, and links the use of words to personality traits. Pennebaker & King have found

significant correlations between these frequency counts and the author's personality

traits as measured by the Big-Five personality dimensions (Faliagka *et al.*, 2012).

Candidate personality traits can be automatically extracted from their presence on social

media by simply entering their blog's URL. The personality mining module applies

linguistic analysis to the blog posts to find out the qualities that reflect the applicant's

personality traits (Faliagka *et al.*, 2012).

Screening Interviews

The software identified in this paper (Suhailan, Fadhilah, Syarifah Nurulhusna,

Fatimah, & Fadzli, 2012) for job interviews was the Instant Messaging Decision

Support System (IM-DSS) which is an instant live text-based interview program

(Suhailan *et al*., 2012). On IM-DSS, the interview session can be realized with more

than one candidate using a virtual room without both interviewee and interviewer

having to be at the same place, yet with the presence of a moderator who has to be a

technical expert to monitor the interviewing process, control the start and end of the

interview, dismiss unethical interviewees and regulate certain constraints of the decision

support system features if needed. The interviewers may send the questions via Instant

Messenger to tackle the candidates' technical and soft skills. Answers submitted in

writing during the interview will be automatically scored and ranked upon keyword and

cooperative scores to shortlist qualified candidates using information retrieval

techniques. One of the most popular techniques is Term Frequency-Inverse Document

Frequency (TF-IDF). Keywords submitted by each interviewer must be complemented

with its weightage value. A cooperative score relates to the interviewee's response to

others' answers which gives an outlook on their teamwork skills). The prototype of IM-

DSS framework is easy to recall, it helps recruiters interview more than a single

candidate in less time and in an efficient and transparent method. It allows interviewees

to prove their competencies and values. It also reduces the chances of any biases or

uncertainties arising during the evaluation process as the data can be shared and

evaluated between many interviewers. Accordingly, shortlisted interviewees will be

called for the face-to-face interview. However, the drawback of this system is that the

keyword assessment model does not take into account the synonyms of keywords

submitted by the interviewer who only score for the exact terms only. Moreover, the

candidate's ethics and values cannot be assessed using provocative questions on this

software.

CHAPTER IV

DISCUSSION

This paper has examined the role of Artificial Intelligence (AI) in the recruitment and selection processes. It is noteworthy to mention that the initial themes and categories were identified among the 15 articles retrieved, from the 3,491 researched. In order to address the research questions, the below discussion revolves around the main themes that study the role of AI in the recruitment process:

Automating the Process of Sifting and Pre-Screening: Optimizing R&S Efficiency

The recruitment and selection processes go together, and through them, recruiters assess the suitability of candidates for different jobs. Hence, without efficient planning systems, organizations might not recruit the needed candidates, and without efficient recruitment, they may not select the right people for the job. What is available today might not be in the future, which consequently makes it challenging for recruiters to find the right people and to matching them to the right jobs. As part of the recruitment process, recruiters assess technical expertise, people skills, cultural fit and candidates' ambition or capacity to grow within the organization (Bersin & Chamorro-Premuzic, 2019) Hiring the right person is perhaps the most important decision a manager makes. Traditionally, in recruitment methods, resumes are usually sent to employers in response to job postings sent by email, through online career portal or by hand. With the development of new tools and the rise of AI and machine learning, this process became more accurate and less biased. Hiring managers should adopt them to

improve the process and the yield of good hires. The traditional job interviewing

process gathers one or several interviewees and interviewers under one roof. As such, a

very small number of applicants receive an offer or a call for a job interview. A study

was carried out by an anonymous industry, which concluded that on average, only one

out of 120 applicants got selected for a vacancy, while the rate of recruited candidates

that made it to the interview phase was around one out of 20 (Faliagka *et al.*, 2012).

The interviewers ask the interviewee questions. They in turn verbally answer them one

after the other, basing themselves on their knowledge and experience. Accordingly, the

interviewers agree which potential candidates are selected for the job. Several e-

recruitment systems have been suggested with the aim to boost the recruitment process,

leading to a better overall user-experience. Top companies in the area of e-recruitment

systems such as JobVite and Monster have automated the screening process of

applicant's profiles (Faliagka *et al.*, 2014). Unlike traditional search engines, these

methods, allow for semantic matching between required skills, knowledge and traits for

a specific job position with the applicants' profiles on LinkedIn or other social media

platforms. Accordingly, candidates who do not have the required skills, are filtered

straight out of the selection process (Faliagka *et al.*, 2014). Recently, recruiters are

assessing job applications coming in through online recruitment systems, using machine

learning algorithms to solve the candidate's ranking problem and implement semantic

matching techniques. The idea regarding 'Applicant – Job Matching' becomes serious

when we see the rise in automated CV assessment as the initial part of the recruitment

process (Humphrey, 2014). Reference checking and screening is being executed by

machines instead of recruiters; CV keywords are the sentences automated recruitment

systems look for during the initial phase of candidate selection for specific job openings

(Humphrey, 2014). HR practitioners spend most of their time screening resumes, and as

a company grows, HR departments have to hire more recruiters, therefore increasing costs. Accordingly, many companies decided to use automated screening systems to increase the efficiency and overcome the challenge associated with the traditional way of handling resumes (Dickson & Nusair, 2010). The automated scanning systems screen resumes for keywords earlier to submission to the recruiter who then sets interviews or assessment tests for the selected candidates. With the technological advancements and automated systems used in the recruitment processes today, recruiters have more time to focus on recruiting quality candidates rather than spending time screening potential candidates' resumes, scheduling interviews and updating applicants' status. AI and robotics are rapidly changing the workforce. Different assessment methods are employed but the most accurate and efficient are those that use consistent methods, which occurs when all interviewees go through the same process and have a predefined scoring key linked to job performance (Bersin & Chamorro-Premuzic, 2019). Interviewing is one of the selection methods used to collect information about the applicants' competencies, qualification attributes and skills. However, this process presents the risk of having biased or unfair decisions, as sometimes interviewers might miss certain points that have been stated by the interviewees or they may have preferences for candidates of a certain gender, age, ethnic background or beliefs. Subsequently, and with technological development, job interviews today are carried out automatically. Besides, personality traits are essential for applicants' selection in many job positions; however, in the Web 2.0 era, there are large amounts of textual data for millions of web users that have shown to be reliable predictors of users' personalities. Personality Data Mining is another tool used to identify talents through their online behavior by indicating their interests, personalities, and abilities, and accordingly predicting their fit for particular jobs or careers.

Thus, recruiters become gradually dependent on advanced technologies. AI and data–driven analysis have made it possible to improve selection methods by identifying candidates that match the job vacancy, assessing them through different automated tools, ranking shortlisted ones and interviewing those that best match the vacancy needs.

The second type of targeting settings determined by AI on correlation with big data, are the additional ones that limit the number of qualified candidates recognized with the use of professional targeting setting (Dalenberg, 2018).The main advantage of the above is that the AI will generate effective targeting settings, which humans would never think of. For example, if AI found through data mining that people who love Japanese cartoons show good coding skills. Then the job advertisement would target those who have college education, also "programmer" as a current occupation and like a specific Japanese cartoon (Dalenberg, 2018). Hence, the recruitment and selection process is influenced by big data settings and the algorithmic models that mine the data, which in turn increases the efficiency of the recruitment process and fills the skill shortage gap by filtering unqualified candidates.

Direct and Indirect Discrimination

Clearly if the recruiter takes responsibility for the outcomes with hiring decisions already biased, we cannot expect anything different from AI or machine e-learning models. First, it is essential to highlight that human decision-making in recruiting is defective. Even if we ignore the bias within human recruiters, the traditional assessment tools for selection cannot be even considered as indicators or predictors of performance. AI is influenced by big data sets and algorithmic models (that concludes if candidates are interested in the job or are fit for it) in developing the

target settings and objectives for each type of job. It examining the discrimination in the automated online targeting of job advertisements and how it can be prevented with the use of AI. These settings are kept into different function profiles or types on which each new advertising campaign can base itself. Hence, it provides employers with the option to adjust their ads based on age, gender, language, education, experience, relationship status, among others. Consequently, these are the factors that determine if an AI-driven job advertising campaign is discriminatory. When those targeting options are employed to exclude people of a certain gender, age, ethnic or racial affinity, it will be considered a discriminatory action. Thus, shrinking the chances for job seekers, and diminishing diversity and equality in the work place somehow violates the principle of equality, which states that every individual should have the same opportunities.

An example of discriminatory job advertising is one published for executive vacancy; it was shown almost six times more to men than to women (Dalenberg, 2018). In the article, the author (Dalenberg, 2018) discussed two types of discriminations in job advertisements namely direct and indirect. Direct discrimination can be justified by a job-related requirement. So, if a certain attribute is not obviously required to fill the job, it should not be used as a targeting setting. Indirect discrimination happens when a neutral setting eliminates a considerably larger percentage of a protected group compared to others. To avoid indirect discrimination, the effect of a setting that is not justifiable needs to be predicted. A setting won't be considered indirect discrimination and can therefore be used only if it does not disregard a considerably large percentage of a protected group. For example, an advertisement for a developer targeting people who have college education and the "developer" job title should always be allowed.

When AI is used with tools to detect AI bias and mitigate its impact, it can efficiently identify and reach the candidates with the required skills for a job while

avoiding individual biases. Therefore, and with the rise of discriminatory challenges facing AI, companies should be guided through non-discrimination laws and conditions and targeting a specific audience should be in line with job requirements. Moreover, many of the data sets used to train AI systems already have biased information. For example, the word woman is more linked with nurse than with doctor and if those links aren't classified and removed, they will be applied in AI systems. Developing AI systems that combat bias is not only a matter of having more diverse-minded design teams. It also includes guidance from humans to promote diversity and inclusions. Microsoft, for example, has set values of Fairness, Accountability, Transparency, and Ethics within the AI team, which is responsible for recognizing any biases that have sneaked into the data used by the company's AI systems (Daugherty *et al*., 2019). Another method recommended by a Microsoft researcher is to use several algorithms to analyze diverse groups. For example, the algorithm for assessing a female candidate's suitability for a sales position might be different from the one used for assessing a male's. So the female being a football player at her college team might be a better indicator of success for women than for men who might have had professional sales experience (Daugherty *et al*., 2019).

Subsequently, we believe AI will play a main role in creating a more diverse and inclusive workforce. Nevertheless, humans who work with the technology have to design, train and modify those systems properly to mitigate the risk of unintended bias.

Human Element: Still Needed and Overriding When Required

Based on the articles examined, the results covered the role of AI in the recruitment and selection process. AI is disrupting the recruitment industry and is replacing repetitive tasks that were traditionally performed by human recruiters thus

speeding up the hiring process. Companies today are using software and automation to expand and augment distinctive human strengths, enabling large economic gains and more satisfying work. AI tools are replacing human observations and intuitive inferences with data driven sorting and ranking (Upadhyay & Khandelwal, 2018). No longer will humans be sifting CVs and selecting people to interview. The information systems used to perform these tasks are termed e-recruitment systems, automating the process of position openings and receiving applicant CVs, thus allowing Human Resource practitioners to target a large pool of applicants at a small cost (Faliagka, Iliadis, Karydis, Rigou, Sioutas, Tsakalidis & Tzimas, 2014).However, AI is good at identifying talent but still the activities like assessment of cultural fit and negotiation needs to be done by humans who now act as talent advisors. Hence, AI tools integrated with the recruitment and selection processes with an objective to support the human recruiters in the selection of applicants without substituting the human factor. Its objective is to provide a valuable support in the first stage of the selection (the screening phase), by decreasing the number of errors that can occur when thousands of CVs are manually filtered. Therefore, we believe that Artificial Intelligence will assist but not replace the human factor in the decision-making process. As long as there are Human in the jobs, there will be need for HR roles to override AI decisions especially that in some cases where potential talents might be lost because the decision was not contextual and thus AI might not select the right fit.

CHAPTER V

STUDY LIMITATIONS

There are several limitations to this review's reach. First, systematic reviews involve the support of secondary data for analysis. A major drawback of such an approach is that the data collection in every study is not initially designed to answer the specific research questions of this review. Therefore, we guaranteed that the data retrieved is thoroughly analyzed according to the procedure defined earlier. Moreover, our study's design relied on other specified published studies, which generally tend to over-report findings. Additionally, we limited our search to English only studies, although other relevant findings may have been available in other languages. Last, the insertion and elimination criteria as well as the keywords selected in any systematic review remain the most biased part of this approach (Tranfield, Denyer & Smart, 2003). Hence, future research can benefit from a comparison of different approaches and the effect they may have on the findings of a specific systematic review by implementing several search strategies (such as search engines).

CHAPTER VI

CONCLUSION

With AI used for recruiting, online skill tests and video interviewing will become a dominant theme for HR technology replacing the traditional screening process. Recruiters will use AI to get deep insights on talent needs, understand where and how to source candidates, reduce time-consuming activities like manually screening resumes, and identify the right candidates from a large and diverse pool of applicants, therefore giving the organization a competitive talent advantage. Our review of the research literature covering the implication on the recruitment and selection processes revealed a variety of AI tools adopted by the recruiters during the pre-screening phase of the recruitment process. This process is influenced by big data settings and the algorithmic models that mine the data, which in turn increases the efficiency of the recruitment process and fills the skill shortage gap by filtering unqualified candidates; however, it assists the human recruiters in the selection of applicants without substituting the human factor.

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